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Status of Iodine Content of Salt and Urinary Iodine Excretion Levels in India

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Introduction

Iodine is an essential dietary element which is required for the synthesis of the thyroid hormones, thyroxine (T_4) and triiodothyronine (T_3). T_4 and T_3, which are iodinated molecules of the essential amino acid tyrosine, regulate cellular oxidation and hence effect calorigenesis, thermoregulation and intermediary metabolism. These hormones are necessary for protein synthesis and they promote nitrogen retention, glycogenolysis, intestinal absorption of glucose and galactose, lipolysis and uptake of glucose by adipocytes.

Synthesis and secretion of T_4 and T_3 are under the control of the thyroid-stimulating hormone (TSH) which is secreted from the anterior lobe of the pituitary gland. TSH stimulates iodide transport from the blood into thyroid cells, oxidation of iodide to iodine and iodine binding to tyrosine. Synthesis of thyroid hormones is regulated by the levels of circulating free T_4 and T_3 as a negative feedback mechanism (American Medical Association, 1980).

Iodine Deficiency: Food crops and water derive iodine from the soil. In areas with no iodine deficiency, 60-75% of the iodine needs are met by the iodine present in the diet and the rest through the iodine content of water (Gopalan and Ramashastri, 2002). Consumption of crops and plants grown on iodine deficient soils leads to iodine deficiency in population solely dependent on these diets for their iodine requirements (Hetzel, 1997). The food grown in iodine deficient regions can never provide enough iodine to the population and livestock living there (Gopalan and Ramashastri, 2002; Hetzel, 1997). 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.

Dietary iodine deficiency stimulates TSH secretion which results in thyroid hypertrophy. The enlargement of the thyroid gland due to 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 thyroid hormones may occur. This condition is referred to as hypothyroidism (Markou *et al*., 2001).

Iodine content in foods: National Institute of Nutrition (NIN) conducted studies on iodine content of various food stuffs. It was 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 96.0 µg/100g) and condiments, while fruits and vegetables had the lowest level of iodine content (2.7 to 20.0 µg/100g). The iodine content of food samples collected and analyzed from endemic and non-endemic regions of the country has been depicted in Table 1. All types of foodstuffs in endemic districts had lower iodine content as compared to non-endemic districts (NIN, 1987).

Table 1: Iodine content of food samples from different regions (values are µg iodine per 100g dry weight)

Food sample	Hyderabad (A.P.) (Non-Endemc)	Jabalpur (Endemic TGR 45%)
Rice, Milled	36-48	3.8-15.3
Maize	32-34	6.0-15.0
Amaranth seeds	73-86	6.4
Soyabean	49	4.4
Blackgram	48	6.0-28.2
Amaranth leaves	130-170	8.2-36.0
Cucumber	36	28.2

Magnitude of IDD in India: Iodine deficiency is the most common preventable cause of mental deficiency in the world today. IDD constitute 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 (Kapil, 2000a). These districts are present in all the states and union territories of country (Table 2).

Iodine and Health Consequences: Iodine deficiency affects all the stages of human development: fetus, neonate, child and adult. If a pregnant woman is starved of iodine, the fetus does not get adequate iodine and hence cannot produce enough thyroxin. This leads to fetal growth retardation. Hypothyroid fetuses often perish in the womb and many infants die within a week of birth. Hypothyroid children are intellectually subnormal and have impaired school performance due to lowered IQ points. They are often incapable of completing school. In

Table 2: 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 and 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 and Nicobar Islands	2	2	2	Complete	Yes
Chandigarh	1	1	1	Complete	Yes
Dadar and Nagar Haveli	1	1	1	Complete	Yes
Delhi	1	-	1	Complete	Yes
Daman and Diu	1	1	1	Complete	Yes
Lakshwadeep	1	-	-	Complete	Yes
Pondicherry	4	-	-	Complete	Yes
Total No. of districts	587	282	241		

Table 3: The Spectrum of Iodine Deficiency Disorders

Stage in Life	Health Effects
Foetus	Abortions
	Stillbirths
	Congenital Anomalies
	Increased Perinatal Mortality
	Increased Infant Mortality
	Neurological Cretinism :
	- mental deficiency
	- deaf-mutism
	- spastic diplegia
	- squint
	Myxedematous Cretinism :
	- mental deficiency
	- dwarfism
	Psychomotor Defects
Neonate	Neonatal goiter
	Neonatal hypothyroidism
Child and Adolescent	Goiter
	Juvenile hypothyroidism
	Impaired mental function
	Retarded physical development
Adult	Goiter with complications
	Hypothyroidism
	Impaired mental function

