



Present position of salt iodization and degree of iodine supplement in India

Ngo Bum Kapil

Department of Public, Oman Medical College, Sohar, Sultanate of Oman, India.

Abstract

In India, Iodine Deficiency Disorders (IDD) are present throughout the country. Out of 282 districts surveyed by Government of India institutions like Indian Council of Medical Research and Central Goiter Survey Teams in different States and Union Territories, 241 have been found to be endemic for iodine deficiency disorders. Issues relating to the safety of Universal Salt Iodization were carefully examined by eminent Scientists, Programme Managers and Administrators and based on hard scientific evidences, the Government of India implemented a policy decision, in 1984, for Universal Salt Iodization (USI) that is, all edible salt in the country should be fortified with iodine. This became the mandate for the National Iodine Deficiency Disorders Control Programme. The present research communication reviews the history of iodine deficiency disorders, progress of achieved under USI, safety of iodized salt and impact of this intervention on the iodine status of Indian population.

Keywords: Iodine, Goitre, Urinary Iodine Excretion

INTRODUCTION

Iodine deficiency is the most common preventable cause of mental deficiency in the world today. IDD is a major nutrition deficiency disorder in India. Out of 587 districts in the country, 282 districts have been surveyed for IDD and 241 districts have been found to be endemic (Hetzl, 1997) . These districts are present in all the states and union territories of country (Table 1). According to an estimate, in India, 167 million people are “at risk” of IDD, about 55 million people have a goiter and more than 8.8 million people have IDD-related mental/motor handicaps (Kapil, 2000). Iodine is an essential dietary element which is required for the synthesis of the thyroid hormones, thyroxine (T₄) and tri-iodothyronine (T₃). Synthesis and secretion of T₄ and T₃ are under the control of the thyroid-stimulating hormone (TSH) which is secreted from the anterior lobe of the pituitary gland. Dietary iodine deficiency stimulates TSH secretion which results in thyroid hypertrophy. The enlargement of the thyroid gland due to Nutritional iodine deficiency is called endemic goiter. Iodine intakes consistently lower than 50 µg /day usually result in goiter. With severe and prolonged iodine deficiency, the effects of a deficient supply of T₃ and T₄

hormones may occur (WHO-UNICEF-ICCIDD, 1994).

Etiology of iodine deficiency

Food crops and water derive iodine from the soil. In areas, where soil has adequate iodine, 90% of the iodine requirements are met by the iodine present in the diet and the rest 10% from water. Consumption of crops and plants grown on iodine deficient soils leads to production of foods deficient in iodine leads to IDD in the population. The regions with heavy rainfall or snowfall and with frequent flooding are particularly likely to be iodine deficient as the superficial layer of soil (in which iodine is present) is washed away. The problem of iodine deficiency further gets aggravated by deforestation and subsequent soil erosion. National Institute of Nutrition (NIN), India conducted studies on iodine content of various food stuffs found that the foods of animal origin had more iodine as compared to plant. Amongst vegetarian foods, nuts and oilseeds had highest amount of iodine (35.0 to 54.0 µg/100g) followed by spices (6.0 to

Table 1. Prevalence of iodine deficiency disorders and status of national iodine deficiency disorders programme in different states/UTs of India.

State	Total No of Districts	No of District Surveyed	No of District Endemic	Ban Notification issued	IDD Cell
Andhra Pradesh	23	10	9	Partial*	Yes
Arunachal Pradesh	10	10	10	Complete	Yes
Assam	23	18	18	Complete	Yes
Bihar	55	22	21	Complete	Yes
Goa	2	2	2	Complete	Yes
Gujarat	25	16	8	Complete	Yes
Haryana	19	9	8	Complete	Yes
Himachal Pradesh	12	10	10	Complete	No
Jammu & Kashmir	15	14	11	Complete	No
Karnataka	27	17	6	Complete	Yes
Kerala	20	14	11	No ban	Yes
Madhya Pradesh	61	16	16	Complete	Yes
Maharashtra	35	29	21	Partial*	Yes
Mizoram	8	4	4	Complete	Yes
Manipur	9	8	8	Complete	Yes
Meghalaya	7	2	2	Complete	Yes
Nagaland	8	7	7	Complete	Yes
Orissa	30	4	4	Complete	Yes
Punjab	17	3	3	Complete	Yes
Rajasthan	31	3	3	Complete	Yes
Sikkim	4	4	4	Complete	Yes
Tamil Nadu	29	12	12	Complete	Yes
Tripura	4	3	3	Complete	Yes
Uttar Pradesh	83	34	29	Complete	Yes
West Bengal	18	5	5	Complete	Yes
Andaman & Nicobar Islands	2	2	2	Complete	Yes
Chandigarh	1	1	1	Complete	Yes
Dadar & Nagar Haveli	1	1	1	Complete	Yes
Delhi	1	-	1	Complete	Yes
Daman & Diu	1	1	1	Complete	Yes
Lakshwadeep	1	-	-	Complete	Yes
Pondicherry	4	-	-	Complete	Yes
Total No. of districts	587	282	241		

Table 2. Iodine content of salt samples.

