ORIGINAL ARTICLE

Universal Salt Iodinization is not that Universal - A study among school age children in Mandla District, Madhya Pradesh.

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Abstract	Introduction	Methodology	Results	Conclusion	References	Citation	Tables / Figures

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Abstract

Background: Iodine deficiency is a preventable cause of brain damage. **Aims &Objectives**: The present study was conducted to determine the prevalence of goiter in school going children clinically, to assess the iodine status (urinary iodine excretion) of school children, and to assess the iodine content of the salt consumed by the population. **Materials and Methods:** It is school based cross-sectional study, conducted in Mandla district of Madhya Pradesh state in central India in 2016. The study participants were school children in 6-12 years of age. Probability-proportional-to-size cluster sampling was used. Palpation method was used to identify the presence of goiter. Urine samples were collected and median urinary iodine excretion was found. The salt samples were also collected from the households and local market to determine the iodinization status. **Results**: A total of 2700 school children were studied. The total goitre rate was 0.74%. Among those clinically palpable goiter 15(75%) were girls. The prevalence of goitre higher among girls was statically significant with p=0.025. All the cases of clinically palpable goiter belonged to caste other than general with p<0.001. The median urinary iodine excretion of 270 urine samples of school children was 184 µg/l. The prevalence of iodine deficiency disorders using urinary iodine excretion as indicator in the present study was 22.9% Seven percent of the samples had median urinary iodine The normal iodine content i.e more than the 15 ppm iodine was present in 84% of samples collected from households. **Conclusion**: The children of Mandla district of Madhya Pradesh had low prevalence of goiter. However, there is significant burden of goiter among backward classes.

Keywords

Iodine; Salt; Goiter; Deficiency; School; India

Introduction

Iodine deficiency is one of the major preventable causes of brain damage. It deteriorates the quality of life of millions of people through its effects on the developing brain. As per the estimates of World Health Organization 54 countries across the world are still iodine-deficient.(1) In India as estimated by pooling 24 state and district surveys, comprising 84,407 school children, the total goitre prevalence

was 17.9 % [17.6–18.2]. By pooling 20 state and district surveys, comprising 17,321 school children the median urinary iodine excretion in India, was 133 µg/l. The prevalence of iodine deficiency disorders using urinary iodine excretion as indicator was 31.3% [30.6–32.0] in India. (2)

To reduce the risk of iodine deficiency disorder, salt is fortified with iodine.(3) Globally approximately 350 million people do not eat adequately iodized salt. (4) Coverage evaluated survey by UNICEF in 2009 reported of the 325 districts in India, iodized salt coverage and households consuming adequately iodized salt was 91% and 71% respectively.(3)

According to the World Health Organization recommended daily intake of iodine for preschool children, schoolchildren, adolescents and pregnant and lactating women is 90 µg, 120 µg, 150 µg, and 250 µg, respectively.(5) Iodine deficiency occurs due to low iodine intake in food compared to recommended daily intake. The primary reason for lack of iodine in food is erosion of soils, overgrazing by livestock, tree-cutting for firewood and others. As a result of low iodine intake, the thyroid gland is insufficient to synthesize required amounts of thyroid hormone, leading to hypothyroidism and brain damage.(6)

In community assessment of Iodine deficiency, urinary iodine excretion is a good marker of recent dietary iodine intake. Iodine deficiency is defined as, in children and non-pregnant women, median urinary iodine concentrations of between 100 µg/l and 299 µg/l among children and non-pregnant women define a population which has no iodine deficiency. In addition, not more than 20% of samples should be below 50 µg/l.(7)

The iodine deficiency disorders studies in India are documented (8-24); there is still a paucity of studies from the rural population of the central India.

Aims & Objectives

To determine the prevalence of goiter in school going children clinically, to assess the iodine status (urinary iodine excretion) of school children, and to assess the iodine content of the salt consumed by the population.

Material & Methods

The present study was conducted in Mandla district of Madhya Pradesh state in central India. As per census 2011 Mandla District has a population of 1,053,522, the district is much forested with a population density of 182 people per square kilometer. It has a sex ratio of 1005 and a literacy rate of 68.28%.(9)

A cross-sectional school based descriptive study was conducted in 2016. The study participants were school children in 6-12 years of age, A list of all government primary schools in Mandla district was obtained. Thirty government primary schools were selected by using the probability-proportional-to-size cluster sampling. A sample of 90 children (45 boys and 45 girls) was selected from each school. Thus final sample of 2700 children were examined for goiter in the district.(10) All eligible children in the studied sample were included in the study.

