Rapid survey of status of salt iodization and urinary iodine excretion levels in Karnataka, India

Iodine deficiency disorders (IDD) are an important cause of mental handicap and poor educability of children[1]. IDD are widespread in India; 241 districts out of 282 surveyed have been identified as endemic to iodine deficiency[2]. The most cost-effective and sustainable strategy to eliminate IDD is to iodize all edible salt[3].

Earlier surveys conducted by the central IDD survey team, Government of India in Karnataka documented that 6 out of 17 districts surveyed were endemic to iodine deficiency with goitre prevalence rates[2] in the range of 10.67–41.11%. The recent National Family Health Survey (NFHS) II conducted[4] in 1998–1999 revealed that in Karnataka, 56.5% of the families were consuming salt with iodine content less than 15 ppm. The government had issued a notification[2] on the complete ban on the sale of non-iodized salt in the State since 1996. According to this, iodized salt should contain a minimum of 30 ppm of iodine at the manufacturers' and 15 ppm of iodine at the consumers' level[5]. The present rapid survey was conducted to assess the district-wise status of salt iodization and urinary iodine excretion levels 5 years after the ban notification on the sale of non-iodized salt in the state. This would help the State Government strengthen the existing Universal Salt Iodization (USI) programme.

The study was undertaken in 25 districts of Karnataka during the year 2001. Senior professors from the Department of Preventive and Social Medicine from 11 medical colleges in the state participated in the study. Each investigator collected data from 2 to 3 adjacent districts. Uniform research methodology was utilized by all the investigators for collection of data. The guidelines recommended by WHO/UNICEF/ICCIDD for a rapid assessment of salt iodization in a district were adopted. According to the recommendation, at least 100 salt samples should be collected from ten remote villages in order to assess the availability of iodized salt[3]. In each district, all the senior secondary schools were enlisted and one school was selected by random sampling for detailed study. The informed consent of the children to participate in the study was taken. Two hundred children in the age group of 11 to 18 years studying in the school were included in the study and briefed about the objectives of the study during the morning assembly. Children belonging to different villages attending the school on the day of the survey were identified and were provided with auto-seal polythene pouches with an identification slip. They were requested to bring four teaspoons of salt (about 20 g) from their family kitchen. A minimum of 150 salt samples were collected from each district utilizing the uniform sampling methodology. The iodine content of salt samples was analysed using the standard iodometric titration method[6]. A known positive iodized salt sample was obtained and by performing multiple analyses on this positive salt sample, a concentration range was established and used for internal quality control (IQC) purposes. This IQC sample having a known concentration range of iodine content was run with every batch of test samples. If the results of the IQC sample were within the range, then the test was deemed in control and if the results were outside the range, then the whole batch was repeated.

More than 75 children from the same school were randomly selected and were requested to provide 'on the spot' casual urine samples. Plastic bottles with screw caps were used to collect the urine samples. The samples were stored in the refrigerator until analysis. The urinary iodine excretion (UIE) levels were analysed using the wet digestion method[7]. A pooled urine sample was prepared for IQC assessment. The IQC sample was analysed 20–25 times with standards and blank in duplicate. This IQC sample having a known concentration range of iodine content was run with every batch of test samples. If the results of the IQC sample were within the range, then the test was deemed in control and if the results were outside the range, then the whole batch was repeated. The salt and urine samples were analysed by trained technicians under the supervision of a biochemist. In addition to the proportion of children consuming iodized salt and their urinary iodine excretion levels, 95% confidence interval was also worked out.

A total of 3980 salt samples were collected at beneficiaries' level from 25 districts of Karnataka. Nearly 24% of the salt samples were powdered and 76% were crystalline. The district-wise distribution of iodine content of salt is depicted in Table 1. It was observed that 45.6% of the families were consuming iodized salt with less than 5 ppm of iodine (the 95% confidence interval was 43.3 to 47.9%). It was found that in the districts of Gulbarga, Tumkur, Bellary, Davangere, Hassan, Kappal, Kolar, Haveri and Bijapur, less than 10% of the families were consuming salt with iodine content more than 15 ppm. The mean iodine content of salt samples was 8.06 ± 3.71.