Iodine content (ppm)	1994-1999 No. of samples	2000-2001 No. of samples
0-<15	372 (3.5)	11222 (79.3)
15-<30	5334 (50.1)	2081 (14.7)
30-<45	3369 (31.6)	616 (4.3)
45-<60	1294 (12.2)	188 (1.3)
60-<75	197 (1.8)	38 (0.3)
75	78 (0.7)	9 (0.01)
Total	10,644	14,154

96.0 µg/100g) and condiments, while fruits and vegetables had the lowest level of iodine content (2.7 to 20.0 µg/100g). All types of foodstuffs in endemic districts had lower iodine content as compared to non-endemic districts (National Institute of Nutrition.1986-1987)

National iodine deficiency disorders control program (NIDDCP)

Keeping in view of magnitude of iodine deficiency in the country, Government of India initiated the NIDDCP in 1962. However, till in 1983, the country's production of iodized salt was only 300,000 Tons, which increased to 5.2 Million Tons by year 2006 (Kochupillai, 1992). Under the NIDDCP the level of Salt iodization have been fixed to a minimum of 30 ppm at the manufacturers level and 15 ppm at the consumption or beneficiary level (Ranganathan and Reddy, 1995)

Iodine content of salt samples collected from different parts of the country

During 1994 -1999, Human Nutrition Unit, AIIMS collected a total of 10,644 salt samples from various research surveys from more than 70 districts of 8 states of the country. These salt samples were analyzed using the standard iodometric titration method. More than 85% salt samples had iodine content of less than 45 ppm (Kapil et al., 2000).

Similarly, during the years 2000 and 2001 a total of 14,154 salt samples were collected from 90 districts in 5 southern states of the country. It was found that more than 98% of salt samples had iodine content of less than 45 ppm (Table 2). The data on iodine content of salt from 160 districts in the country indicates that the iodised salt manufacturers in the country are iodizing the salt as recommended under NIDDCP. The profile of iodine content of salt in 189 districts of the country has been depicted in Table 3 (Kapil et al., 1997; Kapil 1998; Kapil et al., In press; Kapil et al., 1997a, b; Kapil et al., 1995; Kapil et al., 1996a, b, c; Kapil et al., 1999; Sohal et al.,

1998; Sohal et al., 1999; Kapil et al., 2002; Bhardwaj et al., 1997; Kapil et al., 2001; Kapil et al., 2000; ICCIDD/UNCF/WHO. WHO, 2001

Urinary iodine excretion levels amongst population in different parts of the country

WHO recommends that the median UIE levels in a community, with optimal iodine nutrition, should be in the range of 100 - 200 µg/l. Human Nutrition Unit, AIIMS collected a total of 21,546 urine samples from 116 districts during 1994 to 2001. The samples were analyzed by the wet digestion method. The percentage of districts with median UIE levels less than 100 µg/l, 100-<200 µg/l and 200 µg/l were 14.6, 61.2 and 24.2%, respectively (Table 4). More than 75% districts had UIE level less than 200 µg/L.

A multi-centric study conducted in 15 districts by Indian Council of Medical Research in which a total of 27,481 urine samples were collected, found that the median UIE levels were less than 200 µg/l for all the districts (Table 5) (Indian Council of Medical Research, New Delhi, 2001).

Conclusion

- The available scientific evidence indicates that the total intake of iodine through iodised salt and food in India is within safe limits as revealed by UIE data from different districts of the country.
- There is scientific evidence that salt manufacturer's are not over iodizing the salt with iodine as revealed by the data on urinary iodine excretion levels and iodine content of salt collected from various districts of the country.
- The median UIE levels in majority (75%) of districts in our country is within safe limits that is, less than 200 µg/L.
- The existing USI program has led to the reduction in IDD in endemic population groups.
- In view of the existing scientific evidence and recommendations made by the international scientific bodies, the RDA of iodine of 150 µg per day for adults, presently followed in the country is adequate to make the iodine Nutrition satisfactory.

Table 3. Iodine content of salt samples collected at beneficiary level in selected districts of India.