The sampled schools were contacted. The sampled teachers, parents, and students were explained the objectives of the study. A trained investigator interviewed, clinically examined and collected urine sample form the school children. We used a semi-structured pretested questionnaire to interview the study participants. The questionnaire was translated in the local language i.e., Hindi for better understanding of the study participants. Hindi version of form was back translated in English to check the validity of the form.

Palpation method was used to identify the presence of goitre, and the graded as recommended by the joint WHO/UNICEF / ICCIDD. The Total Goitre rate was calculated by the sum of Grade I and II goitre in the study population. The rate of goitre among this age group children is a proxy indicator for assessing status of iodine deficiency in the community.(11)

Urine samples were collected from 10% of the children (n=270). They were selected randomly, to estimate the urinary iodine excretion level, and assess the iodine status among them. On the spot mid stream urine samples were collected in the plastic containers with screw cap. Urinary iodine levels were measured by wet digestion method. The urinary iodine level of ≥ 100 µg/l considered to have no iodine deficiency. (11)

The salt samples were collected from the households of the studied school children (n=150). They were selected randomly, to determine the proportion of households consuming adequately iodized salt. The salt samples were also collected from the local market (n=30) to determine the availability of iodized salt.(12)

The institute's ethics committee approved the study. Informed written consent from patients was taken from the teachers and assent was taken from the children. Data were entered into a Microsoft Excel

spreadsheet and analyzed with SPSS 20.0, windows compatible software. Wherever applicable, proportions and mean (SD) were calculated. A probability p value of < 0.05 was taken for statistical significance.

Results

A total of 2700 school children were studied. The demographic and socioeconomic characteristics of the study population are shown in (Table 1). Only twenty cases of goitre were detected in the studied school children. Grade 1 goitre was present in 19 (0.7%) school children. Grade II goitre was present in one child. Therefore, the total goitre rate was 0.74%. (Table 1)

Among those clinically palpable goiter 15(75%) were girls. The prevalence of goitre higher among girls compared to boys was statically significant with p=0.025.(Table 2) All the cases of clinically palpable goiter belonged to caste other than general and this difference was found to be statistically significant with p<0.001.(Table 2)

The median urinary iodine excretion of 270 urine samples of school children was 184 µg/l. A total of 62(22.9%) of the samples had median urinary iodine excretion < 100 µ/l. Seven percent of the samples had median urinary iodine excretion < 50 µ/l. (Table 3)

The normal iodine content i.e more than the 15 ppm iodine was present in 84% of samples collected from households. The level of awareness about the importance of use of iodized salt was 27.3% among studied households and 53.3% among shopkeepers. (Table 4)

Discussion

In the present study, a total goitre rate was of 0.74%. As per WHO/UNICEF/ICCIDD guidelines, the area is classified as endemic to iodine deficiency if over 5% of school age children (6-12 years) are suffering from goitre. Therefore, Mandla district is not an endemic area and USI programme is established. Similarly, other population based studies have reported that the prevalence of goitre nearly ranges from 0.1% to 24%.(13-24) The studied in late ninetees and early twenties reported higher prevalence of goitre. In recent years, in India, the prevalence of iodine deficiency and goitre had drastically reduced due to effective implementation of Universal iodization programme (UIP). Likely are the findings from the developed world. (Table 5) However, countries like Ethopia, still document high prevalence of iodine deficiency.(24) This highlights the need of the strengthening the existing monitoring system under the National Iodine Deficiency Disorder Control Program for ensuring adequately iodized salt to achieve the elimination of IDD. Nevertheless, despite of the fact Mandla district is not an endemic area and USI programme is established, the present study found significant association was found between the prevalence of goiter with female gender and backward caste of the child. This point towards the chance of non-availability of iodinated salt to certain sectors of the community.

In the present study the median urinary iodine excretion level amongst the studied school children was found to be 184µg/L. This indicates that there was no biochemical deficiency of iodine. The finding of the median urinary iodine was comparable to the studies conducted among school children in Himachal Pradesh (13), Delhi (19), and Karnataka (20). (Table 5) The prevalence of iodine deficiency disorders using urinary iodine excretion as indicator in the present study was 22.9% and the proportion of households consuming adequately iodized salt was 84%. The result was similar to a recent study in conducted in Delhi among municipal school children. They documented the prevalence of iodine deficiency disorders as 16.8% and the proportion of households consuming adequately iodized salt was 88·8%.(19) An earlier survey conducted in 2005-6 found a prevalence rate of iodine deficiency disorders in Karnataka as 9.75%. This could be because, the above study enrolled both government and private schools; thereby there exists a chance of better nutrition status as of high purchasing parity among private school children.(20)