Table 2 depicts the district-wise distribution of UIE levels. It was found that Gulbarga, Bellary, Davangere, Kolar, Bijapur, Dakshina Kannada, Kodagu and Shimoga had median UIE less than 100.0 μg/l, indicating deficient iodine nutriture in children included in the survey.

The results of the present study showed that only 15.8% of the population was consuming salt with the stipulated level of iodine, i.e. 15 ppm and more. However, the NFHS II survey documented that 43.5% of the population in Karnataka was consuming salt with 15 ppm of iodine[4]. The variation in the findings of the two surveys could be possibly because of the differences in the sampling methodology of the population included in the survey. Another reason could be the method of estimation of iodine content of salt utilized. In the present study the iodometric titration method was used, while in NFHS II survey, the quantitative spot testing kit method was used.

It was also found that in Gulbarga, Tumkur, Bellary, Davangere, Hassan, Kappal, Kolar, Haveri and Bijapur, more than 90% of the families was consuming salt with iodine content less than 15 ppm. This could be possibly because Karnataka is a salt-producing State and these districts received their supply of salt by road transport. The iodine content of salt transported by road is not monitored by the government. Earlier studies conducted in salt-producing States have documented poor implementation of the USI programme[4]. An earlier study[8] conducted in coastal Karnataka revealed that 51.7% of families were consuming salt with iodine content of less than 15 ppm.

Table 1. Iodine content of salt samples collected at beneficiaries' level in different districts in Karnataka

(*n* = 3980)

District	*N*	Iodine content in ppm <5	5–< 15	15 and more
Gulbarga	150	139 (92.7)	11 (7.3)	0 (0.0)
Tumkur	150	91 (60.7)	56 (37.3)	3 (2.0)
Bellary	152	68 (44.7)	80 (52.6)	4 (2.6)
Davangere	156	97 (62.2)	54 (34.6)	5 (3.2)
Hassan	152	141 (92.8)	5 (3.3)	6 (3.9)
Kappal	152	76 (50.0)	70 (46.1)	6 (3.9)
Kolar	150	75 (50.0)	67 (44.7)	8 (5.1)
Haveri	150	33 (22.0)	107 (71.3)	10 (6.7)
Bijapur	190	71 (37.4)	103 (54.2)	16 (8.4)
Uttara Kannada	200	164 (82.0)	16 (8.0)	20 (10.0)
Dakshina Kannada	150	99 (66.0)	33 (22.0)	18 (12.0)
Chamarajanagar	158	69 (43.7)	68 (43.0)	21 (13.3)
Udupi	149	79 (53.0)	47 (31.5)	23 (15.4)
Belagaum	200	118 (59.0)	51 (25.5)	31 (15.5)
Kodagu	150	93 (62.0)	31 (20.7)	26 (17.3)
Raichur	153	20 (13.0)	130 (85.0)	3 (2.0)
Mandya	154	105 (68.2)	16 (10.4)	33 (21.4)
Shimoga	165	105 (63.6)	21 (12.7)	39 (23.6)
Mysore	152	63 (41.4)	49 (32.2)	40 (26.3)
Bidar$	150	INA	108 (72.0)	42 (28.0)
Bangalore Rural	163	91 (55.8)	25 (15.3)	47 (28.9)
Chickmanglur	150	68 (45.3)	33 (22.0)	49 (32.7)
Dharwad	150	18 (12.0)	81 (54.0)	51 (34.0)
Chitradurga	156	44 (28.2)	58 (37.2)	54 (34.6)
Bangalore Urban	178	27 (15.2)	77 (43.3)	74 (31.5)
Total	3980	1815 (45.6) [43.3–47.9]*	1536 (38.6) [36.2–41.0]*	629 (15.8) [12.9–18.6]*

Figures in parentheses denote percentages.
INA, Information not available; *95% confidence interval; $Salt samples analysed using spot testing kit method.