Table 4: Relationship between Iodine intake and IDD

Nutritional Status	Daily Iodine intake (µg)
Associated with cretinism	20 or less
Associated with goiter	20 - 50
Marginal	50 - 100
Normal	100 - 300
More than normal	300 and above

areas with prevalence of mild to moderate Iodine deficiency, the school children are, on an average, 10 points of IQ below those of children living in areas where there is no iodine deficiency (WHO, 1994). Children may also suffer from physical impairment. The spectrum of disorders caused due to iodine deficiency is presented in Table 3. The relationship between iodine intake and IDD is depicted in Table 4.

National Iodine Deficiency Disorders Control Programme (NIDDCP): Following the successful trial of iodized salt in the Kangra valley, Himachal Pradesh, a National Iodine Deficiency Disorders Control Program (NIDDCP) was launched by the Government of India in 1962. The objectives of the programme were i) to

Table 5: Resurvey Results of Total Goiter Rate (TGR) after Supply of Iodized Salt

States/Districts	Prevalence Rate (%)	Commencement of Iodized Salt Year	Re-Survey Year	Time interval Between (5 and 6 Year)	Prevalence Rate (%)
Andhra Pradesh	30.0	1965	1982	22	26.8
Bihar					
E.Champaran	40.3	1964	1979	19	64.5
Chandigarh UT	11.2	1968	1977	10	45.9
H.P.					
Kangra	41.2	1957	1962	5	32.1
Mandi	39.9	1963	1981	18	34.5
Sirmaur	35.8	1963	1980	17	28.1
PUNJAB					
Gurdaspur	40.3	1964	1969	5	23.6
Hoshiarpur	40.3	1964	1969	5	23.6
UP					
Bijnore	23.2	1966	1969	3	16.9
Dehradun	39.7	1966	1969	3	16.9
Garhwal	40.0	1966	1974	8	25.4
Pithoragarh	40.0	1966	1974	8	25.4
Tehri Garhwal	35.0	1966	1974	8	25.4
Uttar Kashi	40.0	1966	1974	8	25.4
Delhi	55.0	1989	2002	13	6.8

Table 6: ICMR Repeat survey on IDD 1985-86 and 1997 total goiter rate

Age Gp.	Dibrugarh		Vishkhapattanam		Mandla	
	85-86	98-99	85-86	98-99	85-86	98-99
<4 yrs	55.23	0.59	9.30	1.03	16.2	0.28
5-9 yrs	90.00	2.57	12.42	4.48	28.3	0.21
10-14 yrs	86.40	7.98	16.23	9.48	59..3	1.01
15-19 yrs	77.10	5.72	9.90	7.00	53.5	2.10
20-29 yrs	70.10	7.93	21.40	5.57	43.4	2.01
30-.39 yrs	57.60	8.06	21.00	4.56	31.0	3.46
> 40 yrs	32.30	5.14	13.80	2.47	25.6	3.70
Total	65.60	5.93	15.70	4.81	34.4	2.00
N	42347	6693	3350.8	7419	13088	8211

Table 7: Incidence of Neonatal Hypothyroidism in three endemic goiter districts of Uttar Pradesh, before and after Successful Salt Iodization

Districts	Incidence per 1000 birth	
	Pre-iodation	Post-iodation
Deoria	133	16
Gonda	75	9
Gorakhpur	85	17

Table 8: 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

conduct survey to assess magnitude of iodine deficiency disorders, ii) to supply of iodized salt in place of common salt and iii) to resurvey the area after every five years to assess IDD and the impact of the iodized salt (Kapil, 2000a).

