7. MICRONUTRIENT DEFICIENCIES

Introduction

Goitre due to iodine deficiency, blindness due to Vitamin A deficiency, dry and wet beriberi and pellagra were the major public health problems in pre-independent India. Sustained dietary changes of the population resulted in the elimination of beriberi and pellagra. Keratomalacia due to severe Vitamin A deficiency is no longer a public health problem. However, there has not been any decline in the prevalence of anaemia due to iron and folic acid deficiency; the decline in Vitamin A deficiency and iodine deficiency disorders has been very slow.

In the last five years several major surveys (NNMB, NFHS and DLHS) have been done to obtain data on prevalence of micronutrient deficiencies in India. NNMB carried out a micronutrient survey on preschool children, adolescent girls, pregnant and lacating women in the rural communities in 9 states (2003). Data regarding prevalence of anaemia in adult men is available from the 2006 NNMB survey conducted in rural areas. ICMR carried out a task force study on micronutrient deficiency disorders including anaemia in pregnant women and adolescent girls 16 districts of India (2001). District Level Household Survey (DLHS) carried out haemoglobin estimation in preschool children, adolescent girls and pregnant women in 548 districts in all states. All these surveys had used cyanmethaemoglobin method for haemoglobin estimation. NFHS 2 and 3 also undertook haemoglobin estimation in women in reproductive age group and preschool children using haemocue and improved hemocue methods respectively. Studies from India had shown that hemocue method overestimates Hb and under estimates the prevalence of anaemia. All the surveys also provide information on coverage under IFA supplementation.

All these surveys also provide information on coverage under massive dose vitamin A administration. NNMB surveys provide information on prevalence of Bitots spots in preschool children and goitre in 6-12 year old children. NIN has undertaken vitamin A estimation in a sub sample of children in NNMB states to compute the prevalence of subclinical vitamin A deficiency.

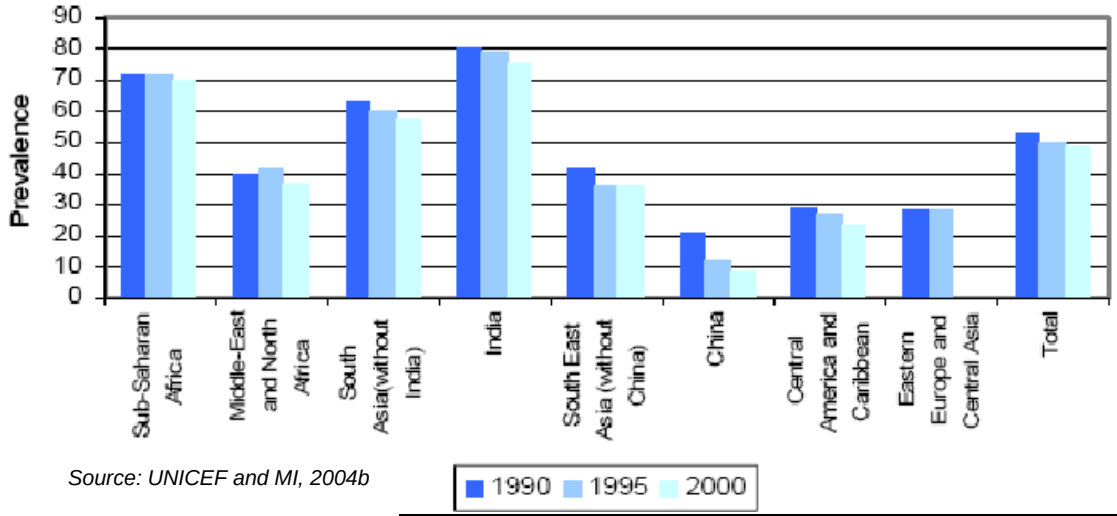
All these surveys provide data on household access to iodised salt. NNMB surveys provide data on goitre prevalence in school children. There are small-scale studies on IDD using urinary excretion of iodine and IQ in children. These provided indepth information on impact of IDD in different time periods.

7.1 ANAEMIA

Prevalence of anaemia

India is among the countries with highest prevalence of anaemia in the world (Figure 7.1.1). As India is a population billionaire, the country accounts for the largest number of anaemic persons in the world (Table 7.1.1). The magnitude of reduction in the prevalence of anaemia during nineties in India is lower than that in neighbouring South and South East Asian countries.