State	Name of the District	Ref No.	Yr of survey	No. of salt samples	Iodine content of salt (ppm)			
					<5	5-<15	15-<30	30 & above
1. Andaman & Nicobar	Andaman & Nicobar	10	1996	275	1(0.3)	117(42.5)	157(57.1)*	**
	Andaman & Nicobar	11	1997	211	1(0.5)	26(12.3)	184(87.2)*	**
2 Andhra Pradesh	Vijayanagram	12	2001	211	93(44.1)	72(34.1)	45(21.3)	1 (0.5)
	Srikakulam		2001	205	25(12.2)	153(74.6)	25 (12.2)	2 (1.0)
	East Godavari District		2001	152	63(41.4)	79(52.0)	10 (6.6)	0(0.0)
	West Godavari District		2001	148	77(52.0)	50 (33.6)	21(14.2)	0(0.0)
	Guntur		2001	150	60(40.0)	43 (28.7)	32(21.3)	15(10.0)
	Prakasam		2001	150	125(83.3)	11 (7.3)	14(9.3)	0(0.0)
	Warangal		2001	158	69(43.7)	67(42.4)	8 (5.1)	14(8.9)
	Adilabad		2001	155	35(22.4)	70(44.9)	15(9.6)	36(23.1)
	Kurnool		2001	106	9(8.5)	88(83.0)	8(7.5)	1(0.9)
	Mehboobnagar		2001	116	17(14.7)	86(74.1)	8(6.9)	5(4.3)
	Chittor		2001	183	61(33.3)	84(45.9)	34(18.6)	4(2.2)
	Nellore		2001	119	95(79.8)	21(17.6)	3(2.5)	0(0.0)
	Krishna	2001	150	107(71.3)	6(4.0)	35(23.3)	2(1.3)	
	Khammam	2001	150	79(52.7)	33(22.0)	33(22.0)	5(3.3)	
	Nalgonda	2001	150	93(62.0)	38(25.3)	17(11.3)	2(1.3)	
	Karim Nagar	2001	150	23(15.3)	56(37.3)	55(36.7)	16(10.7)	
	Medak	2001	150	61(40.7)	37(24.7)	37(24.7)	15(10.0)	
	Hyderabad	2001	200	4(2.0)	114(56.7)	67(33.3)	15(7.5)	
	Nizamabad	2001	200	110(55.0)	46(23.0)	40(20.0)	4(2.0)	
	Rangareddy	2001	204	134(65.7)	62(30.4)	7(3.4)	1(0.5)	
Anatpur	2001	155	78(50.3)	69(44.5)	7(4.5)	1(0.6)		
Cuddapah	2001	155	94(60.6)	43(27.7)	16(10.3)	2(1.3)		
Vishakapatnam	2001	205	156(76.1)	39(18.9)	10(4.9)	0(0.0)		
3. Bihar	WestChamparan	13	1997	164	0(0.0)	108(65.9)	42(25.6)	14(8.5)
	EastChamparan		1997	292	0(0.0)	78(26.7)	182(62.3)	32(11.0)
	Munger	14	1997	198	0(0.0)	40(20.2)	100(50.5)	58(29.3)
	Muzafarpur		1997	210	0(0.0)	42(20.0)	120(57.1)	48(22.9)
	Vaishali		1997	188	0(0.0)	32(17.0)	110(58.5)	46(24.5)
	Sahibganj	\$	2001	345	1(0.3)	272(78.8)	51(14.8)	21(6.1)
	Palamu		2001	102	3(2.9)	53(52.0)	29(28.4)	17(16.7)
4. Delhi	Delhi	15	1994	763	5(0.7)	129(16.9)	629(82.4)*	**
	Delhi	16	1996	1307	26(2.0)	429(32.8)	852(65.2)*	**
	Delhi	17	1999	1854	492(26.5)	293(15.8)	176(9.5)	893(48.2)
	Delhi	18	2002	999	163(16.3)	206(20.6)	511(51.1)	119(12.0)
	5. Goa	Goa	19	1996	133	65(48.9)	29(22.0)	39(29.1) *
6. Gujarat	Vadodara	20	1999	700	INA	208(29.7)	492(70.3) *	**

Table 3. Contd.

State	Name of the District	Reference No.	Year of survey	No. of salt samples	Iodine content of salt (ppm)			
					<5	5<15	15-<30	30 & above
7. Haryana	Ambala	21	1997	139	1(1.0)	46(33.0)	92 (66.0) *	**
	Bhiwani		1997	94	16(17.0)	50(53.0)	28(30.0) *	**
	Faridabad		1997	135	3 (2.0)	70 (52.0)	62 (46.0) *	**
	Gurgaon		1997	249	1 (0.5)	37 (14.8)	211 (84.7) *	**
	Hissar		1997	152	0 (0.0)	122 (80.0)	30 (20.0) *	**
	Jind		1997	149	15 (9.0)	91 (61.0)	43 (30.0) *	**
	Kaithal		1997	239	7 (3.0)	91 (38.0)	141 (59.0) *	**
	Karnal		1997	77	2 (2.5)	22 (28.5)	53 (69.0) *	**
	Kurukshetra		1997	174	4 (2.0)	49(28.0)	121(70.0) *	**
	Mahendergarh		1997	174	25(14.5)	122 (70.0)	27 (15.5) *	**
	Panipat		1997	185	3 (2.0)	15 (8.0)	167(90.0) *	**
	Rewari		1997	93	5 (5.4)	44 (47.3)	44 (47.3) *	**
	Rohtak		1997	664	79(12.0)	309 (40.5)	276 (41.5) *	**
	Sirsa		1997	146	4 (2.8)	90 (61.6)	52 (35.6) *	**
	Sonepat		1997	188	4 (2.0)	37 (20.0)	147 (78.0) *	**
Yamuna Nagar	1997	142	7 (5.0)	29 (20.0)	106 (75.0) *	**		
8 Himachal Pradesh	Hamirpur	22	1996	242	72(2.5)	318(10.8)	217 (89.6)*	**
	Kangra	23	1997	372	11(3.0)	76(20.0)	285(77.0)*	**
	Kullu		1997	1046	28(2.6)	287(27.4)	741(70.8)*	**
	Una		1998	213	2(1.0)	127(60.0)	84(39.0)*	**
	Kinnaur	24	1998	242	2(0.8)	23(9.5)	217(89.6)*	**
	Kangra	25	1999	1175	9(0.8)	140(11.9)	1026(87.3)*	**
	Kangra	26	1999	746	INA	49(6.6)	697(93.4)*	**
	Solan	27	1999	1481	96(6.5)	299(20.2)	1086(73.3)*	**
Kullu	\$	2001	113	0(0.0)	17(15.0)	50(44.2)	46(40.7)	
9. Karnataka	Shimoga	28	2001	165	105(63.6)	21(12.7)	33(20.0)	6(3.6)
	Dharwad		2001	150	18(12.0)	81(54.0)	26(17.3)	25(16.7)
	Haveri		2001	150	33(22.0)	107(71.3)	7(4.7)	3(2.0)
	Udupi		2001	149	79(53.0)	47(31.5)	20(13.4)	3(2.0)
	Dakshina Kannada		2001	151	100(66.2)	33(21.9)	17(11.3)	1(0.7)
	Chikmagalur		2001	150	68(45.3)	33(22.0)	43(28.7)	6(4.0)
	Gulbarga		2001	150	139(92.7)	11(7.3)	0(0.0)	0(0.0)
	Belgaum		2001	200	118(59.0)	51(25.5)	25(12.5)	6(3.0)
	Uttara Kannada		2001	201	165(82.1)	16(8.0)	18(9.0)	2(1.0)
	Bijapur		2001	190	71(37.4)	103(54.2)	13(6.8)	3(1.6)
	Raichur		2001	153	20(13.1)	130(85.0)	3(2.0)	0(0.0)
	Bangalore(Urban)		2001	178	27(15.2)	77(43.3)	55(30.9)	19(10.7)
	Davangere		2001	156	97(62.2)	54(34.6)	3(1.9)	2(1.3)
	Chitradurga		2001	156	44(28.2)	58(37.2)	29(18.6)	25(16.0)
	Tumkur		2001	150	91(60.7)	56(37.3)	2(1.3)	1(0.7)
	Kodagu		2001	150	93(62.0)	31(20.7)	15(10.0)	11(7.3)
	Bangalore (Rural)		2001	163	91(55.8)	25(15.3)	40(24.5)	7(4.3)
	Madya		2001	154	105(68.2)	16(10.4)	28(18.2)	5(3.2)
	Hassan		2001	152	141(92.8)	5(3.3)	4(2.6)	2(1.3)
	Mysore		2001	152	63(41.4)	49(32.2)	35(23.0)	5(3.3)
Bellary	2001	152	68(44.7)	80(52.6)	2(1.3)	2(1.3)		
Koppal	2001	152	76(50.0)	70(46.1)	6(3.9)	0(0.0)		
Chamaraja Nagar	2001	158	69(43.7)	68(43.0)	17(10.8)	4(2.5)		