India has observed a steady progress in the production of iodized salt during last two decades. In 1983, the country's production of iodized salt was only 3 Lakh tones and after adoption of Universal Salt Iodization Policy in 1984 (under which the production of iodized salt was opened to the private manufacturers) the total quantity of iodized salt production increased to 42 lakh tonnes by year 2002 There are 886 iodization plants and

Table 9: Iodine Content of Salt Samples Collected at Beneficiary Level in Selected Districts of India

State	Name of the District	Year of Survey	No. of salt samples	Iodine content of salt (ppm)			
				<5	5-<15	15-<30	30 and above
Andaman and Nicobar	Andaman and Nicobar	1996	275	1 (0.3)	117 (42.5)	157 (57.1)*	**
	Andaman and Nicobar	1997	211	1 (0.5)	26 (12.3)	184 (87.2)*	**
Andhra Pradesh	Vijayanagram	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)
Bihar	WestChamparan	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	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)
Delhi	Delhi	1994	763	5 (0.7)	129 (16.9)	629 (82.4)*	**
	Delhi	1996	1307	26 (2.0)	429 (32.8)	852 (65.2)*	**
	Delhi	1999	1854	492 (26.5)	293 (15.8)	176 (9.5)	893 (48.2)
	Delhi	2002	999	163 (16.3)	206 (20.6)	511 (51.1)	119 (12.0)
Goa	Goa	1996	133	65 (48.9)	29 (22.0)	39 (29.1) *	**
Gujarat	Vadodara	1999	700	INA	208 (29.7)	492 (70.3) *	**

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

State	Name of the District	Year of survey	No. of salt samples	Iodine content of salt (ppm)			
				<5	5-<15	15-<30	30 and above
	Kolar	2001	150	75 (50.0)	67 (44.7)	3 (2.0)	5 (3.3)
Kerala	Palghat	1997	149	2 (1.3)	67 (44.9)	80 (53.7) *	**
	Ernakulam	1998	199	5 (2.6)	17 (8.4)	177 (89.0) *	**
	Kerela	1999	295	51 (17.3)	64 (21.7)	40 (13.6)	140 (47.5)
	Kottayam	2000	420	1 (0.2)	164 (39.0)	75 (17.8)	180 (42.8)
	Kollam	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)
	Ernakulum	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)
Madhya Pradesh	Bastar	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) *	**
Pondicherry	Pondicherry	1998	201	INA	138 (68.6)	63 (31.4)*	**
	Kariakal	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)
Punjab	Amritasr	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)

State	Name of the District	Year of sample	No. of salt samples	Iodine content of salt (ppm)			
				<5	5-<15	15-<30	30 and above
	Muktsar	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)
Rajasthan	Bikaner	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) *	**
Tamil Nadu	Nagapattinam	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)
	Perambalor	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)
	Tiruvarur	2001	150	61 (40.7)	87 (58.0)	2 (1.3)	0 (0.0)
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)
Uttar Pradesh	Uttar Kashi	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)

State	Name of theDistrict	Year of survey	No. of salt samples	Iodine content of salt (ppm)			
				<5	5-<15	15-<30	30 and above
	Mahoba	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	1999	680	58(8.5)	299(44.0)	163(24.0)	160(23.5)
	Udham Singh Nagar	1999	736	INA	168(22.8)	568(77.2) *	**
	Dehradoon	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

refineries with an annual installed capacity of producing 120 lakhs tonnes of iodized salt (Salt Department, 2003).

Iodine content of Salt under NIDDCP:

At beneficiary Level: Keeping in view of the mean daily intake of common salt of 10g by the population in different parts of the country, it is mandatory under NIDDCP that a minimum of 15 ppm of iodine should be present in per gram of edible salt at the beneficiary level to ensure at least 150 µg of dietary intake of iodine per day through the salt.

At Manufacturer Level: There is considerable loss of iodine during transportation and storage, hence under NIDDCP it is mandatory that a minimum of 30 ppm should be present in per gram of edible salt at the manufacturers level.

The Impact of Salt Iodization in India: Surveys have been conducted by the Central IDD Survey Team of Directorate General of Health Services, Government of India to monitor the progress of NIDDCP. The repeat surveys conducted under NIDDCP have shown a significant reduction in the total goiter prevalence after the supply of iodized salt (Table 5) (Salt Department, 1996).

A survey conducted in the National Capital Territory of Delhi in 1980 revealed a high prevalence of goiter (55.2%) (Pandav *et al.*, 1980). In 1989, the Universal Salt Iodization programme was introduced in the state. A repeat survey conducted in 1996 revealed that the total goiter prevalence was reduced to 8.6% (Kapil *et al.*, 1996a). A more recent survey conducted in 2002 revealed a further reduction of TGR to 6.2% indicating the success of USI (Kapil *et al.*, 2003a).

