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Original Article:

Current iodine status and progress over the last decade towards elimination of iodine deficiency in Rajkot District, Gujarat

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Abstract:
Objective: To find out prevalence of goitre in primary school children; to compare prevalence with previous survey; to determine median urinary iodine concentration; to assess level of iodine in salt samples at household and retail shop level; and to study profile of salt sold at retail shops. **Design & Settings:** 30 cluster survey study in primary schools of Rajkot district. **Subjects:** Children studying in 1st to 7th standard. **Methods:** Total 70 students including five boys and five girls from 1st to 7th standard present in class on the day of visit were selected randomly for Goitre examination, so, total 2100 students were examined in schools. Urine sample was collected from one boy & one girl from each standard in each cluster. From community, 28 students including two boys and two girls from each standard in same age group were examined and also salt samples were tested from their households. From each village, one retail shop was visited and salts were purchased and tested for iodine on the spot with spot kit. **Results:** Goitre prevalence was found 8.8% among primary school children compare to 5.6% in 1999. As the age increases the Goitre prevalence also increases except in age group of 12 years. Median urinary iodine excretion level was found 110 µg/L. Iodine level >15 ppm was found in 81% salts samples tested at household level. **Conclusion:** Present study showed mild Goitre prevalence in primary school children in Rajkot district of Gujarat but still iodine content of salt found inadequate at household level.
Key Words: Goitre survey, IDD, elimination, prevalence, primary school children, household level

Introduction:

Iodine is an important micronutrient required for human nutrition. Iodine Deficiency Disorders (IDD) refers to a complex clinical and subclinical disorder caused for the lack of adequate dietary intake. Globally, 2.2 billion people live in areas with iodine deficiency and risk its complications, while in India, 167 million people are at risk of IDD, 54.4 million people have goitre and 8.8 million people have IDD related mental/motor handicaps.[1] IDD prevailing in all states and union territories as out of 587 districts in the country, 282 have been surveyed for IDD and 241 found goitre endemic.[2] There were several studies conducted all over India have shown high prevalence of goitre.[3-5] In 1983, compulsory iodization of all table salt was introduced in India in an attempt to eliminate iodine deficiency. Government of India has re-launched National Iodine Deficiency Disorders Control Programme (NIDDCP) in the year 1992 with goal to reduce the prevalence of IDD to non endemic level. After implementation of NIDDCP, India has made considerable progress towards IDD elimination. Less than 5 % total goitre rate was found in 9 out of 15 districts studied in 11 states by an Indian Council of Medical Research (ICMR).[6] NIDDCP included IDD surveys, supply of iodized salt, re-surveys every five years, monitoring iodized salt consumption, laboratory monitoring of iodized salt, urinary iodine concentration and health education.

In February 2009, government of Gujarat has started IDD re-survey in all the districts of Gujarat state. In Rajkot district, first baseline IDD survey was done in 1989, and then res-survey was done in 1998-99. The present goitre survey was done in Rajkot district with the objectives to find out the prevalence of goitre in primary school children aged 6-12 years; compare prevalence with previous survey; to determine median urinary iodine concentration in sample of children; to assess the level of iodine in salt samples at household and retail shop level; and to study the profile of salt sold at retail shops

Materials and Methods:

Selection of study area: The present study was done in Rajkot district of Gujarat state. The district is centrally located in Saurashtra region of Gujarat state and surrounded by Kutchh, Jamnagar, Surendranagar, Bhavnagar and Amreli district. Rajkot district is an Industrial hub of Gujarat state. The main source of water is rain. Almost all type of routine vegetables

is available and consumed by the people. The district is divided into 13 talukas, having 31, 69,881 total populations as per 2001 census.[7] The national programme was implemented in the district in 1992 and goitre survey was done in 1999, which indicated low goitre prevalence (5.6%).[8]

Selection of study population & sample size: As per guidelines provided by State Nutrition Cell, Ministry of Health & Family Welfare, Government of Gujarat, cross sectional study of children aged 6-12 years age groups studying in 1st to 7th standard in primary schools of rural areas were selected for the study. The study included two types (1) school survey & (2) community survey. Five boys and five girls from each standard present in class on the day of visit were selected randomly for examination. So total, 70 students were examined from each school in selected villages. As per guidelines provided, almost 30% school children were considered absent at any given time and so, 28 students were examined from community from each selected village. Out of 28 students examined out of schools in community, two boys and two girls from each standard in age group 6-12 years were examined. So, total 2100 students were examined in schools and 840 students were examined out of schools in the selected villages.