Table 3. Contd.

State	Name of the District	Ref No.	Year of survey	No. of salt samples	Iodine content of salt (ppm)			
					<5	5-<15	15-<30	30 & above
	Kolar	29	2001	150	75(50.0)	67(44.7)	3(2.0)	5(3.3)
10. Kerala	Palghat	30	1997	149	2(1.3)	67(44.9)	80(53.7) *	**
	Ernakulam	31	1998	199	5(2.6)	17(8.4)	177(89.0) *	**
	Kerala	\$	1999	295	51(17.3)	64(21.7)	40(13.6)	140(47.5)
	Kottayam	32	2000	420	1(0.2)	164(39.0)	75(17.8)	180(42.8)
	Kollam	31	2001	155	30(19.4)	28(18.1)	80(51.6)	17(11.0)
	Pathanmthita		2001	146	48(32.9)	18(12.3)	64(43.8)	16(11.0)
	Alappuza		2001	148	71(48.0)	7(4.7)	45(30.4)	25(16.9)
	Idduki		2001	152	90(59.2)	13(8.6)	42(27.6)	7(4.6)
	Kottayam		2001	153	52(34.0)	24(15.7)	72(47.1)	5(3.3)
	Trissur		2001	150	74(49.3)	17(11.3)	51(34.0)	8(5.3)
	Palakkad		2001	151	121(80.1)	12(7.9)	14(9.3)	4(2.6)
	Ernakulam		2001	156	40(25.6)	69(44.2)	38(24.4)	9(5.8)
	Calicut		2001	146	56(38.4)	11(7.5)	26(17.8)	53(36.3)
	Malappuram		2001	150	1(0.7)	5(3.3)	16(10.7)	128(85.3)
	Kannur		2001	153	59(38.6)	43(28.1)	43(28.1)	8(5.2)
	Kasargod		2001	149	90(60.4)	31(20.8)	26(17.4)	2(1.3)
Wyanad		2001	146	76(52.1)	32(21.9)	32(21.9)	6(4.1)	
Thiruvanthapuram		2001	156	40(25.6)	30(19.2)	72(46.2)	14(9.0)	
11 Madhya Pradesh	Bastar	32	1996	201	0(0.0)	58(28.9)	75(37.3)	68(33.8)
	Dhar		1996	168	0(0.0)	47(28.0)	63(37.5)	58(34.5)
	Gwalior		1996	321	3(0.9)	59(18.4)	76(23.6)	183(57.0)
	Ratlam		1996	199	0(0.0)	75(37.7)	56(28.1)	68(34.2)
	Shahdol		1996	153	1(0.6)	36(23.5)	64(41.8)	52(34.0)
	Vidisha		1996	169	1(0.4)	78(46.1)	55(32.5)	35(20.7)
	Indore		1996	212	1(0.5)	95(44.8)	116(75.8) *	**
	Morena		1996	185	14(7.6)	74(40.0)	57(52.4) *	**
	Sidhi		1996	168	3(1.8)	79(47.0)	86(51.2) *	**
	Sihore		1996	216	2(0.9)	75(34.7)	139(64.4) *	**
12. Pondicherry	Pondicherry	33	1998	201	INA	138(68.6)	63(31.4)*	**
	Kariakal	34	2001	150	61(40.7)	86(57.3)	2(1.3)	1(0.7)
	Yanam		2001	150	37(24.7)	92(61.3)	17(11.3)	4(2.7)
	Mahe		2001	150	44(29.3)	37(24.7)	49(32.7)	20(13.3)
	Pondicherry		2001	150	100(66.7)	40(26.7)	5(3.3)	5(3.3)
13. Punjab	Amritasr	35	1997	170	17(10.0)	62(36.5)	34(20.0)	57(33.5)
	Bhatinda		1997	417	8 (1.9)	99(23.7)	82(19.7)	113(47.1)
	Faridkot		1997	164	0 (0.0)	36(22.0)	70(42.6)	58(35.4)
	Fatehgarh		1997	205	0(0.0)	73(35.6)	68(33.2)	64(31.2)
	Ferozpur		1997	196	16(8.2)	43(21.9)	49(25.0)	88(44.8)
	Gurdaspur		1997	199	0(0.0)	43(21.6)	99(49.7)	57(28.6)
	Hoshiarpur		1997	341	1(0.3)	60(17.6)	138(40.5)	142(41.6)
	Jalandhar		1997	201	5(2.5)	42(20.9)	89(44.3)	68(33.8)
	Kapurthala		1997	240	15(6.3)	73(30.4)	97(40.4)	55(22.9)
	Ludhiana		1997	201	1(0.5)	33(16.4)	54(26.9)	113(56.2)
	Mansa		1997	395	16(4.1)	248(62.8)	78(19.8)	53(13.4)
	Moga		1997	204	10(4.9)	14(6.9)	49(24.0)	131(64.2)