Similarly, repeat surveys conducted by ICMR after a gap of 12 years revealed a significant reduction in total goiter prevalence in all the age groups (Table 6) (ICMR). Studies conducted in selected districts of Uttar Pradesh have also revealed the lowering of incidence of neonatal hypothryroidism after introduction of iodized salt (Table 7) (Kochupillai, 1992).

Iodine Content of Salt Samples Collected from Different Parts of the Country: The level of salt Iodization should provide a physiological intake of 100-150 µg/day, which should bring the median urinary iodine excretion (UIE) level within a range of 100-200 µg/l (WHO, 1996). To achieve this, 30±10 ppm iodine are needed to be added to salt at manufacturing level (WHO, 1996). During 1994-2002, Human Nutrition Unit, AIIMS collected a total of 24,798 salt samples from various research surveys from more than 160 districts of 13 states of the country. These salt samples were analyzed using the standard iodometric titration method. Only 7% of the salt samples had iodine content of more than 45 ppm indicating that the iodized salt manufacturers in the country are not over iodizing the salt (Kapil *et al.*, 2000b). The profile of iodine content of salt in 189 districts of the country has been depicted in Table 9 (Kapil *et al.*, 2003a, 1997a, 1998a, 2003b, 1997b, 1997c, 1995, 1996b, 1996c, 1996d, 1999a, 1996e, 1998, 1997d, 2000c,1997e, 1999b, 2003c, 1997f, 1999c, 2002a, 2003d, 1998c,1998e, 2002b, 1998d, 1997g, 2003e, 2001, 2000e). These findings indicated that the present level of salt iodisation in India is within the safe limits.

Table 10: Urinary Iodine Excretion levels in selected districts of India

State	Name of the district	Year	No. of Urine samples	Median (μ g/l)
Andaman and Nicobar	Andaman and Nicobar	1997	154	200.0
Andhra Pradesh	Vijayanagram	2001	21	>200.0
	Srikakulam	2001	33	>200.0
	East Godavari District	2001	102	>200.0
	West Godavari District	2001	70	>200.0
	Guntur	2001	120	>200.0
	Prakasam	2001	102	150.0
	Warangal	2001	100	>200.0
	Adilabad	2001	101	125.0
	Kurnool	2001	103	130.0
	Mehboobnagar	2001	100	150.0
	Chittor	2001	100	100.0
	Nellore	2001	93	>200.0
	Krishna	2001	96	>200.0
	Khammam	2001	100	200.0
	Hyderabad	2001	174	150.0
	Nizamabad	2001	200	150.0
	Rangareddy	2001	107	65.0
	Anatpur	2001	98	100.0
	Cuddapah	2001	97	90.0
	Vishakapatnam	2001	35	>200.0
Bihar	WestChamparan	1997	123	100.0
	East Champaran	1997	138	100.0
	Sahibganj	2001	136	90.0
	Palamu	2001	159	160.0
Delhi	Delhi	1996	1652	170.0
	Delhi	1998	749	150.0
	Delhi	1999	680	150.0
Himachal Pradesh	Hamirpur	1996	787	135.0
	Kangra	1997	245	165.0
	Kullu	1997	147	150.0
	Solan	1997	720	150.0
	Kinnaur	1998	226	195.0
	Kangra	1999	1952	150.0
	Kangra	1998	394	175.0
	Kullu	2001	289	100.0
Karnataka	Shimoga	2001	96	30.0
	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