Figure 7.1.1: Trends in prevalence of iron deficiency in preschool children, 1990-2000



Source: UNICEF and MI, 2004b

It is estimated that about 20%-40% of maternal deaths in India are due to anaemia; India contributes to about 50% of global maternal deaths due to anaemia (Table 7.1.1).

Table 7.1.1: Prevalence of Iron Deficiency Anaemia in South Asia (%)

	Children < 5yrs	Women 15-49 yrs	Pregnant women	Maternal deaths from anaemia/yr
Afghanistan	65	61	-	-
Bangladesh	55	36	74	2800
Bhutan	81	55	68	< 100
INDIA	**75**	**51**	**87**	**22000**
Nepal	65	62	63	760
Pakistan	56	59	-	-
S.A region total				25,560
World total				50,000

Source: UNICEF 2003 b: WHO 2000; UNICEF and MI 2004 a

In India, the prevalence of anaemia is high because of

* low dietary intake, poor iron (less than 20 mg /day) and folic acid intake (less than 70 micrograms/day);
* poor bio-availability of iron (3-4 percent only) in phytate fibre-rich Indian diet; and
* chronic blood loss due to infection such as malaria and hookworm infestations

Table 7.1.2: Time trends and interstate differences in intake of iron, folic acid and vitamin C in rural and urban areas (c/day)- NNMB & INP

	NNMB							INP (1995-96)	
	Rural					Urban Slums		Rural	Urban
	1975-79	1988-90	1996-97	2000-01	2004-05	1975-79	1993-94		
Iron (mg)	30.2	28.4	24.9	17.5@	14.8	24.9	18.96	23.2	22.3
Vitamin C	37	37	40	51	44	40	42	55.2	62.4
Folic acid	*	*	153	62	52.3	*	*	*	*

*Source: National Nutrition Monitoring Bureau, India Nutrition Profile @method of estimation different *data not available*
Survey Population: Rural & urban
Sample Size: Rural, 33048 (1975-79), 14391 (1996-97), 30968 (2000-01), 32500 (1975-80), 5447 (1993-94), INP (46457)

Data from NNMB surveys and INP survey show that iron and folic acid intake in all the states of the country is very low (Table 7.1.2- 7.1.4). There has not been any increase in iron intake over the last three decades in any group. The apparent reduction in iron intake in the NNMB surveys 2000-01 and beyond is due to the finding that only 50% of the iron is absorbable. Interstate differences in iron intake are of small magnitude. The low dietary intake of iron and folic acid coupled with poor bioavailability of iron is the major factor responsible for very high prevalence of anaemia in the country.

Criteria used for assessing anaemia are given in Table 7.1.5. Data from NNMB, ICMR and DLHS surveys have shown that prevalence of anaemia is

Table 7.1.3: Time trends in intake of iron (mg / day) in different groups

Age group		1975-79	1996-97	2000-01	2004-05
10-12	B	19	20	12.2	12
	G	18	19	12.1	11.5
13-15	B	21	21	15.4	13.3
	G	20	21	12.9	13
16-17	B	25	26	16.7	16.4
	G	22	22	15.3	13.5
Adult males		26	27	17.5	16.9
Adult females (NPNL)		21	22	14.1	13.8
Pregnant women		20	23	14	14
Lactating women		23	23	14.6	14.7

Source: NNMB reports, 1975-2005

Table 7.1.4: State wise average intake of nutrients (per consumption unit/day)

States	Iron (mg)			Vitamin C (mg)		
	R	U	C	R	U	C
RDA			28			40
Haryana	26			38		
Himachal	23			55		
Punjab	28			38		
Rajasthan	32	25	31	45	51	46
Chandigarh	23	22	22	39	54	52
Delhi	32	21	21	54	57	57
Bihar	22	23	22	58	69	60
Sikkim	21	22	21	65	75	66
Arunachal	21			131		
Assam	12			47		
Manipur	27	26	27	98	124	103
Meghalaya	20	25	20	50	52	50
Mizoram	18	24	19	118	158	126
Nagaland	23			108		
Tripura	26	21	26	71	29	69
Daman & Diu	23			84		
D & N Haveli	23			64		
Goa	19	19	19	44	53	46