Table 3. Contd.

State	Name of the District	Ref No.	Year of survey	No. of salt samples	Iodine content of salt (ppm)			
					<5	5 <15	15-<30	30 & above
	Muksar	36	1997	138	0(0.0)	15(10.9)	65(47.1)	58(42.0)
	Navashahar		1997	208	4(1.9)	20(9.6)	112(53.8)	72(34.6)
	Patiala		1997	144	2(1.4)	95(66.0)	45(31.2)	2(1.4)
	Ropar		1997	197	0(0.0)	14(7.1)	48(24.4)	135(68.5)
	Sangrur		1997	249	7(2.8)	40(16.1)	52(21.0)	150(60.2)
14 Rajasthan	Bikaner	37	1997	526	168(31.9)	42(8.0)	316(60.1) *	**
	Bikaner	\$	1999	700	0(0.0)	351(50.1)	349(49.9) *	**
	Udaipur	\$	2000	282	0(0.0)	40(14.2)	242(85.8) *	**
15 Tamil Nadu	Nagapattinam	38	2001	150	68(45.1)	81(54.2)	1(0.7)	0(0.0)
	Cuddalore		2001	149	71(47.9)	72(48.0)	5(3.4)	1(0.7)
	Nilgiris		2001	150	22(15.2)	91(60.3)	35(23.2)	2(1.3)
	Coimbatore		2001	150	40(26.5)	86(57.6)	20(13.3)	4(2.6)
	Erode		2001	150	45(30.5)	69(45.7)	32(21.2)	4(2.6)
	Dindigul		2001	150	67(44.7)	65(43.3)	16(10.7)	2(1.3)
	Ramanathapuram		2001	140	13(9.3)	113(80.7)	14(10.0)	0(0.0)
	Pudukkotai		2001	151	35(23.2)	87(57.6)	12(7.9)	17(11.3)
	Thanjavur		2001	202	148(73.3)	35(17.3)	17(8.4)	2(1.0)
	Sivaganga		2001	180	24(13.3)	84(46.7)	53(29.4)	19(10.6)
	Perambalur		2001	150	7(4.7)	126(84.0)	17(11.3)	0(0.0)
	Villupuram		2001	181	85(47.0)	92(50.8)	4(2.2)	0(0.0)
	Trichy		2001	157	48(30.6)	62(39.5)	30(19.1)	17(10.8)
	Karur		2001	200	57(28.5)	81(40.5)	26(13.0)	36(18.0)
	Madurai		2001	150	23(15.3)	122(81.3)	5(3.3)	0(0.0)
	Salem		2001	200	94(47.0)	73(36.5)	19(9.5)	14(7.0)
	Namakkal		2001	207	98(47.3)	47(22.7)	19(9.2)	43(20.8)
	Kancheepuram		2001	200	99(49.5)	70(35.0)	17(8.9)	14(7.0)
	Thiruvannamalai		2001	162	58(35.8)	99(61.1)	0(0.0)	5(3.1)
	Virudunagar		2001	160	88(55.0)	68(42.5)	1(0.6)	3(1.9)
Dharmapuri		2001	100	41(41.0)	39(39.0)	12(12.0)	8(8.0)	
Vellore		2001	130	89(68.5)	24(18.5)	16(12.3)	1(0.8)	
Tiruvallore		2001	170	88(51.8)	16(9.4)	23(13.5)	3(25.3)	
Tiruvapur		2001	150	61(40.7)	87(58.0)	2(1.3)	0(0.0)	
16 Tripura	Tripura	\$	2000	212	6(2.8)	56(26.4)	61(28.8)	89(42.0)
	Tripura		1999	60	1(1.7)	35(58.3)	14(23.3)	10(16.7)
	Tripura		1999	148	1(0.7)	20(13.5)	46(31.1)	81(54.7)
	Agartala		1999	126	10(7.9)	70(55.6)	39(31.0)	7(5.6)
17 Uttar Pradesh	Uttar Kashi	39	1998	255	6(2.4)	27(10.6)	140(47.1)	82(40.0)
	Saharanpur		1998	290	2(0.7)	234(80.7)	52(17.9)	2(0.7)
	Pauri		1998	224	1(0.5)	21(9.5)	85(38.3)	117(51.8)
	Pithoragarh		1998	244	0(0.0)	40(16.4)	124(50.8)	80(32.8)
	Meerut		1998	205	36(17.6)	104(50.7)	38(18.5)	27(13.2)
	Meerut		1998	716	28(4.0)	354(49.4)	334(46.6) *	**
	Bareilly		1998	200	17(8.5)	147(73.5)	29(14.5)	7(3.5)
	Agra		1998	195	25(12.8)	88(45.1)	58(29.7)	24(12.3)
	Kanpur		1998	200	3(1.5)	195(97.5)	2(1.0)	0(0.0)
	Lakhimpur		1998	238	12(5.0)	218(91.6)	6(2.5)	2(0.8)
Jhansi		1998	855	7(0.8)	454(53.1)	185(21.6)	209(24.4)	

Table 3. Contd.

