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Original Research Article

Assessment of iodine deficiency disorder among school going children aged 5-10 years in Sagar district of Madhya Pradesh: an observational cross sectional study

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ABSTRACT

Background: Iodine deficiency (IDD) is the world's most prevalent cause of brain damage. glaciations, flooding, rivers lead to deficiency of iodine in crops grown on iodine. Diet low in iodine can result in stillbirth and abortions and many more sequelae. Objectives of the research work were to study the prevalence of IDD amongst 6-12 years children by clinical examination and to determine the concentration of iodine in salt sample at consumer level. Also, to determine the urinary iodine excretion amongst 6-12 years age group children.
Methods: It was a cross sectional study conducted in the government schools of Sagar district among school children of 6-12 years of age. Total 2700 school children from 30 villages were included using PPS sampling. Students were clinically examined and their urine samples were taken for MUIC estimation.
Results: Prevalence of goiter was more in 10 to 11 years of age (14.07%) and less in 8 to 9 years age group (7.59%). Overall prevalence of goiter in district Sagar is 10.51%.
Conclusions: Despite NIDDCP, there is still dearth of awareness among general public about the usage and storage of iodized salt which is the root cause of Iodine deficiency.

Keywords: IDD, Rapid test kit, Salt sample

INTRODUCTION

Iodine deficiency disorder (IDD) is a serious public health threat for 2 billion people worldwide.[1] Iodine deficiency is the world's most prevalent, yet easily preventable, cause of brain damage. Iodine deficiency disorders (IDD), which can start before birth, jeopardize children's mental health and often their very survival. Serious iodine deficiency during pregnancy can result in stillbirth, spontaneous abortion, and congenital abnormalities such as cretinism.[2] Impaired cognitive development leading to poor school performance and reduced work capacity.[1] Iodine deficiency disorders (IDD) are linked to iodine deficient soil. Due to glaciations, flooding, rivers changing course and deforestation the iodine present in top soil is constantly leached. This leads to deficiency of iodine in crops grown on iodine deficient soil with consequently low iodine in the diet for livestock and humans. Majority of consequences of IDD are invisible and irreversible but at the same time preventable.[3] The most damaging consequences of IDD are in the first 1000 days of life, from conception until the age of 2 years. Severe iodine deficiency during this period increases the risk of stillbirth, congenital abnormalities, and perinatal and infant mortality and impairs physical growth, motor function, and cognitive development.[4] This spectrum includes disorders such as goiter, subnormal intelligence,

delayed motor milestones, strabismus, nystagmus, neuromuscular weakness, endemic cretinism, still birth, hypothyroidism, defect in vision, hearing, and speech, spasticity, mental retardation, and intrauterine death.[5] The most critical period is from the second trimester of pregnancy to the third year after birth. Normal levels of thyroid hormones are required for optimal development of the brain. In areas of iodine deficiency, where thyroid hormone levels are low, brain development is impaired.[6] A spectacularly simple, universally effective, wildly attractive and incredibly cheap technical weapon-that's iodized salt.[1] The Salt iodisation programme in India dates back to STARTED IN 1962.USI involves the iodization of all human and livestock salt, including salt used in the food industry. Adequate iodization of all salt will deliver iodine in the required quantities to the population on a continuous and self-sustaining basis.[6] In 1983, mandatory iodization of all table salt was introduced in India in an attempt to eliminate iodine deficiency. The Government of India has relaunched National Iodine Deficiency Disorders Control Programme (NIDDCP) in the year 1992 with a goal to reduce the prevalence of IDD to nonendemic level.[7] The WHO recommendation for adequate daily iodine intake of 150 micro gram per day for man and non pregnant, non lactating women, 250 microgram per day for pregnant and lactating women and a daily intake of iodine of 90 micro gram for preschool children (0-59 months) and 120 micro grams for school children (6-12 yrs).[8] In India the salt should contain at least 15 ppm iodine to provide the normal requirements of 150 microgram per day to the population i.e. at consumer level. It is usually necessary to iodize the salt at higher levels (30 ppm or more) to compensate for the loss of iodine during storage and distribution i.e. at retailer and production level 24.[9]

Total goiter rate of Madhya Pradesh was 78% in 20154-16 by NIDDCP. As per the revised guidelines of NIDDCP, Sagar district was categorized as one of the fourteen endemic districts for goiter in MP in year 2006.[6] (DHS) Households using iodized salt (%) 97.9 (urban) 91.2 (rural) 93.2 (total) – Madhya Pradesh (NFHS). The present study was conducted with the objective to estimate the prevalence of IDDs in among school-going children (age 6-12 years) in Sagar district of Madhya Pradesh, India and to determine the prevalence of adequate iodine in salt samples at consumer level.

