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Original Article

IODINE NUTRITIONAL STATUS & GOITER PREVALENCE IN PRIMARY SCHOOL CHILDREN AGED 6-12 OF PANCHMAHAL DISTRICT, GUJARAT, INDIA

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Abstract

Introduction: Iodine deficiency disorders (IDD) create major public health problems in India, including Gujarat. Panchmahal district is known for endemic iodine deficiency. The present study was conducted to (1) estimate the prevalence of goiter in primary school children, (2) determine median urinary iodine concentration, (3) assess the level of iodine in salt samples at the household and retail shop level, and (4) profile of salt sold at retail shops in Panchmahal district, Gujarat.

Methods: A total of 70 students including five boys and five girls from 1st to 7th standard who were present on the day of the first visit were selected randomly for goiter examination from each village. Urine samples were collected from one boy and one girl from each standard in each cluster. From the

community, at least 28 students, including two boys and two girls from each standard in the same age group, were examined, and salt samples were tested from their households. A total of 2100 students were examined in schools and 928 students were examined in the selected villages. From each village, one retail shop was visited, and salts purchased from those shops were immediately tested for iodine with spot kits.

Results: Among young primary school children, goiter prevalence was 23.35% (grade 1—18.35%, grade 2—5.0%). As the ages increase, goiter prevalence also increases except for 9-year-olds. The median urinary iodine excretion level was 110 µg/L. An iodine level >15 ppm was found in 78.3% of the salt samples tested at household level.

Conclusion: The present study showed considerable goiter prevalence in primary school children in Panchmahal district of Gujarat and an inadequate iodine content of salt at the household level.

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Keywords: Goiter survey, IDD, 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 due to the lack of adequate dietary intake. Globally, 2.2 billion people live in areas with iodine deficiencies and the risks of resulting complications, while in India; 167 million people are at risk of IDD, 54.4 million people have goiters, and 8.8 million people have IDD-related mental/motor handicaps (1). IDD is prevalent in all states and union territories; out of 587 districts in the country, 282 have been surveyed for IDD and 241 show goiters to be endemic (2). Several studies conducted all over India have shown a high prevalence of goiters (3-5).

In 1983, compulsory iodization of all table salt was introduced in India in an attempt to eliminate iodine deficiency. The government of India re-launched the National Iodine Deficiency Disorders Control Programme (NIDDCP) in 1992 with a goal to reduce the prevalence of IDD to non-endemic levels. After the re-implementation of NIDDCP, India has made considerable progress towards IDD elimination. Less than 5% total goiter rate was found in 9 out of 15 districts studied in 11 states by the Indian Council of Medical Research (ICMR) (6). NIDDCP performed IDD surveys with follow-up surveys every five years, assessed the supply of iodized salt, monitored iodized salt consumption, performed laboratory monitoring of iodized salt, urinary iodine concentration and health education.

In February 2009, the government of Gujarat started a follow-up IDD survey in all the districts of the state. In Panchmahal district, the first baseline IDD survey was done in 1989, and the next survey was done in 1998-99. The present goiter survey was done in Panchmahal district had four objectives: (1) to estimate the prevalence of goiters in primary school children aged 6-12 years, (2) to determine median urinary iodine concentration in a sample of children, (3) to assess the level of iodine in salt samples at the household and retail shop level, and (4) to study the profile of salt sold at retail shops.

MATERIALS AND METHODS

Selection of study area: The present study was done in Panchmahal district of Gujarat

state. The district is centrally located and surrounded by Vadodara, Dahod, Kheda, and Sabarkantha district. The main source of water is rain. Almost all types of routine vegetables are available for consumption. The district is divided into 13 talukas (blocks), having total population of 3,169,881 as per the 2001 census (7). The national program was implemented in the district in 1992 after the result of a baseline survey conducted in 1989 which indicated high goiter prevalence. The follow-up surveys were done in 1998-99 and again in 2009 (present study).