C=Combined; R=Rural; U=Urban;
Source India Nutrition Profile 1998

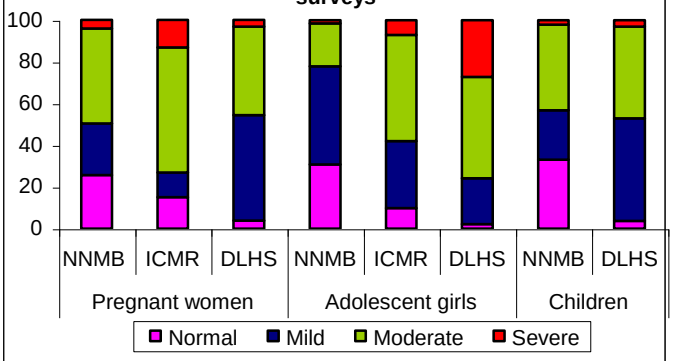
Table 7.1.5: Criteria used for anaemia in DLHS survey

Group		Anaemia (g/dl)		
	Norm	Mild	Mod.	Sev
Preg women Preschooler	≥11	8.0-10.9	5.0-7.9	≤5
Adol girls	≥12	10.0-11.9	8.0-9.9	≤8

Source: DLHS, 2002-03

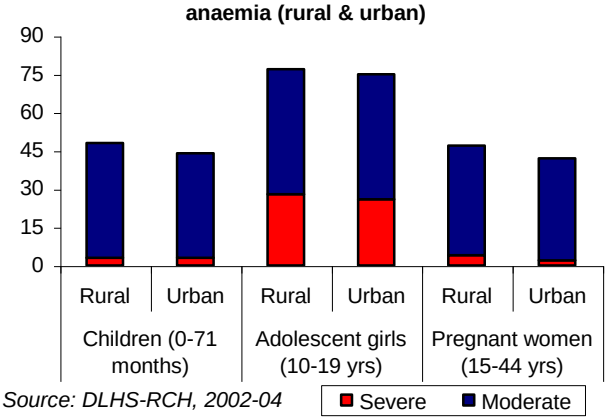
very high (ranging between 80->90%) in preschool children, pregnant and lactating women and adolescent girls (Figure 7.1.2 & 7.1.3). Moderate and severe anaemia is seen even among educated families and the higher income group (Figure 7.1.4 & 7.1.5). NNMB survey in 2006 showed that 55% of the adult men also suffer from anaemia (Figure 7.1.6). Interstate differences in prevalence of anaemia in children, pregnant women and adolescent girls from DLHS survey are presented in Annexure 7.1.1, 7.1.2 and 7.1.3. Prevalence of anaemia is high in all the states; however, there are considerable variations between states in prevalence of moderate and severe anaemia.

Figure 7.1.2: Prevalence of anaemia in children, adolescent girls and pregnant women from 3 surveys



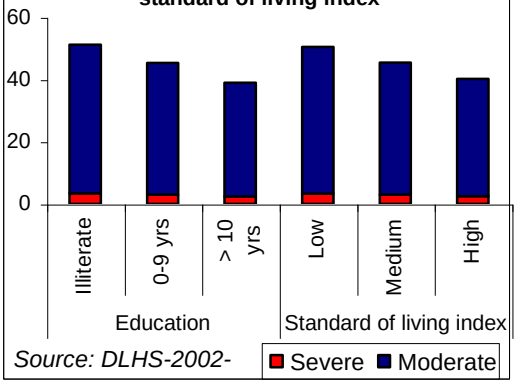
Source: NNMB-MND2003, ICMR 2001, DLHS-RCH 2002-04

Figure 7.1.3: Percentage of severe and moderate anaemia (rural & urban)