Table 2. Urinary iodine excretion levels in study subjects in different districts in Karnataka

(*n* = 1952)

District	*N*	Median (ig/l)	<20.0	UIE levels (μg/l) 20.0–49.9	50.0–99.9	≥ 100.0
Gulbarga	94	70.0	4 (4.3)	19 (20.2)	43 (45.7)	8 (29.8)
Tumkur	97	100.0	0 (0.0)	5 (5.2)	29 (29.9)	63 (64.9)
Bellary	95	65.0	5 (5.3)	14 (14.7)	44 (46.3)	32 (33.7)
Davangere	90	52.0	19 (21.1)	17 (18.9)	19 (21.1)	35 (38.9)
Kappal	86	100.0	3 (3.5)	4 (4.7)	24 (27.9)	55 (64.0)
Kolar	101	95.0	2 (2.0)	7 (6.9)	48 (47.5)	44 (43.6)
Haveri	99	100.0	0 (0.0)	12 (12.1)	32 (32.3)	55 (55.6)
Bijapur	76	85.0	9 (11.8)	0 (0.0)	32 (42.1)	35 (46.1)
Uttara Kannada	100	100.0	11 (11.0)	15 (15.0)	21 (21.0)	53 (53.0)
Dakshina Kannada	97	70.0	17 (17.5)	8 (8.2)	42 (43.3)	30 (30.9)
Udupi	84	>200.0	0 (0.0)	1 (1.2)	6 (7.1)	77 (91.7)
Belagaum	100	100.0	1 (1.0)	13 (13.0)	28 (28.0)	58 (58.0)
Kodagu	96	30.0	25 (26.0)	34 (35.4)	21 (21.9)	16 (16.7)
Raichur	93	120.0	0 (0.0)	3 (3.2)	21 (22.6)	69 (74.2)
Mandya	98	120.0	0 (0.0)	2 (2.0)	30 (30.6)	66 (67.3)
Shimoga	96	30.0	30 (31.3)	23 (24.0)	33 (34.4)	10 (10.4)
Bangalore Rural	94	100.0	5 (5.3)	3 (3.2)	23 (24.5)	63 (67.0)
Chickmanglur	100	150.0	2 (2.0)	5 (5.0)	19 (19.0)	74 (74.0)
Dharwad	99	100.0	3 (3.0)	5 (5.1)	40 (40.4)	51 (51.5)
Chitradurga	71	>200.0	8 (11.3)	0 (0.0)	4 (5.6)	59 (83.1)
Bangalore Urban	86	185.0	2 (2.3)	1 (1.2)	4 (4.7)	79 (91.9)
Total	1952		146 (7.5) [3.2–11.8]*	191 (9.8) [5.6–14.0]*	563 (28.8) [25.1–32.5]*	1052 (53.9) [50.1–56.9]*

Figures in parentheses denote percentages; *95% confidence interval.

In the present study, Shimoga, Kodagu and Dakishna Kannada had deficient iodine nutriture as revealed by median UIE levels less than 100 μg/l. An earlier survey conducted by the central IDD survey team, Government of India, had documented high prevalence of goitre in these districts[2]. Gulbarga, Bellary, Davangere, Kolar and Bijapur were identified as areas endemic to iodine deficiency according to the median UIE levels.

The present study revealed that the population in Karnataka continues to consume salt with inadequate iodine. Only 16% of the population was consuming salt with iodine content of 15 ppm and more. Five more districts were found with deficient iodine nutriture according to UIE levels. There is a need of undertaking detailed survey on the prevalence of IDD in these districts to substantiate the findings of the present study. The policy implication of this research investigation is that USI should be aggressively implemented so that the entire population consumes iodized salt, irrespective of whether they are receiving sufficient iodine from their diet or not. There are districts in Karnataka which are possibly consuming diet with sufficient iodine but salt with inadequate quantity of iodine. On the other hand, there are districts which are possibly consuming diet with low quantity of iodine and low iodine content in salt. It is difficult to provide a population with two types of salt and hence USI has been recommended. There is a need of strengthening the system of monitoring the quality of iodized salt provided to the beneficiaries under the USI programme.

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