Selection of study population & sample size: As per the guidelines provided by the State Nutrition Cell, the Ministry of Health & Family Welfare, and the government of Gujarat, a cross-sectional study of children aged 6-12 years studying in 1st to 7th standard in primary schools of rural areas were selected for the study. The study included two types—a school survey and a community survey. From each standard, five boys and five girls who were present in class on the day of the visit were selected randomly for examination. In total, 70 students were examined from each school in the selected villages. Almost 30% of school children are considered absent at any given time, so at least 28 students were examined from the community for each selected village. For this group, at least two boys and two girls from each standard (1st to 7th) were examined. So, total 2100 students were examined in schools and 928 students were examined out of schools in the selected villages.

Sampling method: The cluster sampling method was used for the selection of villages. A list of the villages of all the talukas of Panchmahal district was obtained from Jilla Panchayat, District Health Office (DHO). Then, the cumulative population was figured using Microsoft Office Excel. By calculating cluster intervals, 30 villages were selected from the list. As the study was confined to only rural areas of Panchmahal district, urban populations were excluded from cumulative population calculations. Primary schools in each of the 30 selected villages were visited for school surveys. When the desired sample size of five boys and five girls from each standard was not achieved, a primary school in the nearest village was approached and the desired sample size was achieved; the community survey conducted in a similar manner. The children were examined by the palpatory method. The following classification was used for goiters: (a) grade 0—not visible, not palpable, (b) grade 1—palpable, but not visible, and (c) grade 2—palpable and visible, as per the WHO/UNICEF/ICCIDD guidelines (8).

Urine Samples: One boy and one girl from 1st to 7th standard were selected randomly for urine samples. In each cluster, 14 urine samples were collected, including 7 samples from boys and 7 from girls. In 30 clusters, a 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 the state IDD laboratory at Surat for testing by an expert technician. A few drops of toluene were added to each urine sample to inhibit bacterial growth and to minimize bad odor. Child number, cluster number, and the date of urine collection were noted on every bottle of urine sample for identification. The ammonium per sulfate titration method was used to detect urinary iodine excretion levels.

Salt samples: As per the guidelines provided, 10 random salt samples were tested from the homes of children examined for goiters during the community survey in each village. A total of 300 salt samples were tested. These samples were tested on the spot with MIB kit provided by UNICEF, and iodine concentration was recorded as 0, <15 & >15 ppm (9). From each village, one retail shop was visited, and salts were purchased and tested for iodine immediately with spot kits.

Data analysis: All the data was entered in Microsoft Office Excel 2007 and analyzed using Epi Info software, version 3.5.1.

RESULTS

Goiter prevalence in Panchmahal district was found to be 23.35% among primary school children (table 1).

Table 1. Goiter prevalence in different study areas of Panchmahal 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)*	
Ghoghamba	312	36 (11.5)	8 (2.5)	44 (14.10)	Mild
Godhra	494	94 (19.03)	22 (4.45)	116 (23.48)	Moderate
Halol	194	21 (10.82)	3 (1.55)	24 (12.37)	Mild
Jambughoda	98	23 (23.47)	7 (7.14)	30 (30.61)	Severe
Kadana	202	40 (19.8)	8 (3.96)	48 (23.76)	Moderate
Kalol	299	116 (38.79)	15 (5.02)	131 (43.81)	Severe
Khanpur	104	11(10.58)	6 (5.77)	17 (16.35)	Mild
Lunavda	298	48 (16.11)	9 (3.02)	57 (19.13)	Mild
Morwa	224	25 (11.17)	10 (4.46)	35 (15.63)	Mild
Sahera	399	92 (23.06)	34 (8.52)	126 (31.58)	Severe
Santrampur	404	51 (12.62)	28 (6.93)	79 (19.55)	Mild
Total	3028	557 (18.35)	150 (5.0)	707 (23.35)	Moderate

*Severity of public health problem: <5% No; 5-19.9% Mild; 20-29.9% Moderate; >30% Severe (10)