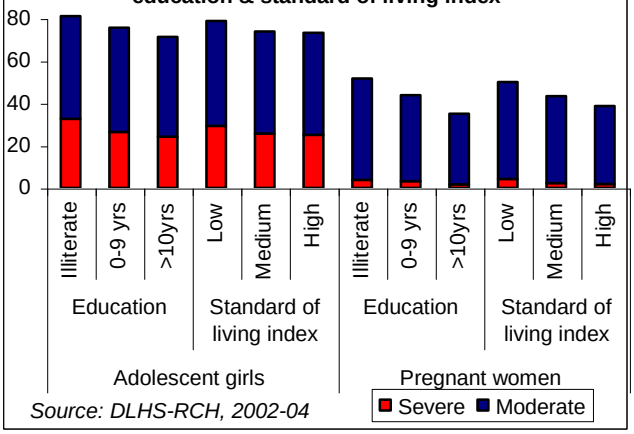
Source: DLHS-RCH, 2002-04

Figure 7.1.4: Prevalence of anaemia in children by mothers education & standard of living index



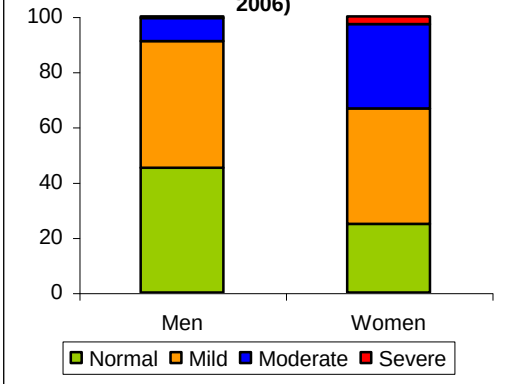
Source: DLHS-2002-

Figure 7.1.5: Prevalence of anaemia in adolescent girls & pregnant women by education & standard of living index



Source: DLHS-RCH, 2002-04

Figure 7.1.6: Prevalence of anaemia among adult men & women (NNMB, 2006)



Source: NNMB, 2006

Adverse health consequences of anaemia

Anaemia is associated with increased susceptibility to infections, reduction in work capacity and poor concentration. Anaemia remains to be major cause of maternal mortality and low birth weight in India. Pregnant women with Hb less than 8 g/dl show functional decompensation and constitute a high-risk group (Table 7.1.6).

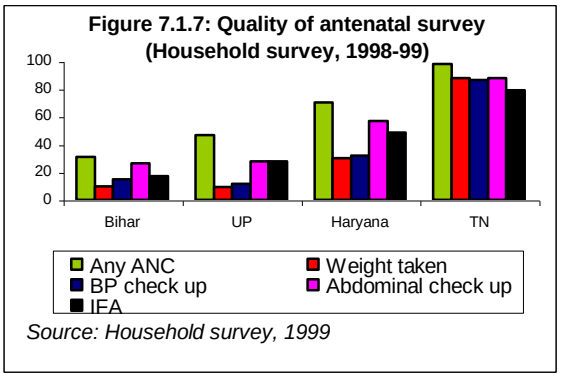
Table 7.1.6: Effect of maternal haemoglobin level on birth weight and perinatal mortality

	Haemoglobin gm/decilitre (g/dl)			
Effects on	<5	5 - 7.9	8 - 10.9	11.0
Mean birth weight (g)	2,400	2,530	2,660	2,710
Perinatal mortality rate/1000	500	174	76	55
Number of observations	312	362	1015	1456

Source: Prema et al, 1981

National Anaemia Prophylaxis Programme (NAPP)

India was the first developing country to take up a National Nutritional Anaemia Prophylaxis Programme of iron folic acid supplementation to all pregnant women and children to prevent anaemia among pregnant women and children. Screening for anaemia and iron-folate therapy in appropriate doses and route of administration for the prevention and management of anaemia in these vulnerable groups have been incorporated as an essential component of antenatal care and paediatric practice. In spite of all these efforts anaemia continues to be a major problem affecting all segments of the population and there has not been any substantial decline in the adverse consequences of anaemia.