Sampling method: Cluster sampling method was used for selection of villages. A list of villages of all talukas of Rajkot district was obtained from Jilla Panchayat, office of District Health Office (DHO), Rajkot. Then cumulative population was counted by using MS excel. By calculating cluster interval, 30 villages were selected from the list. Only rural areas were included and urban population was excluded in calculating cumulative population. So, the study was confined to only rural areas of Rajkot district. Then primary schools of these 30 selected villages visited for school survey. When desired sample size of five boys and girls each from each standard was not achieved, primary school of nearest village was approached and desired sample size was achieved and similarly, community survey was also done. The following classification was used for goitre: (a) grade 0 – not visible, not palpable, (b) grade 1- palpable, but not visible, & (c) grade 2- palpable & visible, as per the WHO/UNICEF/ICCIDD guidelines.[9]

Urine Samples: One boy and one girl from 1st to 7th standard were selected randomly for taking urine sample. So, in each cluster 14 urine samples were collected including 7 samples from boys and 7 from girls. In 30 clusters, total 420 urine samples were 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 state IDD laboratory, at Government Medical College, Surat, for testing by expert technician. Few drops of toluene were added to each urine sample to inhibit bacterial growth and to minimize bad odor. Child no., cluster no. and date of urine collection were mentioned on every bottle of urine sample to identify it. Ammonium per sulfate titration method was used to detect the urinary iodine excretion level.

Salt samples: As per the guidelines provided, 28 salt samples were tested of all the children of 6-12 years examined for goitre during community survey at their homes in each village. So, total 840 salt samples were tested. These samples were tested qualitatively on the spot with MIB kit provided by UNICEF and iodine concentration was recorded as 0, <15 & >15 ppm.[10] From each village, one retail shop was visited and salts were purchased and tested for iodine on the spot with spot kit.

Data analysis: All the data was entered in MS excel 2007 and analyzed by using Epi Info software, version 3.5.1.

Results:

Goitre prevalence in Rajkot district was found 8.8% among primary school children (Table 1). Severe goitre prevalence was found only in Jamkandorna taluka while in Upleta taluka it was moderate.

Table 1: Goitre prevalence in different study areas of Rajkot district

Study Talukas	Total no. of children examined	No. (%) of children with Goitre			Severity as public health problem*
		Grade 1	Grade 2	Total (1+2)	
Dhoraji	196	13 (6.6)	0	13 (6.6)	Mild
Gondal	294	23 (7.8)	6 (2)	29 (9.9)	Mild
Jamkandorna	98	31 (31.6)	3 (3.1)	34 (34.7)	Severe
Jasdan	490	19 (3.9)	9 (1.8)	28 (5.7)	Mild
Jetpur	196	6 (3.1)	0	6 (3.1)	No
Kotdasangani	196	12 (6.1)	0	12 (6.1)	Mild
Lodhika	98	6 (6.1)	0	6 (6.1)	Mild
Maliya	98	1 (1)	0	1 (1)	No
Morbi	294	25 (8.5)	11 (3.7)	36 (12.2)	Mild
Padadhari	98	10 (10.2)	0	10 (10.2)	Mild
Rajkot	294	5 (1.7)	1 (0.3)	6 (2)	No
Tankara	196	32 (16.3)	2 (1)	34 (17.3)	Mild
Upleta	98	20 (20.4)	0	20 (20.4)	Moderate
Wankaner	294	21 (7.1)	3 (1)	24 (8.2)	Mild
Total	2940	224 (7.6)	35 (1.2)	259 (8.8)	Mild

*Severity of public health problem: <5% - No; 5-19.9% - Mild; 20-29.9% - Moderate; >30% -Severe 11

Table 2 shows comparative age specific goitre prevalence in Rajkot district. As the age increases the goitre prevalence also increases except in age group of 12 years in present study. The total goitre prevalence was found 8.8% in present study compare to 5.6% in 1999 study.