Table 2. Age specific goiter prevalence in Panchmahal district

Age in years	Total no. of children examined	Goitre Prevalence		
		Grade 1 (%)	Grade 2 (%)	Total Goitre* (%)
6 years	432	65 (15.0)	15 (3.5)	80 (18.5)
7 years	429	65 (15.2)	17(3.9)	82 (19.1)
8 years	434	84 (19.4)	29 (6.7)	113 (26.1)
9 years	432	84 (19.4)	18 (4.2)	102 (23.6)
10 years	434	86 (19.8)	24 (5.5)	110 (25.3)
11 years	432	85 (19.7)	24 (5.5)	109 (25.2)
12 years	435	88 (20.2)	23 (5.3)	111 (25.5)
Total	3028	557 (18.4)	150 (5.0)	707 (23.35)

*P=0.57

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

Study Talukas	n	Urinary Iodine Excretion level (µg/L)*			
		< 20.0 (%)	*20.0-49.9 (%)*	*50.0-99.9 (%)*	*≥ 100 (%)*
Jambughoda	14	0	2 (14.2)	6 (42.9)	6 (42.9)
Halol	28	1 (3.6)	3 (10.7)	14 (50.0)	10 (35.7)
Kalol	42	0	0	12 (28.6)	30 (71.4)
Godhra	70	1 (1.4)	5 (7.1)	12 (17.2)	52 (74.3)
Sahera	56	0	2 (3.6)	18 (32.1)	36 (64.3)
Lunavada	42	1 (2.4)	2 (4.8)	9 (21.4)	30 (71.4)
Khanpur	14	1 (7.2)	8 (57.1)	5 (35.7)	0 (0)
Kadana	28	0	3 (10.7)	12 (42.9)	13 (46.4)
Santrampur	56	0	3 (5.4)	13 (23.2)	40 (71.4)
Morwa	28	0	3 (10.7)	11 (39.3)	14 (50)
Goghamba	42	1 (2.4)	2 (4.8)	20 (47.6)	19 (45.2)
Total	420	5 (1.2)	33 (7.9)	132 (31.4)	250 (59.5)

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

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*	
Jambughoda	10	0	0	10	100
Halol	20	0	1	19	95
Kalol	30	3	8	19	63.3
Godhra	50	0	1	49	98
Sahera	40	17	2	21	52.5
Lunavada	30	1	1	28	93.3
Khanpur	10	6	1	3	30
Kadana	20	2	2	16	80
Santrampur	40	12	2	26	65
Morwa	20	3	0	17	85
Goghamba	30	3	0	27	90
Total	300	47	18	235	78.3

Severe (highest/maximum) goiter prevalence was found in Kalol taluka (43.81%), while the findings for Godhra and Kadana taluka were moderate. Table 2 shows age-specific goiter prevalence in Panchmahal district. As the age increases, the goiter prevalence also increases except in 9-year-old age group. In those aged 10-12 years, it is almost the same.

A total of 420 urine samples were collected in Panchmahal district, out of which 59.5% samples were found to have a urinary iodine

excretion (UIE) level of 100 µg/L or more, while 31.4% of the samples showed UIE levels between 50 and 99.9 µg/L, 7.9% between 20 and 49.9 µg/L, and 1.2% below 20 µg/L (table 3).

Taluka-specific assessment of iodine at the consumer level was found to be the lowest in Khanpur taluka, where more than half of the salt samples were found to have <15 ppm iodine or no iodine at all (table 4). Out of 300 salt samples tested, 78.3% salt samples showed >15 ppm iodine at the consumer level. Table 5 shows a summary of salt sold at a retail shop in Panchmahal district where all salt samples were well-packed, branded, powdered, and iodized as per manufacturers' statuses.