State	Name of the district	Year	No. of Urine samples	Median (μ g/l)
	Madya	2001	98	120.0
	Bellary	2001	95	65.0
	Koppal	2001	86	100.0
	Kolar	2001	101	95.0
Kerala	Ernakulam	1998	220	200.0
	Kottayam	2000	251	175.0
	Alappuza	2001	94	100.0
	Idduki	2001	72	55.0
	Kottayam	2001	99	85.0
	Calicut	2001	56	120.0
	Malappuram	2001	88	150.0
	Kannur	2001	90	150.0
	Kasargod	2001	92	75.0
	Wyanad	2001	98	100.0
Orissa	Puri	2001	145	125.0
Pondicherry	Pondicherry	1998	187	145.0
	Kariakal	2001	80	150.0
	Yanam	2001	100	200.0
	Mahe	2001	100	65.0
	Pondicherry	2001	97	200.0
Rajasthan	Bikaner	1997	400	155.0
	Ajmer	2001	100	175.0
	Bharatpur	2002	450	155.0
Tamil Nadu	Nagapattinam	2001	100	150.0
	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
	Perambalor	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
Tripura	Tripura	1999	133	175.0
Uttar Pradesh	Uttar Kashi	1998	61	200.0
	Pauri	1998	100	175.0
	Pithoragarh	1998	154	200.0
	Meerut	1998	710	150.0
	Saharanpur	1998	192	200.0
	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
	Sultanpur	1998	103	100.0
	Gorakhpur	1998	147	150.0
	Varanasi	1998	107	100.0
	Meerut	1999	710	150.0

* Unpublished data

Table 11: Median values (µg/l) of Urinary iodine excretion levels for children (6-<12 years)

Name of district	No. of urine samples	Median value (µg/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	

Urinary Iodine Excretion Levels of urine samples collected from different parts of the country: It is recommended that the median UIE levels in a community with optimal iodine nutriture should be in the range of 100-200 µg/l (WHO, 2001). Human Nutrition Unit, AIIMS collected a total of 21,546 urine samples through various research surveys 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 10). More than 75% districts had UIE level less than 200 µg/L (Pandav *et al*., 1980; Kapil *et al*., 1996a,1998a, 2003b, 1997b, 1998, 1997d, 1998b,2000c, 1997e, 1999b, 2003c, 1997f, 1999c, 2002a, 2003d, 1998c, 1998e, 2002b, 1997g, 2003e, 1999d, 1997g, 2003f, 1999e, 2000d).

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 11) (ICMR, 2001).

Conclusion:

a) The population in majority of the districts was consuming iodized salt.
b. The median UIE levels in majority (66%) of districts in our country is more than 100 µg/L.
c. The existing USI program has led to the reduction in IDD in endemic population groups.
d. The available scientific evidence indicates that the total intake of iodine through iodized salt and food in our country is within safe limits as revealed by UIE data from different districts of the country.
e. 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.

References

American Medical Association, 1980. Current exposure to iodine. Summary report of a workshop, Department of Foods and Nutrition, pp: 22-52.

Gopalan, C. and B.V. Ramashastri, 2002. Nutritive Value of Indian Foods, National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, pp: 20.

Hetzel, B.S., 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 Edn. Eds. Hetzel BS and Pandav CV. Oxford university press, pp: 1-29.

Indian Council of Medical Research (ICMR), 2001. 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.

Kapil, U., S. Bhasin, G. Goindi and D. Nayar, 1995. Iodine Content of Salt in National Capital Territory of Delhi. Asia Pacific J. Clin. Nutr., 4: 257-258.

Kapil, U., N. Saxena, S. Ramachandran A. Balamurugan, D. Nayar and S. Prakash, 1996a. Assessment of Iodine deficiency disorders using the 30 cluster approach in the National Capital Territory of Delhi. Ind. Pediat., 33: 1013-1017.

Kapil, U., S. Bahsin, A. Dhar and D. Nayar, 1996b. The iodine content of salt used in 1311 households in the NCT of Delhi, India. Aust. J. Nutr. Diet., 53: 72-73.

Kapil, U., N. Saxena, D. Nayar and S. Ramachandran, 1996c. Assessment of status of salt Iodisation in Delhi. Ind. J. Pediat., 66: 185-187.

Kapil, U., D. Nayar and S. Ramachandran, 1996d. Assessment of Iodine deficiency in Tiswadi Block, Goa. The Ind. Practicioner, 749-750.

Kapil, U., D. Nayar, C. Singh and N. Saxena, 1996e. Monitoring the implementation of universal iodisation of salt programme through school approach in the state of Haryana, India. Ind. J. Maternal and Child Health, 7: 69-72.

Kapil, U., M.G. Karmarkar, G. Goindi and D. Nayar, 1997a. Iodine content of salt in Union Territory of Andaman and Nicobar islands. Asia Pacific J. Clin. Nutr., 6: 95-96.

