Original Research Paper

Volume : 5 | Issue : 8 | August 2016 • ISSN No 2277 - 8179 | IF : 3.508 | IC Value : 69.48

A Schoolbased Survey on Prevalence of Iodine Deficiency By Monitoring Urinary Iodine Excretion in A Municipality Area of South 24 Parganas District of West Bengal

Medical Science

KEYWORDS : Goitre, iodine deficiency, urinary iodine excretion

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ABSTRACT

Background: *In India, an estimated 200 million people were at risk for iodine deficiency disorders. Objectives: To determine the prevalence of iodine deficiency by monitoring urinary iodine level among the high school children and to find out the any association between urinary iodine excretion with iodine content of salt consumed at the household level.*

Methods: *The study was conducted in a municipality area of South 24 Parganas among 1249 high school children of different schools selected randomly from different boroughs of this municipality area. Goitre was searched by observation and palpation and urinary iodine was measured by FAST B method. Iodine content of salt samples was estimated using spot-testing kit.*

Findings: *There was a 20% prevalence of goitre among the study children. It was highest in the age- group 10 – 13 years. It was not significantly associated with age but was significantly more common among the girls than boys ($p < 0.05$). Urinary iodine excretion of <100 µg/litre was found in 16.0% children which was not significantly associated with age but was significantly more common among girls than boys ($p < 0.05$). Occurrence of goiter was not significantly associated with low urinary iodine. All the salt samples had an iodine content of >15 ppm.*

Conclusion: *Although the entire South 24 parganas district is considered to be an iodine-replete area and all salt samples tested had adequate iodine content at the consumer level, about one-fifth of the study children had goitre and quite a few (16%) had urinary iodine excretion <100 µg/litre. However, as there was no significant association between the occurrence of goitre and urinary iodine excretion, further investigations should be conducted to find out the possible role of loss of iodine in cooking process and presence of other goitrogens.*

Introduction:

Iodine is an essential micronutrient and when its intake falls below recommended levels, the thyroid fails to synthesize sufficient amounts of thyroid hormone and the resulting low level of thyroid hormones in the blood (hypothyroidism) is the principal factor responsible for damage to the developing brain and other harmful effects known collectively as "iodine deficiency disorders" [1]

In areas of iodine deficiency, where thyroid hormone levels are low, brain development is impaired. For the developing fetus it may lead to many detrimental effects on brain development, leading to cretinism. Iodine deficiency is also an important cause of stillbirths, increased infant and child mortality.[2]

Though spectrum of iodine deficiency include many severe effects but of much greater public health importance are the more subtle degrees of brain damage and reduced cognitive capacity affecting the entire population. Particularly the mental ability of apparently normal children often becomes low and they will often develop as slow and sleepy adult.[1]

The source of iodine in locally grown foods and water often depends upon the iodine content of the soil[3].

In riverine areas, often soil is eroded due to loss of vegetation from clearing for agricultural production, overgrazing by livestock, and tree-cutting for firewood results in a continued and increasing loss of iodine from the soil and groundwater and foods grown locally in these areas lack iodine[1].

In this background various surveys were conducted in different parts of India and also worldwide and on a worldwide basis, iodine deficiency is the single most important preventable cause of brain damage.[1]

In India, an estimated 200 million people were at risk for iodine deficiency disorders (IDD).[4] Of those, 71 million have goitre, 2.2 million suffer from cretinism and 6.6 million have mild neurological deficits.[4, 5] Sample surveys conducted in 28 states and 7 union territories in India revealed that out of the 325 districts surveyed, IDD is a major public health problem in 263 districts where the prevalence is more than 10%.[4]

WHO, UNICEF and ICCIDD (International Council for Control of IDD)[6] recommend that, in typical circumstances, where the iodine lost from salt is 20% from production site to household, another 20% is lost during cooking before consumption, and average salt intake is 10 g per person per day, iodine concentration in salt at the point of production should be within the range of 20–40 mg of iodine per kg of salt (i.e., 20–40 ppm of iodine) in order to provide 150 µg of iodine per person per day.[7] A cost benefit analysis in India quantified the ratio between cost and economic benefits as 1:3, which further justifies the necessity of a universal salt iodization program in India.[8]

Most iodine absorbed in the body eventually appears in the urine. Therefore, urinary iodine excretion is a good marker of very recent dietary iodine intake[1]. Studies have convincingly demonstrated that a profile of iodine concentrations in morning or other casual urine specimens (child or adult) provides an adequate assessment of a population's iodine nutrition, provided a sufficient number of specimens were collected. Round the clock urine samples were difficult to obtain and were not necessary.[1]

In the light of the above the present study was conducted in different schools of a municipality area of south 24 parganas district of West Bengal with the objectives to determine the prevalence of iodine deficiency by monitoring urinary iodine level among the high school children and to find out the any association between urinary iodine excretion with iodine content of salt consumed at the household level.