State	Name of the District	Reference No.	Year of survey	No. of salt samples	Iodine content of salt (ppm)			
					<5	5-<15	15-<30	30 & above
	Mahoba	40	1998	390	6(1.5)	269(69.0)	73(18.7)	42(10.8)
	Lalitpur		1998	202	0(0.0)	146(72.3)	52(25.7)	4(2.0)
	Sidharth Nagar		1998	184	7(3.8)	119(64.7)	17(9.2)	41(22.3)
	Padrona		1998	225	1(0.4)	47(20.9)	111(49.3)	66(29.3)
	Sultanpur		1998	179	3(1.7)	117(65.4)	27(15.1)	32(17.8)
	Gorakhpur		1998	212	1(0.5)	37(17.5)	70(33.0)	104(49.1)
	Varanasi		1998	288	0(0.0)	220(76.4)	28(9.7)	40(13.9)
	Meerut		41	1999	680	58(8.5)	299(44.0)	163(24.0)
	Udham Singh Nagar	19	1999	736	INA	168(22.8)	568(77.2)	**
	Dehradun		1999	797	INA	302(38.2)	495(61.8)	**

* Data of 30 ppm and above category included

** Data of 30 ppm and above category not available

Figures in parenthesis denote percentages

\$ Unpublished data of surveys conducted by All India Institute of Medical Sciences

Table 4. Urinary iodine excretion levels in selected districts of India

State	Name of the district	Year	No. of Urine samples	Median (g/l)	Reference
	Kullu	2001	289	100.0	*
6 Karnataka	Shimoga	2001	96	30.0	27
	Dharwad	2001	99	100.0	
	Haveri	2001	99	100.0	
	Udupi	2001	84	>200.0	
	Dakshina Kannada	2001	97	70.0	
	Chikmagalur	2001	100	150.0	
	Gulbarga	2001	94	70.0	
	Belgaum	2001	100	100.0	
	Uttara Kannada	2001	100	100.0	
	Bijapur	2001	76	85.0	
	Raichur	2001	93	120.0	
	Bangalore(Urban)	2001	86	185.0	
	Davangere	2001	90	52.0	
	Chitradurga	2001	71	>200.0	
	Tumkur	2001	97	100.0	
	Kodagu	2001	96	30.0	
	Bangalore (Rural)	2001	94	100.0	
Madya	2001	98	120.0		
Bellary	2001	95	65.0		
Koppal	2001	86	100.0		
Kolar	2001	101	95.0		
7. Kerala	Ernakulam	1998	220	200.0	29
	Kottayam	2000	251	175.0	30
	Alappuza	2001	94	100.0	31
	Idduki	2001	72	55.0	
	Kottayam	2001	99	85.0	
	Calicut	2001	56	120.0	
	Malappuram	2001	88	150.0	

Table 4. Contd.

	Kannur	2001	90	150.0	
	Kasargod	2001	92	75.0	
	Wyanad	2001	98	100.0	
8 Orissa	Puri	2001	145	125.0	*
9 Pondicherry	Pondicherry	1998	187	145.0	33
	Kariakal	2001	80	150.0	34
	Yanam	2001	100	200.0	
	Mahe	2001	100	65.0	
	Pondicherry	2001	97	200.0	
10 Rajasthan	Bikaner	1997	400	155.0	36
	Ajmer	2001	100	175.0	*
	Bharatpur	2002	450	155.0	44
11 Tamil Nadu	Nagapattinam	2001	100	150.0	37
	Cuddalore	2001	100	>200.0	
	Nilgiris	2001	56	180.0	
	Coimbatore	2001	90	130.0	
	Erode	2001	85	155.0	
	Dindigul	2001	90	150.0	
	Pudukkotai	2001	56	>200.0	
	Thanjavur	2001	89	150.0	
	Sivaganga	2001	63	155.0	
	Perambalur	2001	157	85.0	
	Trichy	2001	112	>200.0	
	Karur	2001	110	180.0	
		Madurai	2001	107	>200.0
	Salem	2001	98	180.0	
	Namakkal	2001	98	>200.0	
	Kancheepuram	2001	88	>200.0	
	Thiruvannamalai	2001	72	120.0	
	Villupuram	2001	67	100.0	
	Dharmapuri	2001	70	195.0	
	Vellore	2001	80	150.0	
	Tiruvallore	2001	92	>200.0	
	Tiruvarur	2001	94	>200.0	
12 Tripura	Tripura	1999	133	175.0	*
13 Uttar Pradesh	Uttar Kashi	1998	61	200.0	45
	Saharanpur	1998	192	200.0	46
	Pauri	1998	100	175.0	39
	Pithoragarh	1998	154	200.0	44
	Meerut	1998	710	150.0	63
	Bareilly	1998	82	102.0	
	Agra	1998	92	175.0	
	Kanpur	1998	72	105.0	
	Lakhimpur	1998	128	50.0	
	Lalitpur	1998	109	135.0	
	Sidharth Nagar	1998	148	100.0	
Padrona	1998	80	200		

Table 4. continue

	Sultanpur	1998	103	100.0	
	Gorakhpur	1998	147	150.0	
	Varanasi	1998	107	100.0	
	Meerut	1999	710	150.0	

* Unpublished data

Table 5. Median values (g/l) of Urinary iodine excretion levels for children (6-<12 years) (64).