METHODS

Study area

30 villages/ wards selected from Sagar District by PPS Sampling.

Survey method

IDD Survey at Sagar district is proposed to conduct by using Population Proportionate to size (PPS) sampling in the age group of 6-12 years children.

Initially, for the selection of villages/wards by PPS method, the current lists of villages/wards along with their respective population was collected from the District CMHO office.

Villages/wards of the district was listed and numbered along with their cumulative population and then the required sampling table was prepared.

The method of sampling to be used in PPS systematic sampling involves following steps.

Total population of Sagar district.

Sample size = 30 village /wards

Calculation of sampling interval

= Total population/30 = k

By using currency note technique, first village (R1) with r1 cumulative population in every district was selected. After that subsequent 29 cluster villages were selected by adding sampling interval tor1 + (r2) + r3+…..+ r30.

Random Selection of the first village/ward(S) from the list is done within sampling interval. Selection of 30 villages/wards from the list using the sampling interval (k) was then done.

Activities conducted in each listed above 30 cluster villages

Investigators visited the selected villages of the Sagar district/blocks initially and then proceeded towards the primary schools of that particular area. As the school enrolment rate of the selected villages was more than 90%, the required samples i.e clusters were limited to the primary schools of the respective villages/wards. Children belonging to the age group 6-12 years, studying in class I-V were then approached for the clinical examination to assess the presence of IDD. Samples of 90 children (45 boys and 45 girls) were examined from each school. This selection of students followed the following criteria. Out of those students present during the day of visit from each class, 9 boys and 9 girls were selected from each class randomly from the attendance register, thus contributing to a total of 18 students per class and 90 in total for a school. Thus, a total of 2700 students were clinically examined.

If the required number of students was not fulfilled by a particular primary school due to some reason or the other, the nearby Government/Private primary school in the same village was then identified and the required number of total 90 students were obtained.

Technique of clinical examination used for diagnosis of goiter was inspection and palpation of neck. (As per WHO grading guidelines).

Grade 0 was no palpable or visible goiter/no goiter; Grade 1 was a mass in the neck that is consistent with an enlarged thyroid, which is palpable but not visible when the neck is in normal position. It moves upward in the neck as the subject swallows or seen as visible swelling on extended neck. Nodular alteration(s) can occur even when the thyroid is not enlarged/goiter palpable but not visible; and Grade 2 was a swelling in the neck that is visible in normal position and is consistent with an enlarged thyroid when neck is palpated/goiter visible and palpable.

Salt sample collection and analysis for iodine content

Out of 90 children, who were selected initially for clinical examination, the team then randomly selected 9 boys and 9 girls, preferably from different sections and asked them to bring the salt sample from their respective households for the analysis of iodine content in them. Thus a total of 18 salt samples were collected from each school and was then subjected to testing on spot for iodine content by MBI kits supplied by the DHS. A total of 540 salt samples were tested in. Later on, the salt used in the cooking of mid-day meal of that particular school was also subjected to analysis.

Urine sample of children for Urinary iodine estimation

Among these 9 boys and 9 girls who were selected for the earlier step of salt collection, a total of 9 students were then recruited for collection of urine sample for Urinary iodine estimation (UIE). A small amount, up to 5ml of urine sample was then collected for urinary estimation of iodine in thymol preserved containers having screw tops. Containers were then sealed, labelled and transported to State IDD lab, J. P. hospital. Bhopal. A total of 270 urine samples were collected and send for estimation. Urinary iodine content was then estimated using standard estimation procedure in the State IDD lab, J P Hospital Bhopal.

Demonstration and education regarding iodine content of cooking salt was done among school children, teachers and committee members of mid day meal programme.

RESULTS

Out of 2700 children of 6-12 years age group clinically examined by inspection and palpation for goiter, 284 (10.5%) were found to have visible goiter, (enlarge or nodular). Prevalence of rate of goitre observed in 11 blocks of Sagar district is 10.5%.

Table 1: Prevalence rate of goitre among boys and girls according to age group and gender.

Age group (years)	Gender	Total examinations	Grades of goitre			Total cases goiter	Percentage
			Grade 0	Grade I	Grade II	(I^{st} + 2^{nd})	%
6 to 7 years	Male	270	246	23	1	24	8.9
	Female	270	250	16	4	20	7.4
	Total	540	496	39	5	44	8.14
8 to 9 years	Male	270	245	23	2	25	9.2
	Female	270	254	16	0	16	5.9
	Total	540	499	39	2	41	7.59
9 to 10 years	Male	270	243	17	10	27	10.0
	Female	270	236	23	11	34	12.6
	Total	540	479	40	21	61	11.29
10 to 11 years	Male	270	232	28	10	38	14.0
	Female	270	232	27	11	38	14.0
	Total	540	464	55	21	76	14.07
12 years	Male	270	240	19	11	30	11.1
	Female	270	238	23	9	32	11.8
	Total	540	478	42	20	62	11.48

Table 2: Overall prevalence of goiter according to gender.