Materials and Methods:
The present study was conducted in the year 2015 with the high school children of different schools in a municipality area of South 24 Parganas, West Bengal. The students between classes V to IX were included in the study. For the conduction of the study necessary approval was taken Institutional Ethics Committee of Calcutta National Medical College, Kolkata.

In the municipality area under study, there were six boroughs and one school from each region was chosen randomly. Thus six schools were chosen and for some operational feasibility the co-educational schools were chosen.

The sample size of students to be surveyed was based on the assumed goiter prevalence rate of 50% (as there was no available information on likely prevalence in the study district and in the age group studied), confidence interval (CI) of 95%, a design effect of three and a relative precision of 10% and thus the sample size of 1200 children was considered as sufficient.[9] Accordingly from each school 200 children were included. The students were taken from class V to IX considering 40 students from each class. From each class, students were selected by systematic random sampling. Along with those 40 children from each class some other children requested the investigators to participate in the study and over all the number of participants was 1249.

Necessary permission was taken from the school authority and local municipality through a formal letter from the Principal, Calcutta National Medical College. Informed consent was obtained from the parents of each student included in the study.

The students from each class were selected by systematic random sampling. The age of the selected students were recorded from the school register. Two separate rooms were identified for boys and girls and they were briefed about all the procedures of clinical examinations and biochemical tests separately.

The students were examined clinically by the researchers for presence of goitre. Enlargement of thyroid was searched by observation and palpation as per WHO recommendation.[1] Each of the students was given a plastic container with cap for collection of urine samples up to 2 ml Urine. The urine samples were stored in a refrigerator at 4°C until analysis. The collected urine samples were tested in the Biochemistry department of Calcutta National Medical College and iodine level was measured. The urinary iodine was measured by **FAST B – method which is a simple semi quantitative method for urinary iodine concentration.[10] According to FAST B – method[10] the level more than 300 μg/lit was considered as excessive, within 100-300 μg/lit as sufficient and <100 μg/lit as deficient.**

Children in whom urinary iodine level was found to be <100 **μg/lit or > 300 μg/lit were** asked to bring 20 g of salt which was routinely being consumed in their respective families, in auto-seal polythene pouches. The iodine content of altogether salt samples was estimated using spot-testing kit to assess the level of iodization (whether more or less than 15 ppm).[1]

The data was analyzed by Statistical Package for Social Scientists (SPSS) version 19.0. Chi-square test was applied to compare the non-parametric data at 5% significance level.

Results:
Among the study children 40.4% (505/1249) were males and 59.6% (744/1249) were females and among the males 45.2% (28/62) were below 10 years, 37.6% (373/992) were within 10-13 years and 53.3% (104/195) were within 14-17 years. Likewise among the females 54.8% (34/62) were below 10 years, 62.4% (619/992) were within 10-13 years and 46.7% (91/195) were within 14-17 years. **(Table 1)**

Prevalence of goitre among the study children was found to be 20.0% (250/1249). It was highest in the age- group 10 – 13 years [21.3% (211/992)], followed by <10 years age-group [17.7% (11/62)] and was lowest in 14 – 17 years age-group [14.4% (28/195)]. However it was not significantly related with age (p = 0.079). **(Table 2)** Goitre was more prevalent among the female children (23.3%) than male ones (15.2%) and this difference was found to be statistically significant (p = 0.001). **(Table 2)**

Urinary iodine excretion of less than 100 **μg/litre was found in 16.0% children. No significant association was found between age and urinary iodine excretion (p = 0.6). (Table 3)** Urinary iodine excretion of less than 100 μg/litre was found to be more common among female children (17.3%) than among male children (14.1%) and this difference was found to be statistically significant (p = 0.002). **(Table 4)** However no significant association was found between occurrence of goiter and urinary iodine excretion (p = 0.673). **(Table 5)** Altogether 345 salt samples brought by children having urinary iodine level of <100 μg/litre and >300 μg/litre were tested by spot testing kits for determining iodine content. No salt sample had an iodine content of less than 15 ppm.

Discussion:
The present study was conducted 1249 students from class V – IX from different schools located in a municipality area of South 24 pargans district of West Bengal which encompassed the age group ranging from 8 to 17 years.

Prevalence of goitre among the study children was found to be 20.0% and was highest in the age- group 10 – 13 years (21.3%) followed by <10 years age-group (17.7%) and lowest in 14 – 17 years age-group (14.4%). However it was not significantly related with age. Das et al in their school based study in Chandigarh reported a goitre prevalence of 15.1% among the study children aged 6 – 16 years and observed that the prevalence of goiter was higher in the adolescents (13 to 16 years) as compared to younger children (6 to 12 yr) (17.7 and 13.9%, p=0.03).[11] Kamath et al, from rural Bangalore reported highest incidence of goitre among adolescents.[12] Earlier Kharrazi and Salimi from Iran reported a goitre prevalence of 11.5% among 7 – 11 years, 23.8% among 12 – 15 years and 26.1% among 15 – 18 years but no significant relation was found between

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goitre and age.[13] Usually higher prevalence of goitre is expected with increase in age due to hormonal influence on thyroid during the peri-pubertal period.[11]