Kapil, U., J. Singh, R. Prakash, S. Sundaresan, S. Ramachandran and M. Tandon, 1997b. Assessment of iodine deficiency in selected blocks of east and west Champaran districts of Bihar. Ind. Pediat., 34: 1087-91.

Kapil, U., R. Prakash, S. Sundaresan, S. Ramachandran and M. Tandon, 1997c. Status of Universal Salt Iodisation Programme in the selected districts of Bihar. Ind. J. Maternal and Child Health, 8: 90-91.

Kapil, U., D. Nayar, S. Ramachandran and T.D. Sharma, 1997d. Status of salt iodisation in Una, Kangra and Kullu Districts of Himachal Pradesh. Ind. J. Prev. Social Med., 28: 36-39.

Kapil, U., N. Saxena, S. Ramachandran, T.D. Sharma and D. Nayar, 1997e. Status of iodine deficiency in selected blocks of Kangra District, Himachal Pradesh. Ind. Pediat., 34: 338-340.

Kapil, U., S. Ramachandran, N. Saxena and D. Nayar, 1997f. Iodine Content of Salt in District Palghat, Kerala. Ind. J. Comm. Health, 3: 106-108.

Kapil, U., N. Saxena, S. Ramachandran and D. Nayar, 1997g. Iodine status of pregnant mothers residing in an iodine deficiency endemic district in the state of Himachal Pradesh, Ind. Asia Pacific J. Clin. Nutr., 3: 224-225.

Kapil, U., S. Ramachandran and M. Tandon, 1998a. Assessment of Iodine Deficiency in Andaman District of Union territory of Andaman and Nicobar. Ind. J. Maternal and Child Health, 9: 19-20.

Kapil, U., N.C. Sharma, S. Ramachandran, D. Nayar and M. Vashisht, 1998b. Iodine deficiency in district Kinnaur, Himachal Pradesh. Ind. J. Pediat., 65: 451-453.

Kapil, U., C. Singh, A. Mathur, S. Ramachandran, D. Nayar, N. Saxena and M. Vashisht, 1998c. Status of Universal Iodisation of Salt Programme in selected districts of Madhya Pradesh state. Indian Practitioner, 51: 111-114.

Kapil, U., R.K.D. Goel, C. Singh and S. Ramachandran, 1998d. Status of iodine Content of Iodised Salt Supplied for Prevention of Iodine Deficiency Disorders at beneficiary level in the state of Punjab. J. Assoc. Physic. Ind., 46: 879-881.

Kapil, U., S. Ramachandran and M. Tandon, 1998e. Assessment of iodine deficiency in Pondicherry. Ind. Pediat., 35: 357-359.

Kapil, U., S.N. Dwivedi, R.S. Raghuvanshi, Khanna Kumud, B.P. Mathur, T.D. Sharma, Beena, S.S. Swami and Seshadri, 1999a. Utility of Spot Testing Kit in the Assessment of Iodine Content of Salt-A Multicentric Study. Technical Report, Shivansh Computers, New Delhi, pp: 1-43.

Kapil, U., M. Tandon and P. Pathak, 1999c. Assessment of iodine deficiency in Ernakulam district, Kerala state. Ind. Pediat., 36: 178-180.

Kapil, U., P. Pathak, C. Singh, M. Tandon, R. Pradhan and S.N. Dwivedi, 1999d. Micronutrient Deficiency Disorders amongst Pregnant women in Urban Slum communities of Delhi. Ind. Pediat., 36: 983-989.

Kapil, U., M. Tandon, R. Pradhan and P. Pathak, 1999e. Status of Iodine deficiency in selected hill districts of Uttar Padesh- A Pilot Study. Ind. J. Maternal and Child Health, 10: 24-27.

Kapil, U., 2000a. Progress made in Elimination of IDD and Possible Impact of Lifting Ban on sale of Non Iodised Salt. J. Academy of Hospital Admin., 12: 33-41.

Kapil, U., M. Tandon and P. Pathak, 2000b. Level of iodine content in iodised salt. Ind. Pediat., 37: 113.

Kapil, U., K.S. Sohal, T.D. Sharma, M. Tandon and P. Pathak, 2000c. Assessment of iodine deficiency disorders using the 30 cluster approach in district Kangra, Himachal Pradesh, Ind. J. Trop. Pediat., 46: 264-266.

