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ORIGINAL ARTICLE

Goitre prevalence and progress over the last decade towards iodine deficiency elimination in Kutch district, Gujarat, India

Rajesh K Chudasama[1], Umed V Patel[1], Pramod B Verma[1], Ravikant Patel[1]

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.
Material and Methods : 30 cluster survey study in primary schools of Kutch district. Children studying in 1st to 7th Standard. 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: Total Goitre Rate was found 11% among primary school children compared to 1.2% in year 2000. As the age increases the Goitre prevalence also increases except in age of 8 years. Median urinary iodine excretion level was found 110 µg/L. Iodine level >15 ppm was found in 92% salts samples tested at household level.
Conclusion: Present study showed mild goitre prevalence in primary school children in Kutch district of Gujarat state due to inadequate iodine intake or content from salt at household level.

Keywords: Goitre survey, IDD, elimination, prevalence, primary school children, household level
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Introduction

Iodine is an important micronutrient required for human nutrition. Iodine Deficiency Disorders (IDD) refers to a complex clinical and subclinical disorder caused mainly due to inadequate intake of food with sufficient iodine. 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

Rajesh K Chudasama[1], Umed V Patel[1], Pramod B Verma[1], Ravikant Patel[1]

[1]Community Medicine Department, PDU Medical College, Rajkot, Gujarat, India

Corresponding Author: Rajesh K Chudasama
Vandana Embroidary, Mato Shree Complex, Sardar Nagar Main Road, Rajkot – 360001, Gujarat, India
E-mail: dranakonda@yahoo.com

out of 587 districts in the country, 282 have been surveyed for IDD and 241 found endemic for goitre [2]. Several studies carried out in India have shown high percentage of Goitre incidences [3-5]. In 1983, mandatory 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. The total Goitre rate was less than 5 % in 9 out of 15 districts in 11 states surveyed by an Indian Council of Medical Research (ICMR) [6]. NIDDCP adopted a periodic monitoring system wherein supply and iodine content of salt and urinary iodine concentration were examined, beside a health education system.

The first base line survey was carried out In Kutch district in 1991; the second survey took place in year 2000. The survey was carried out in Kutch district with the aims to determine the prevalence of Goitre in primary school children aged 6-12 years; and compare the result with pervious report on prevalence; and determine median urinary iodine concentration(UIC) and to assess the level of iodine in salt samples at household and retail shop levels.

Methodology

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 1^{st} to 7^{th} standard in primary schools of rural areas were selected for the study as per revised guidelines provided under NIDDCP by Government of India [7]. 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, making total of 2940 students examined.

Sampling method: Cluster sampling method was used for selection of villages. A list of villages of all talukas of Kutch district was obtained from Jilla Panchayat, office of District Health Office (DHO), Kutch. 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 Kutch district. In previous survey all talukas were covered but in present study with 30 clusters sampling technique no village was selected from Mundra taluka because of very small population.

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 [8].

Urine Samples: One boy and one girl from 1^{st} to 7^{th} 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 [7]. In 30 clusters, total 420 urine samples were collected and tested for urinary iodine excretion. Plastic bottles with

Table 1. Comparative goitre prevalence in different study areas of Kutch district

Taluka	Total no. of children examined		Goitre prevalence					
			Grade 1 (%)		Grade 2 (%)		Total Goitre (%)	
	2000	2009	2000	2009	2000	2009	2000	2009
Bhuj	2217	588	13 (0.58)	60 (10.20)	00	22 (3.74)	13 (0.58)	82 (13.94)**
Nakhatrana	1177	490	08 (0.68)	52 (10.61)	00	18 (3.67)	08 (0.68)	70 (14.28)**
Lakhpat	509	98	04 (0.78)	18 (18.37)	00	01 (1.02)	04 (0.78)	19 (19.38)**
Mundra	811	00	04 (0.49)	00	00	00	04 (0.49)	00
Mandvi	1331	294	07 (0.52)	33 (11.22)	00	15 (5.10)	07 (0.52)	48 (16.32)**
Anjar	1415	294	25 (1.72)	00	00	00	25 (1.72)	00
Rapar	1449	490	39 (2.69)	05 (1.02)	00	00	39 (2.69)	05 (1.02)*
Bhachau	906	392	17 (1.87)	43 (10.97)	00	11 (2.81)	17 (1.87)	54 (13.78)**
Nalia	785	294	10 (1.27)	42 (14.28)	00	08 (2.72)	10 (1.27)	50 (17.00)**
Total	10600	2940	127 (1.20)	253 (8.61)	00	75 (2.55)	127 (1.20)	328 (11.06)**

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

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. The method is based on following principle: urinary iodine is

Table 2. Age specific goitre prevalence in Kutch district

Age in year	No. of children examined	Goitre Prevalence		
		Grade 1 (%)	Grade 2 (%)	Total Goitre (%)
6	420	22 (5.24)	11 (2.62)	33 (07.86)
7	420	36 (8.58)	08 (1.90)	44 (10.48)
8	420	27 (6.43)	08 (1.90)	35 (08.33)
9	420	38 (9.05)	11 (2.62)	49 (11.67)
10	420	39 (9.29)	14 (3.33)	53 (12.62)
11	420	40 (9.53)	14 (3.33)	54 (12.86)
12	420	51 (12.14)	09 (2.14)	60 (14.28)
Total	2940	253 (8.61)	75 (2.55)	328 (11.16)

*Median urinary iodine excretion level for Kutch district was found 110 µg/L.

released after the digestion of urine with ammonium persulfate. The released iodine catalyzes the reduction of ceric ammonium sulfate (yellow) to cerous form (colorless) (Sandell-Kolthoff reaction) [9]. The color disappearance is measured by spectrophotometer in form of Optical Density (OD), which then measured by constructing a standard curve on graph paper by plotting iodine concentration in µg/l.