In the present study it was found that the occurrence of goitre was significantly more common among female than male children. Similar observations were reported in earlier studies.[11, 14-15] This might be attributed to the difference in sex hormones and pubertal growth pattern among male and female children in higher age groups.[14, 16]

In the present study **16.0% of the study children had** urinary iodine excretion <100 **μg/litre. A similar observation was made by Gakkhar et al in their study at Jabalpur who reported 11.2% of the study children aged 6-15 years had urinary iodine excretion <100 μg/litre.**[15]

In the present study no significant association was found between age and urinary iodine excretion. But, significantly more number of girls than boys had urinary iodine excretion <100 μg/litre. Dodd and Samuel in their study among adolescents in urban slums of Mumbai did not find any significant difference in the mean iodine excretion between boys and girls.[17] A similar observation was also made by Joshi et al from Nepal.[18]

In the present study no significant association was found between occurrence of goiter and urinary iodine excretion and all salt samples tested had an iodine content of more than 15 ppm. This indicated further investigations for other causes of goitre besides iodine deficiency. Low urinary iodine excretion in site of consuming salt with adequate iodine content might be due to loss of iodine during the cooking process. It fact it has been documented that about 20% of the iodine in iodized salt is lost during cooking before consumption.[7] Observations from different earlier studies revealed that in spite of being iodine replete, goitre continues to be endemic in most states of India.[14, 19-22] These observations suggest that there might be other goitrogens or deficiency of other micronutrients responsible for the persistence of goitre despite adequate salt iodization.[11]

Limitation: The present study was conducted keeping in mind time constraint and feasibility in carrying out the study in school setting. Hence a rapid survey was done including only clinical examination for goitre and urinary iodine excretion as methods of investigation. Ultra-sonography of the thyroid gland or bio-chemical measurements of thyroid functions could not be done which was the main limitation of this study.

Conclusion and recommendation: Though South 24 pargana district is an iodine-replete area, about one-fifth of the study children had goitre and quite a few had urinary iodine excretion <100 **μg/litre**. However, as there was no significant association between the occurrence of goitre and urinary iodine excretion and since all salt samples tested had adequate iodine content at the consumer level, further investigations should be conducted to find out the possible role of other goitrogens and loss of iodine in the cooking process.

Funding: The study was funded by the Office of the Principal, Calcutta National Medical College & Hospital. Only the researchers were involved in the study design, collection, interpretation or analysis of the data. The corresponding author had full access to all data in the study and had final responsibility for the decision to submit the paper for publication.

Competing interests: None declared

Results:

Table 1: Distribution of study population according to socio-demographic characteristics
n=1249

Age-group (years)	Sex		
	Male	Female	Total
< 10	28	34	62
10 – 13	373	619	992
14 – 17	104	91	195
Total	505	744	1249

Table 2: Relation between age-sex and prevalence of goitre

SEX <10 (n=62)		Age-group (years) 10-13 (n=992)	14-17 (n=195)	Total	**Statistical tests with prevalence of goitre and sex** χ^2 (1) = 12.04 p = 0.001
Male (n=505)	Goiter present (n=77)	2	70	5	77(15.2)
Female (n=744)	Goiter present (n=173)	9	141	23	173(23.3)
Total (n=1249)	Goiter present (n=250)	11 (17.7)	211 (21.3)	28 (14.4)	250(20)
Statistical tests with prevalence of goitre and age group χ^2 (2) = 5.07 p = 0.079					

Table 3: Relation between age and urinary iodine excretion

Age-group (years)	Urinary iodine		
	<100 **μg/litre**	100 – 300 **μg/litre**	> 300 **μg/litre**
< 10 (n = 62)	10 (16.1)	42 (67.7)	10 (16.1)
10 – 13 (n = 992)	159 (16.0)	725 (73.1)	108 (10.9)
14 – 17 (n = 195)	31 (15.9)	137 (70.3)	27 (13.8)
Total (n = 1249)	200 (16.0)	904 (72.4)	145 (11.6)
χ^2 (4) = 2.75 p = 0.6			

Table 4: Relation between sex and urinary iodine excretion

Sex	Urinary iodine		
	<100 **μg/litre**	100 – 300 **μg/litre**	> 300 **μg/litre**
Male (n = 505)	71 (14.1)	391 (77.4)	43 (8.5)
Female (n = 744)	129 (17.3)	513 (69.0)	102 (13.7)
Total (n = 1249)	200 (16.0)	904 (72.4)	145 (11.6)
χ^2 (2) = 11.99 p = 0.002			

Table 5: Relation between prevalence of goiter and urinary iodine excretion

Goitre	Urinary iodine		
	<100 **μg/litre**	100 – 300 **μg/litre**	> 300 **μg/litre**
Absent (n = 999)	159 (15.9)	720 (72.1)	120 (12.0)
Present (n = 250)	41 (16.4)	184 (73.6)	25 (10.0)
Total (n = 1249)	200 (16.0)	904 (72.4)	145 (11.6)
χ^2 (2) = 0.791 p = 0.673			

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