Kapil, U., 2000d. Status of urinary iodine excretion in post salt Iodisation phase in selected districts of India. Ind. Pediat., 37: 1282- 1284.

Kapil, U., J.V. Singh, M. Tandon, P. Pathak, C. Singh and R. Yadav, 2000e. Assessment of Iodine Deficiency Disorders in Meerut district, UP, Ind. Asia Pacific J. Clin. Nutr., 9: 99-101.

Kapil, U., M. Tandon, P. Pathak and R. Pradhan, 2001. Assessment of current status of salt Iodisation at the beneficiaries level in selected districts of Uttar Pradesh, India. Ind. Pediat., 38: 654-657.

Kapil, U., P.R. Jayakumar, P. Singh, B. Aneja and P. Pathak, 2002a. Assessment of iodine deficiency in Kottayam district, Kerala State: a pilot study. Asia Pacific J. Clin. Nutr., 11: 33-35.

Kapil, U., P. Singh and P. Pathak, 2002b. Status of iodine nutriture and salt Iodisation in Union Territory of Pondicherry, India. Pak. J. Nutr., 1: 234-235.

Kapil, U., V. Sethi, G. Goindi, P. Pathak and P. Singh, 2003a. Tracking progress towards elimination of Iodine Deficiency Disorders in National Capital Territory of Delhi Ind. J. Pediat., (In Press).

Kapil, U., P. Singh, P. Pathak and S.N. Dwivedi, 2003b. Current Status of Iodine Nutriture and Iodine Content of Salt in Andhra Pradesh. Ind. Pediat., (In press).

Kapil, U., P. Singh and P. Pathak, 2003c. Current Status of Salt Iodisation and Urinary Iodine Excretion levels in Karnataka state, India. Ind. J. Med. Res., (In Press).

Kapil, U., P. Singh, S.N. Dwivedi and P. Pathak, 2003d. Status of Iodine Nutriture and Universal Salt Iodisation at beneficiaries levels in Kerala State, India. J. Ind. Med. Assoc., (In Press).

Kapil, U., P. Singh, S.N. Dwivedi and P. Pathak, 2003e. Profile of Iodine Content of Salt and Urinary Iodine Excretion levels in selected districts of Tamil Nadu. Ind. J. Pediat., (In Press).

Kapil, U., P. Singh, P. Pathak and C. Singh, 2003f. Assessment of Iodine Deficiency Disorders in District Bharatpur, Rajasthan. Ind. Pediat., 40: 147-149.

Kochupillai, N., 1992. Neonatal Hypothyroidism in India. The Mount Sinai J. Med., 59: 111-115.

Markou, K., N. Georgopolous, V. Kyriazopoulou and G.A. Vagenakis, 2001. Iodine induced hypothyroidism. Thyroid, 11: 501-507.

National Institute of Nutrition (NIN), 1987. Annual Report, Indian Council of Medical Research, Avon Printing Works, Hyderabad, pp: 67-68.

Pandav, C.S., C.S. Pandav, N. Kochupillai, M.G. Karmarkar, K. Ramachandran, P.G. Gopinath and L.M. Nath, 1980. Endemic goiter in Delhi. Ind. J. Med. Res., 72: 81-88.

Salt Department, 1996. Universal Salt Iodisation (USI)-India, Progress and Current Status. Salt Department, Ministry of Industry, August, pp: 43.

Salt Department, 2003. Annual Report 2002- 2003. Government of India, Ministry of Commerce and Industry, Department of Industrial Policy and Promotion, Government of India Press, Jaipur, pp: 46.

WHO, 1994. Indicators for assessing Iodine Deficiency Disorders and their control through salt iodization. WHO-UNICEF-ICCIDD. World Health Organisation, Geneva, pp: 12-16.

WHO, 1996. Review of findings from 7-country study in Africa on levels of salt Iodisation in relation to Iodine deficiency disorders, including Iodine Induced Hyperthyroidism. Joint WHO/UNICEF/ICCIDD Consultation. WHO, Geneva, 8-9 July, pp: 27 .

WHO, 2001. Assessment of Iodine Deficiency Disorders and Monitoring their Elimination. A guide for programme managers. Second Edition. ICCIDD/UNCF/WHO.