Table 5. Summary of salt sold at retail shop in Panchmahal district

	Summary	No	Percentages
Salt status	Packed	47	100
	Unpacked	0	0
Salt characteristics	Branded	47	100
	Unbranded	0	0
Salt type	Powdered	47	100
	Crystal	0	0
Iodine status from manufacturer	Iodized	47	100
	Noniodized	0	0
Iodine status (samples with claim of iodization)	0	6	12.8
	<30	9	19.1
	≥30	32	68.1
Batch No.	Yes	41	87.2
	No	6	12.8
Logo	Yes	39	83
	No	8	17
Address of manufacturer	Yes	41	87.2
	No	6	12.8
Maximum retail price (Rupees/kilogram)	≤1	0	0
	2-5	36	76.6
	6-9	4	8.5
	≥10	7	14.9

DISCUSSION

To evaluate the severity of IDD in a region, the most widely accepted marker is the prevalence of endemic goiter in school children. On the basis of IDD prevalence, WHO/UNICEF/ICCIDD (10) recommended the criteria for understanding 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 mild, 20-29.9% is moderate, and above 30% is considered as a severe public health problem.

In studied district, the total goiter prevalence rate was 23.35% (grade 1—18.35%, grade 2—5.0%), indicating that IDD is a moderate public health problem. A similar study from another district of Gujarat reported 20.5% total goiter prevalence (4) and mentioned the withdrawal of notification banning the sale of non-iodized salt from Gujarat since January, 2001. The present study reports moderate prevalence rates, likely due to the availability of iodized salt now everywhere from cities to smallest villages, yet consumption remains low. That may be one of the reasons why no association was found between the age of children and the high prevalence of goiter compared to earlier studies (3, 4).

In addition, there was a higher prevalence among girls than boys, which was reported by various studies (4, 5). As per the National Family Health Survey (NFHS)-3, the prevalence of goiters and other thyroid disorders was 2.5 times higher for women than for men, and the number of persons with goiter or thyroid disorders increases with age, especially among women (11).

In the present study, the urinary iodine excretion level of 100 µg/L and above was found in almost 59.5% samples. As per the national guidelines (1), the severity of IDD as a public health problem was classified in three categories: (1) <20 µg/L—severe, (2) 20-49.9 µg/L—moderate, and (3) 50-99.9 µg/L—mild. The value of 100 µg/L or above is considered normal. The median urinary iodine level was 110 µg/L in the current study. However, a mild deficiency was found in 31.4% children, a moderate deficiency in 7.9%, and a severe deficiency in 1.2%. These findings indicate that 40.5% of the children in the study have a biochemical deficiency of iodine. It also indicates the continued, though inadequate, efforts to ensure a supply of iodized salt to the population. Authors of other studies indicate different median urinary iodine levels, which indicate either a deficiency or no deficiency for certain populations in their areas (12-15).

WHO/UNICEF/ICCIDD recommended that 90% of household salts should get iodized at the recommended level of 15 ppm (16) but the study showed that about 78% of households consume salts at adequate levels, while about 22% households do not consume iodized salt at the recommended level. Chandra AK *et al.* (5) reported that more than 95% of households consume salt at adequate levels, while Kamath R *et a.l* (17) and Biswas AB *et al.* (18) reported that only 50% of households consuming salt at adequate levels, a finding which was very low. Taken together, these results suggest that there is a need to strengthen the system of monitoring salt quality to ensure the availability of 15 ppm of iodine at the household level.

In present study, only 68.1% of branded packed salt samples claiming iodization showed $\geq$ 30 ppm iodine level sold at retail shops (consumer level), while 19.1% of the samples had < 30 ppm iodine level, which may be the reason for inadequate levels of iodized salt (>15 ppm) in 22% of households. Mishra S *et al.* (4) reported that 39% of salt samples claiming iodization were found with < 30 ppm iodine at retail shops.

CONCLUSION

The present study showed moderate goiter prevalence in primary school children in Panchmahal district of Gujarat and an inadequate iodine content for salt found at the household level. This problem calls for further investigation to identify factors that would strengthen the national program.

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