Table 2: Age specific goitre prevalence in Rajkot district

Age group	Total no. of children examined		Goitre prevalence					
			Grade 1 (%)		Grade 2 (%)		Total Goitre (%*)	
	1999	2009	1999	2009	1999	2009	1999	2009
6-7	3744	840	119 (3.2)	52 (6.2)	53 (1.4)	7 (0.8)	172 (4.6)	59 (7.0)
8-9	3735	840	153 (4.1)	69 (8.2)	53 (1.4)	11 (1.3)	206 (5.5)	80 (9.5)
10-11	3184	840	138 (4.3)	74 (8.8)	53 (1.7)	15 (1.8)	191 (6.1)	89 (10.6)
12-13	1686	420	94 (5.6)	29 (6.9)	34 (2.0)	4 (1.0)	128 (7.6)	33 (7.9)
Total	12349	2940	504 (4.1)	224 (7.6)	193 (1.6)	35 (1.1)	697 (5.6)	259 (8.8)
*p<0.01								

Total 420 urine samples were collected in Rajkot district, out of which 52% samples were found with urinary iodine excretion (UIE) level 100 µg/L or more, while 30% samples shown UIE between 50-99.9 µg/L, 13% between 20-49.9 µg/L and 5% below 20 µg/L (Table 3).

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

Study Talukas	n	Urinary Iodine Excretion level (µg/L)*			
		< 20.0 (%)	20.0-49.9 (%)	50.0-99.9 (%)	≥ 100 (%)
Dhoraji	28	2 (7.1)	1 (3.6)	12 (42.9)	13 (46.4)
Gondal	42	2 (4.8)	6 (14.3)	8 (19.0)	26 (61.9)
Jamkandorna	14	0	2 (14.3)	4 (28.6)	8 (57.1)
Jasdan	70	4 (5.7)	21 (30.0)	24 (34.3)	21 (30.0)
Jetpur	28	0	0	12 (42.9)	16 (57.1)
Kotdasangani	28	4 (14.3)	7 (25.0)	7 (25.0)	10 (35.7)
Lodhika	14	0	2 (14.3)	5 (35.7)	7 (50.0)
Maliya	14	1 (7.1)	1 ((7.1)	6 (42.9)	6 (42.9)
Morbi	42	2 (4.8)	2 (4.8)	12 (28.6)	26 (61.9)
Padadhari	14	0	0	4 (28.6)	10 (71.4)
Rajkot	42	3 (7.1)	7 (16.7)	16 (38.1)	16 (38.1)
Tankara	28	0	6 (21.4)	9 (32.1)	13 (46.4)
Upleta	14	1 (7.1)	0	0	13 (92.9)
Wankaner	42	2 (4.8)	0	8 (19.0)	32 (76.2)
Total	420	21 (5.0)	55 (13.1)	127 (30.2)	217 (51.7)
*Median urinary iodine excretion level for Rajkot district was found 110 µg/L.					

Taluka specific assessment of iodine at consumer level was found lowest in Jasdan taluka where more than half of the salt samples found with <15 ppm iodine or no iodine at all (Table 4).

Table 4 Taluka specific assessment of iodine in salt samples by spot kit at household level

Talukas	No. of salt samples tested	Iodization of salt in ppm			% of salt samples adequately iodized
		0 ppm	<15 ppm	>15 ppm	
Dhoraji	56	5	2	49	87.5
Gondal	84	9	8	67	79.8
Jamkandorna	28	1	2	25	89.3
Jasdan	140	27	59	54	38.6
Jetpur	56	7	10	39	69.6
Kotdasangani	56	3	0	53	94.6
Lodhika	28	0	0	28	100
Maliya	28	4	1	23	82.1
Morbi	84	5	3	76	90.5
Padadhari	28	0	1	27	96.4
Rajkot	84	2	1	81	96.4
Tankara	56	6	0	50	89.3
Upleta	28	1	0	27	96.4
Wankaner	84	0	4	80	95.2
Total	840	70	91	679	80.8

Out of 840 salt samples tested, 81% salt samples shown >15 ppm iodine at consumer level. Table 5 shows summary of salt sold at retail shop in Rajkot district where all salt samples found well packed, branded, powdered & iodized as per manufacturer`s status.