Name of district	No. of urine samples	Median value (g/l)
Northern Region		
Mandi	2001	150
Dehradun	1617	127
Lakhimpur Kheri	2003	90
Badaun	1978	118
Baramulla	2082	200
Bikaner	1824	118
Mainpuri	1050	90
Srinagar	1661	200
Eastern Region		
Bishnupur	2076	106
Gaya	1802	90
Patna	1671	109
Dibrugarh	2040	115
Nagaon	1836	115
Southern Region		
Mehboob Nagar	1748	150
Western Region		
Raigarh	2092	100
All Districts	27,481	

REFERENCES

- Bhardwaj AK, Nayar D, Ramachandran S, Kapil U (1997). Assessment of iodine deficiency in district Bikaner, Rajasthan. *Indian J. Matern. Child Health* 8: 18-20.
- Hetzel BS (1997). SOS for a billion- the nature and magnitude of iodine deficiency disorders. In: SOS for a billion- the conquest of iodine deficiency disorders. 2nd Edition. Eds. Hetzel BS, Pandav CV. Oxford University Press. pp. 1-29.
- Kapil Umesh, Nayar D, Ramachandran S, Sharma TD (1997). Status of salt iodisation in Una, Kangra and Kullu Districts of Himachal Pradesh. *Indian J. Prevent. Soc. Med.* 28: 36-39.
- Kapil U (2000) Utility of Spot Testing Kit in the Assessment of Iodine Content of Salt – A Multicentric Study. Ed. Kapil Umesh, Dwivedi SN, Raghuvanshi RS, Khanna Kumud, Mathur BP, Sharma TD, Beena, Swami SS, Seshadri. 1999 Technical Report, Shivansh Computers, New Delhi, pp. 1-43.
- Kapil U (2000). Progress made in Elimination of IDD and Possible Impact of Lifting Ban on sale of Non Iodised Salt. *J. Acad. Hosp. Admin.* 12: 33-41.
- Kapil U (2000). Status of urinary iodine excretion in post salt Iodisation phase in selected districts of India. *Indian Paediatrics*; 37: 1282-1284.
- Kapil U, Bahsin S, Dhar A, Nayar D (1996). The iodine content of salt used in 1311 households in the NCT of Delhi, India. *Aust. J. Nutr. Dietet.* 53: 72-73.
- Kapil U, Goel RKD, Singh C, Ramachandran S (1998). Status of iodine Content of Iodised Salt Supplied for Prevention of Iodine Deficiency Disorders at beneficiary level in the state of Punjab. *J. Assoc. Phys. India* 46: 879-881.
- Kapil U, Jayakumar PR, Singh P, Aneja B, Pathak P (2002). Assessment of iodine deficiency in Kottayam district, Kerala State: a pilot study. *Asia Pacif. J. Clin. Nutr.* 11: 33-35.
- Kapil U, Nayar D, Ramachandran S (1996). Assessment of Iodine deficiency in Tiswadi Block, Goa. *The Indian Practitioner.* pp. 749-750.
- Kapil U, Prakash R, Sundaresan S, Ramachandran S, Tandon M (1997). Status of Universal Salt Iodisation Programme in the selected districts of Bihar. *Indian J. Matern. Child Health* 8: 90-91.
- Kapil U, Ramachandran S, Saxena N, Nayar D (1999). Iodine Content of Salt in District Palghat, Kerala. *Indian J. Comm. Health.* 3: 106-108.
- Kapil U, Ramachandran S, Tandon M (1998). Assessment of Iodine Deficiency in Andaman District of Union territory of Andaman and