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 including 2 boys and 2 girls from each standard (total 28) in all 30 clusters. 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 [7, 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

Comparative goitre prevalence as per different talukas (table 1) shows that overall goitre prevalence increased in majority talukas. Some talukas like, Anjar & Rapar shows decrease in the goitre prevalence compare to previous survey. Overall goitre prevalence was increased from 1.2 % in 2000 to 11.06 % in present study. No taluka was found with severe or moderate goitre prevalence. Majority talukas reported mild or no goitre prevalence at all.

Table 2 shows age specific goitre prevalence in Kutch district. The goitre prevalence is increasing as the age increases except in 8 year age group. Cases of grade 1 (8.61%) reported more than grade 2 (2.55%).

Total 420 urine samples were collected in Kutch district, out of which 81.4% samples were found with urinary iodine excretion (UIE) level 100 µg/L or more, while 11% samples shown UIE between 50-99.9 µg/L, 7.1% between 20-49.9 µg/L and 2.4% below 20 µg/L (table 3).

Taluka specific assessment of iodine at consumer level was found lowest in Nakhatrana taluka where 14.3% of the salt samples found with <15 ppm iodine or no iodine at all (table 4). Out of

Table 3. Urinary iodine excretion level in different study areas of Kutch district

Study Talukas	n	Urinary Iodine Excretion level (µg/L)*			
		< 20.0 (%)	20.0-49.9 (%)	50.0-99.9 (%)	≥ 100 (%)
Bhuj	84	2 (2.4)	9	10	63 (75.0)
Nakhatrana	70	0	6	3	61 (87.1)
Lakhpat	14	0	0	2	12 (85.7)
Mandvi	42	0	3	4	35 (83.3)
Anjar	42	0	2	4	36 (85.7)
Rapar	70	0	3	16	49 (70.0)
Bhachau	56	0	0	3	53 (94.6)
Nalia	42	0	2	7	33 (78.6)
Total	420	2 (2.4)	30 (7.1)	46 (11.0)	342 (81.4)

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			Percentage of salt samples adequately iodized
		0 ppm	<15 ppm	>15 ppm	
Bhuj	168	0	22	146	86.9
Nakhatrana	140	2	18	120	85.7
Lakhpat	28	0	0	28	100
Mandvi	84	3	4	77	91.7
Anjar	84	0	0	84	100
Rapar	140	2	2	136	97.1
Bhachau	112	3	4	105	93.8
Nalia	84	1	4	79	94.0
Total	840	11	54	775	92.3

*salt samples were tested only at field level and not by titration method and so no salt sample was tested by titration method.

Table 5 Summary of salt sold at retail shop in Kutch district

Variable	Summary	No.	Percentages
Salt status	Packed	30	100
	Unpacked	0	0
Salt characteristics	Branded	30	100
	Unbranded	0	0
Salt type	Powdered	30	100
	Crystal	0	0
Iodine status from manufacturer	Iodized	30	100
	Noniodized	0	0
Iodine status (samples with claim of iodization)	0	0	0
	<30	0	0
	≥30	30	100
Batch No.	Yes	28	93.3
	No	2	6.7
Logo	Yes	30	100
	No	0	0
Address of manufacturer	Yes	30	100
	No	0	0
Maximum retail price (Rupees/kilogram)	≤1	0	0
	2-5	21	70
	6-9	3	10
	≥10	6	20

840 salt samples tested, 92.3% salt samples shown >15 ppm iodine at consumer level.

Table 5 shows summary of salt sold at retail shop in Kutch district where all salt samples found well packed, branded, powdered & iodized as per manufacturer`s status.

Discussion

For evaluation of severity of IDD in any 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 2000 study in same area reported 1.2% goitre prevalence in Kutch district, while in 2009 study, the total goitre prevalence rate was found 11.06% (grade 1- 8.61%; grade 2-2.55%) indicating that IDD is a mild public health problem. The prevalence rate was very low in previous survey of year 2000 but in present study it showed increase of almost 10% in almost one decade period even though it was never become a serious public health problem. 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 Kutch 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 median urinary iodine excretion level 100 µg/L and above was found in almost 81.4% 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 11% children, moderate in 7.1% and severe in 2.4% children. These findings indicate that still 19% 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 92.3% of households consuming salts at adequate level while about 7.7% 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 100% branded packed salt samples claiming iodization shown $\geq$ 30 ppm iodine level sold at retail shops (consumer level); Mishra S et al [4] reported 39% such salt samples claiming iodization was found with < 30 ppm iodine level at retail shops.

Conclusion

Present study showed mild goitre prevalence in primary school children in Kutch district of Gujarat state due to inadequate iodine intake or content from salt at household level.

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