Table 5: Summary of salt sold at retail shop in Rajkot district

	Summary	No.	Percentages
Salt status	Packed	31	100
	Unpacked	0	0
Salt characteristics	Branded	31	100
	Unbranded	0	0
Salt type	Powdered	31	100
	Crystal	0	0
Iodine status from manufacturer	Iodized	31	100
	Noniodized	0	0
Iodine status (samples with claim of iodization)	0	3	9.7
	<30	6	19.3
	>30	22	71
Batch No.	Yes	28	90.3
	No	3	9.7
Logo	Yes	31	100
	No	0	0
Address of manufacturer	Yes	31	100
	No	0	0
Maximum retail price (Rupees/kilogram)	≤1	0	0
	2-5	20	64.5
	6-9	4	12.9
	≥10	7	22.6

Discussion:

To evaluate the severity of IDD in a region, the most widely accepted marker is the prevalence of endemic goitre in school children. WHO/UNICEF/ICCIDD[11] on the basis of IDD prevalence recommended the criteria to understand the severity of IDD as a public health problem in a region. According to these criteria, a prevalence rate of 5.0-19.9% is considered as mild; 20-29.9% as moderate and a prevalence rate of above 30% considered as a severe public health problem.

During 1999 study in same area reported 5.6% goitre prevalence in Rajkot district, while in 2009 study, the total goitre prevalence rate was found 8.8% (grade 1- 7.6%; grade 2-1.2%) indicating that IDD is a mild public health problem. Though the prevalence rate was not high in any of the study and become serious public health problem, still the prevalence rate was increased in last decade in Rajkot district. This may be due to withdrawal of the notification banning the sale of noniodized salt from Gujarat state since January, 2001.[3] During November, 2005, central government has issued notification banning the sale of noniodized salt for direct human consumption in the entire country, which was effective from 17th May, 2006 under the Food Adulteration Act.[12] From January, 2001 upto June, 2006 there was no ban on noniodized salt sale and that was may be the reason for increasing goitre prevalence in Rajkot district.

Similar study from another district of Gujarat, reported 20.5% total Goitre prevalence[4] which was very high compare to present study mentioning withdrawal of notification banning the sale of non-iodized salt from Gujarat since January, 2001. Present study reports lower prevalence rate, most probably due to availability and consumption of iodized salt now at all places from cities to smallest villages. That may be one of the reasons of no association found between age of school children and high prevalence of goitre compare to earlier studies.[3,4] In addition prevalence among girls was more than boys, which was also reported by various studies.[4,5] As per National Family Health Survey (NFHS)-3, the prevalence of goitre or other thyroid disorders found 2.5 times higher for women than for men and number of persons with goitre or thyroid disorders increases with age, especially among women.[13]

In present study, the urinary iodine excretion level 100 µg/L and above was found in almost 52% samples. As per the national guidelines[1], severity of IDD as public health problem was classified in three categories including, (1) <20 µg/L – severe, (2) 20-49.9 µg/L – moderate, and (3) 50-99.9 µg/L - mild. Value 100 µg/L or above considered as normal. The median urinary iodine level was 110 µg/L in current study. Still, mild severity found in 30% children, moderate in 13% and severe in 5% children. These findings indicate that still 48% population having biochemical deficiency of iodine. It also indicates continued though inadequate efforts of ensuring a supply of iodized salt to the population. Different median urinary iodine levels were reported by different authors indicating deficiency or no deficiency of iodine in respective populations in their areas.[14-17]

WHO/UNICEF/ICCIDD also recommends that 90% of household salts should get iodized at the recommended level of 15 ppm[18] but the study shows that about 81% of households consuming salts at adequate level while about 11% households though consuming iodized salt but not at the recommended level. Chandra AK et al[5] reported more than 95% of households consuming salts at adequate level, while Kamath R et al[19] & Biswas AB et al[20] reported only 50% of households respectively consuming salts at adequate level which was very low. All these results suggest that there is need to strengthen the system of monitoring quality of salt to ensure availability of 15 ppm of iodine at household level.

In present study, only 71% branded packed salt samples claiming iodization shown ≥30 ppm iodine level sold at retail shops (consumer level); while 19% samples have <30 ppm iodine level which may be the reason for 11% of households using though iodized salt but not having adequate (>15 ppm) level. Mishra S et al[4] reported 39% such salt samples claiming iodization was found with <30 ppm iodine level at retail shops

Conclusions:

Present study showed mild goitre prevalence in primary school children in Rajkot district of Gujarat but still iodine content of salt found inadequate at household level and this calls for further evaluation of the problem in these area to identify factors to strengthen the national programme.

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Competing Interests:

The authors declare that they have no competing interests

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