In the present study more than three fourth of the household had adequately iodized salt. Another study on household use of iodized salt documented the similar findings.(25) A likely, another study carried out in Karnataka found 90.75% of the sample they studied consumed adequately iodized salt (> 15ppm).(20) A study conducted in 2012 in Nainital, Uttarakhand stated 42.3% of studied families consumed salt with iodine content of less than 15 ppm. This could be that the area was in transition phase from iodine deficient to iodine sufficient.(16)

Conclusion

The children of Mandla district of Madhya Pradesh had low prevalence of goiter. However, the prevalence of iodine deficiency disorders, is still

considerable among children of Mandla district of Madhya Pradesh. The problem is more marked among the females and backward classes of the community. There stands a scope for reducing burden of iodine deficiency disorders possibly by further increasing the coverage of iodized salt availability and consumption. A further evaluation of the topic is needed using a mixed methods approach.

Recommendation

There is need for effective and efficient coordination amongst all stakeholders of IDD control efforts in the study District to achieve and sustain the IDD control goal. Regular monitoring, periodic review and taking corrective measures is crucial for sustainable elimination of IDD.

Limitation of the study

Study was done in the school going children and may not represent the true sample of the total children for the study of goiter prevalence.

Relevance of the study

This study through the light of IDD control program and its status in the Mandla District. It also revealed the success of the program in last decade.

Authors Contribution

SB: Conception of research idea, study proposal development, Data collection tool development, budgeting, data analysis critical interpretation, Study design of the protocol; data analysis, result interpretation and reporting critically reviewing the paper. AG: Review of Proposal, Literature search, proposal development, paper review.

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Tables

TABLE 1 DISTRIBUTION OF SCHOOL CHILDREN BY SOCIODEMOGRAPHIC AND OTHER DETAILS. (N=2700)

Variable	Category	Frequency	Percent
Sex	Female	1350	50.0
	Male	1350	50.0
Age in years (Mean SD)			8.58(1.8)
Block in District Mandla	Bichhia	360	13.3
	Ghughari	360	13.3
	Mandla	450	16.7
	Mohgaon	360	13.3
	Nainpur	450	16.7
	Narayanganj	360	13.3
	Niwas	360	13.3
Student of class	First	540	20.0
	Second	540	20.0
	Third	540	20.0
	Fourth	540	20.0
	Fifth	540	20.0
Goitre Stage	Grade 0	2680	99.3
	Grade1	19	.7
	Grade 2	1	.0
Examined for Salt consumed	Yes	540	20.0
	No	2160	80.0
Examined for urinary iodine excretion	Yes	540	20.0
	No	2160	80.0
Total		2700	100.0

TABLE 2 DISTRIBUTION OF VARIOUS FACTORS WITH RESPECT TO PRESENCE OF GOITER IN SCHOOL CHILDREN. (N=2700)

Variable	Category	Goitre Absent		Goitre Present		Total		Chi Square	p value
		n	%	n	%	n	%		
Sex	Female	1335	49.8%	15	75.0%	1350	50.0%	5.03	0.025*
	Male	1345	50.2%	5	25.0%	1350	50.0%		
Student of class	First	536	20.0%	4	20.0%	540	20.0%	5.5	0.236
	Second	532	19.9%	8	40.0%	540	20.0%		
	Third	537	20.0%	3	15.0%	540	20.0%		
	Fourth	538	20.1%	2	10.0%	540	20.0%		
	Fifth	537	20.0%	3	15.0%	540	20.0%		
Block of District Mandla	Bichhia	357	13.3%	3	15.0%	360	13.3%	1.4	0.962
	Ghughari	358	13.4%	2	10.0%	360	13.3%		
	Mandla	445	16.6%	5	25.0%	450	16.7%		
	Mohgaon	357	13.3%	3	15.0%	360	13.3%		
	Nainpur	447	16.7%	3	15.0%	450	16.7%		
	Narayanganj	358	13.4%	2	10.0%	360	13.3%		
	Niwas	358	13.4%	2	10.0%	360	13.3%		
Caste	General	33	1.2%	0	0.0%	33	1.2%	23.4	<0.001*
	Other backward class	1289	48.1%	9	45.0%	1298	48.1%		
	Schedule class	104	3.9%	5	25.0%	109	4.0%		
	Schedule tribe	1254	46.8%	6	30.0%	1260	46.7%		