Sex	Number	Grade 0	Grade I	Grade II	(I^{st} + 2^{nd}) Grade	Percentage (%)
Male	1350	1206	110	34	144	10.6
Female	1350	1210	105	35	140	10.4

In clinical examination it was found that prevalence is highest in 10 to 11 years of age (14.07%) and least in 8 to 9 years age group (7.59%).

Amongst the children examined, prevalence of goiter was found more or less equal in equal with respect to gender, 10.6% males and 10.4% females were found to have goiter. The chi-square is 0.063. The p value is 0.801876.

Above table shows the mean urinary iodine excretion in children above 6 years and older. On the basis of mean urinary iodine excretion study, finding shows that 104 (38.5%) had insufficient iodine intake whereas only 84 (31.1%) were having adequate iodine intake.

Table 3: UIE analysis of Sagar district.

Mean value of urinary iodine excretion	Iodine intake	Number	% of subjects
0-99 µg/l	Insufficient	104	38.5
100-199 µg/l	Adequate	84	31.1
200-299 µg/l	Above requirement	49	18.2
>300 µg/l	Excessive	33	12.2

There were 240 (44.3%) of the salt samples had insufficient iodine content and 300 (55.6%) salt samples had normal iodine content.

Table 4: Distribution of iodine content of salt samples of Sagar district.

Iodine content in salt sample	Number	% of subjects
0 ppm	75	13.9
<15 ppm	165	30.5
≥15 ppm	300	55.6
Total	540	100

Table 5: IDD Prevalence in Sagar district as severity of public health problem.

Indicator goitre grade>0	Study finding	Mild 5-19.9%	Moderate 20-29.9%	Severe >30%
Sagar goitre grading	10.51%	10.51%		

From survey with clinical examination it was found that prevalence of goiter in district Sagar is 10.51%.

DISCUSSION

According to WHO, the District is considered endemic for IDD if the prevalence of goiter among school children is >5%. The present study revealed that the Sagar district is endemic for the iodine deficiency disorders with 10.51% prevalence which falls under the category of mild endemicity. The prevalence of goitre increased with age with highest in 10-11 years of about 10.47%. This finding is similar to the finding of Kapil et al in which highest prevalence was (%) was observed in the age group of 11-12 years.[10] This maybe due to increased demand during adolescence.[12] The overall prevalence of goiter was higher in girls (10.6%) to boys (10.4%), which corresponds to the finding of Makwana et al in which prevalence higher in females 5.1% compared to males 4.6%, though the sex difference was not statistically significant (χ^2=0.063, p=0.8). Median iodine concentration of >100 µg/l defines a population with no iodine deficiency, i.e. at least 50 per cent of the samples should be above 100 µg/l according to the epidemiological criteria for assessing iodine nutrition based on median urinary iodine concentration in children. Total (84) 31.1% children were found to be 'Adequate' in Iodine Nutrition, in contrast to 22.6% and 40% in a study by Kapil et al and Makwana et al respectively.[10,12] The low level of median urinary iodine concentration can be attributed to improper way of storing salt, storage in open cans and bins, using below standard quality of salt, low awareness activities, weak monitoring mechanisms, insufficient administration of iodized salt during pregnancy and lactation; gaps in the supply and distribution of the salt and poor political will. Assessment of household salt using rapid test kits revealed only 55.6% of the total samples with >15ppm iodine content which is much less considering that almost all the household are using government supplied salt, which is also readily available in the market. The remaining 44.4% of the sample had low iodine conent which can be due to storage of open packets of salt in open containers. This is in contrast to the finding of NFHS-4, Households using iodized salt (%) 90.7 Rural 91.6 total (NFHS- Sagar).[13] In a study by Kaur et al, the use of noniodized salt in the States of Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Uttar Pradesh, Odisha, and Jharkhand, seemed more common compared to other state.[4] The present study identifies the lacunae in monitoring of distribution of iodized salt even after years of implementation. It is essential mandatory sale of only iodized salt is ensured. It is to be ensured that every child born in the state has optimal iodine nutrition and thus can attain their fullest developmental potential.

CONCLUSION

Sagar district was found to be mildly endemic for goitre with prevalence of 10.51%. Further, 44.3% salt samples that were tested with rapid test kit were found to have <15 ppm of iodine in it and 38.5% of the urine samples were found to have insufficient MUIC upon urine analysis indicates the need for bold governmental actions towards reducing the endemicity of goitre in the study district. Despite NIDDCP, there is still dearth of awareness among general public about the usage and storage of iodized salt which is the root cause of Iodine deficiency.

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