- Nicobar. *Indian Journal of Matern. Child Health* 9: 19-20.
- Kapil U, Ramachandran S, Tandon M (1998). Assessment of iodine deficiency in Pondicherry. *Indian Paediatr.* 35: 357-359.
- Kapil U, Saxena N, Nayar D, Ramachandran S (1996) Assessment of status of salt iodisation in Delhi. *Indian J. Paediatr.* 66: 185-187.
- Kapil U, Saxena N, Ramachandran S, Balamurugan A, Nayar D, Prakash S (1980). Assessment of Iodine deficiency disorders using
- Kapil U, Saxena N, Ramachandran S, Nayar D (1997). Iodine status of pregnant mothers residing in an iodine deficiency endemic district in the state of Himachal Pradesh, India. *Asia Pacif. J. Clin. Nutr.* 3: 224-225.
- Kapil U, Saxena N, Ramachandran S, Sharma TD, Nayar D (1997). Status of iodine deficiency in selected blocks of Kangra District, Himachal Pradesh. *Indian Paediatr.* 34: 338-340.
- Kapil U, Sethi V, Goindi G, Pathak P, Singh P (2004). Tracking progress towards elimination of Iodine Deficiency Disorders in National Capital Territory of Delhi. *Indian J. Paediatr.* (In Press).
- Kapil U, Sharma NC, Ramachandran S, Nayar D, Vashisht M (1998) Iodine deficiency in district Kinnaur, Himachal Pradesh. *Indian J Paediatr.* 65: 451-453.
- Kapil U, Singh C, Mathur A, Ramachandran S, Nayar D, Saxena N, Vashisht M (1998) Status of Universal Iodisation of Salt Programme in selected districts of Madhya Pradesh state. *Indian Pract.* 51: 111-114.
- Kapil U, Singh J, Prakash R, Sundaresan S, Ramachandran S, Tandon M (1997) Assessment of iodine deficiency in selected blocks of east and west Champaran districts of Bihar. *Indian Paediatrics.* 34: 1087-1091.
- Kapil U, Singh P, Dwivedi SN, Pathak P (2002). Status of Iodine Nutriture and Universal Salt Iodisation at beneficiaries levels in Kerala State, India. *Journal of Indian Medical Association.* (In Press).
- Kapil U, Singh P, Dwivedi SN, Pathak P (2004). Profile of Iodine Content of Salt and Urinary Iodine Excretion levels in selected districts of Tamil Nadu. *Indian J. Paediatr.* (In Press).
- Kapil U, Singh P, Pathak P (1999). Current Status of Salt Iodisation and Urinary Iodine Excretion levels in Karnataka state, India. *Indian J. Med. Res.* (In Press).
- Kapil U, Singh P, Pathak P (2002). Status of iodine nutriture and salt iodisation in Union Territory of Pondicherry, India. *Pak. J. Nutr.* 1: 234-235.
- Kapil U, Singh P, Pathak P, Dwivedi SN. Current Status of Iodine Nutriture and Iodine Content of Salt in Andhra Pradesh. *Indian Paediatr.* (In press).
- Kapil U, Sohal KS, Sharma TD, Tandon M, Pathak P (2000). Assessment of iodine deficiency disorders using the 30 cluster approach in district Kangra, Himachal Pradesh, India. *J. Trop. Paediatr.* 46: 264-266.
- Kapil U, Tandon M, Pathak P (1999). Assessment of iodine deficiency in Ernakulam district, Kerala state. *Indian Paediatr.* 36: 178-180.
- Kapil U, Tandon M, Pathak P (2000). Level of iodine content in iodised salt. *Indian Paediatr.*, 37: 113.
- Kapil U, Tandon M, Pathak P, Pradhan R (2001) Assessment of current status of salt iodisation at the beneficiaries level in selected districts of Uttar Pradesh, India. *Indian Paediatr.* 38: 654-657.
- Kapil U, Singh P, Pathak P, Singh C (1997). Assessment of Iodine Deficiency Disorders in District Bharatpur, Rajasthan. *Indian Paediatr.* 40: 147-149.
- Kapil U, Tandon M, Pradhan R, Pathak P. (1999) Status of Iodine deficiency in selected hill districts of Uttar Pradesh- A Pilot Study. *Indian J. Matern. Child Health* 10: 24-27.
- Kapil Umesh, Bhasin S, Goindi G, Nayar D (1995) Iodine Content of Salt in National Capital Territory of Delhi. *Asia Pacif. J. Clin. Nutr.* 4: 257-258.
- Kapil Umesh, Karmarkar MG, Goindi G, Nayar D (1997). Iodine content of salt in Union Territory of Andaman and Nicobar islands. *Asia Pacif. J. Clin. Nutr.* 6: 95-96.
- Kapil Umesh, Nayar D, Singh C, Saxena N (1996). Monitoring the implementation of universal iodisation of salt programme through Kapil Umesh, Pathak P, Singh C, Tandon M, Pradhan R, Dwivedi SN. (1999) Micro nutrient Deficiency Disorders amongst Pregnant women in Urban Slum communities of Delhi. *Indian Paediatr.* 36: 983-989.
- Kapil Umesh, Singh JV, Tandon M, Pathak P, Singh C, Yadav R, (2000) Assessment of Iodine Deficiency Disorders in Meerut district, UP, India. *Asia Pacif. J. Clin. Nutr.* 9: 99-101.
- Kochupillai N (1992). Neonatal Hypothyroidism in India. *The Mount Sinai J. Med.* 59: 111-115.
- Micronutrient Deficiency Disorders in 16 districts of India. Part 1 Report of an ICMR task force study – District Nutrition Project. Indian Council of Medical Research, New Delhi, 2001.
- National Institute of Nutrition (1986-1987). Annual Report, Indian Council of Medical Research, Avon Printing Works, Hyderabad. pp. 67-68.
- Pandav CS, Pandav CS, Kochupillai N, Karmarkar MG, Ramachandran K, Gopinath PG, Nath LM (1980) Endemic goiter in Delhi. *Ind. J. Med. Res;* 72: 81-88.
- Ranganathan S, Reddy V (1995). Human Requirements of Iodine and safe Use of Iodised Salt. *Indian J. Med. Res.* 102: 227-232.
- school approach in the state of Haryana, India. *Indian J. Matern. Child Health* 7: 69-72.
- Sohal KS, Sharma TD, Kapil U, Tandon M (1999) Current status of prevalence of goiter and iodine content of salt consumed in District Solan, Himachal Pradesh. *Indian Paediatr.* 36: 1253-1256.
- Sohal KS, Sharma TD, Kapil U, Tandon M. (1998) Assessment of iodine deficiency disorders in district Hamirpur, Himachal Pradesh. *Indian Paediatr.* 35: 1008-1011.
- the 30 cluster approach in the National Capital Territory of Delhi. *Indian Paediatr.* 33: 1013-1017.
- WHO (2001). Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. A guide for programme managers. Second Edition. ICCIDD/UNCF/WHO.
- WHO-UNICEF-ICCIDD (1994). Indicators for assessing Iodine Deficiency Disorders and their control through salt iodization. World Health Organisation, Geneva. pp. 12-16.