TABLE 3 DISTRIBUTION OF VARIOUS FACTORS WITH RESPECT TO URINARY IODINE EXCRETION AMONG SCHOOL CHILDREN. (N=270)

Variable	Category	Median Urinary Iodine Excretion								Chi Square	p value
		<50		50-100		>100		Total			
		n	%	n	%	n	%	n	%		
Sex	Female	10	50.0%	30	71.4%	134	64.4%	174	64.4%	2.7	0.257
	Male	10	50.0%	12	28.6%	74	35.6%	96	35.6%		
Student of class	First	7	35.0%	9	21.4%	45	21.6%	61	22.6%	8.8	0.358
	Second	7	35.0%	7	16.7%	45	21.6%	59	21.9%		
	Third	0	0.0%	5	11.9%	25	12.0%	30	11.1%		
	Fourth	3	15.0%	13	31.0%	44	21.2%	60	22.2%		
	Fifth	3	15.0%	8	19.0%	49	23.6%	60	22.2%		
Block of District Mandla	Bichhia	3	15.0%	5	11.9%	28	13.5%	36	13.3%	18.5	0.102
	Ghughari	6	30.0%	5	11.9%	25	12.0%	36	13.3%		
	Mandla	3	15.0%	8	19.0%	34	16.3%	45	16.7%		
	Mohgaon	1	5.0%	5	11.9%	30	14.4%	36	13.3%		
	Nainpur	5	25.0%	10	23.8%	30	14.4%	45	16.7%		
	Narayanganj	0	0.0%	1	2.4%	35	16.8%	36	13.3%		
	Niwas	2	10.0%	8	19.0%	26	12.5%	36	13.3%		
Caste	General	0	0.0%	0	0.0%	2	1.0%	2	.7%	11.6	0.071
	Other backward class	9	45.0%	29	69.0%	89	42.8%	127	47.0%		
	Schedule class	0	0.0%	2	4.8%	12	5.8%	14	5.2%		
	Schedule tribe	11	55.0%	11	26.2%	105	50.5%	127	47.0%		
Total		20	100.0%	42	100.0%	208	100.0%	270	100.0%		
Mean Urinary Iodine Excretion 187.57±94.1 Median Urinary Iodine Excretion 184											

TABLE 4 DISTRIBUTION OF VARIOUS FACTORS WITH RESPECT TO SALT SAMPLES COLLECTED

Salt sample collected from households of studied school children (n=150)			
Variable	**Category**	**Frequency**	**Percent**
Iodine level in salt	0 PPM	24	16.0
	15 PPM	42	28.0
	30 PPM	84	56.0
Salt sample collected from Block of District Mandla	Bichhia	30	20.0
	Ghughari	20	13.3
	Mandla	25	16.7
	Mohgaon	10	6.7
	Nainpur	25	16.7
	Narayanganj	20	13.3
	Niwas	20	13.3
Type of salt used	Packet	124	82.7
	Loose	26	17.3
Place of purchase of salt	Control Office	101	67.3
	Private office	49	32.7
Storage of salt	In Closed Container	121	80.7
	In open Container	29	19.3
Awareness about use of importance of iodised salt	Present	41	27.3
	Absent	109	72.7
Salt sample collected from shops (n=30)			
Type of salt sold	Packet	26	86.7
	Loose	4	13.3
Cost per kg of salt in rupee	10/-	26	86.7
	4/-	1	3.3
	5/-	3	10.0
Awareness about use of importance of iodised salt	Present	16	53.3
	Absent	14	46.7

TABLE 5 COMPARISON OF TOTAL GOITRE RATE, MEDIAN URINARY IODINE EXCRETION BETWEEN THE WORLD HEALTH ORGANIZATION, THE PUBLISHED LITERATURE, AND THE PRESENT STUDY

Iodine deficiency disorders in school age children												
	India								Outside India			
Variable	India (WHO)[2]	Himachal Pradesh[1]3	Gujarat[1]4	Uttarakhand[15,16]	West Bengal[17,18]	Delhi[19]	Karnataka[20]	**Present study**	Spain[21]	Brazil[22]	Mongolia[23]	Ethiopia[24]
Study design	Pooled data	**Cross sectional study**										
TGR (%)	17.9	23.4	20.5	16.8, 15.9	11.3, 18.6	-	0.125	**0.74**		-	43.3	39.5
Median UIE (µg/l)	133	175	70	115, 125	150, 160	198·4	179	**184**	173	206.4	152.5	39.9
Household salt ≥ 15 ppm of iodine	91	-	54.3	40.4, 57.7	85.1, 67.4	88·8	90.75	**84**		69.8	-	40