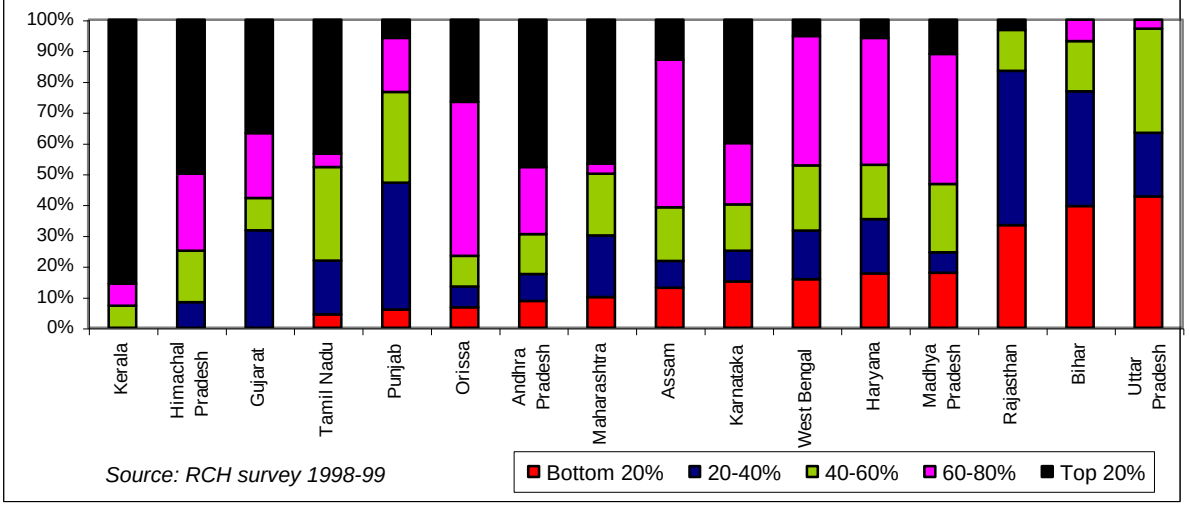


Source: Household survey, 1999

The NAPP was revamped in the nineties and named as National Anaemia Control Programme (NACP). The NACP envisaged screening of all pregnant women for anaemia and providing appropriate doses of iron folate therapy to anaemic pregnant women. RCH survey (1998-99) showed that screening for anaemia has not been operationalised as a part of the RCH programme (Figure 7.1.7). RCH and NNMB surveys have shown that coverage under IFA supplementation was low (Figure 7.1.8)(Annexure 7.1.4 & 7.1.5). Data from smaller indepth studies showed that even among those who received the tablets, only one-third took them regularly. Data from ICMR evaluation of NNAP showed that majority of pregnant women did not receive IFA tablets. Among those who received IFA tablets less than 10% took more than 90 tablets of IFA during pregnancy. Mean Hb even in the small group of women who took 90 tablets was only 9.1 g/dl

(Table 7.1.7). These data clearly indicate the need for screening all pregnant women for anaemia and provide appropriate doses of IFA to non-anaemic and mildly anaemic women. Unlike the situation elsewhere in the world, oral iron therapy is not effective in correction of moderate or severe anaemia in Indian pregnant women, within the short time available because of the poor bioavailability of iron in the Indian diet. Women with moderate anaemia respond well to IM iron therapy.

Figure 7.1.8: Distribution of Districts as per 1 or 2 IFA Tablets regularly-Major States



Source: RCH survey 1998-99

Anaemia in children

Data from DLHS indicates that the prevalence of anaemia in preschool continues to be very high in all states but there are substantial differences in the prevalence of moderate and severe anaemia between states (Annexure 7.1.3). Anaemia contributes to poor scholastic performance and increased susceptibility to infection. Pre-school children were one of the target groups to receive IFA tablets under the National Nutritional Anaemia Prophylaxis Programme. But both access to and intake of IFA tablets by children have been very poor; as a result there has been very little impact in terms of reduction in anaemia in childhood. Neither the RCH nor the school-based programmes have operationalised the programmes for detection and treatment of anaemia in children in the country.

Table 7.1.7: Mean Hb in Pregnant women taking Iron Supplementation

No of tablets ingested	No.	Hb (g/dl)	
		Mean	S.D
1-15	310	8.8	1.7
16-30	251	9.2	1.5
31-60	196	9.3	1.8
61-90	99	9.2	1.6
>90	74	9.1	2.1
Total who had IFA	930	9.1	2.2
B. Not known	16	9.1	2.6
C. Not had IFA	3829	9.1	3.8
A+B+C	4775	9.1	3.5

Source: Evaluation of NNAPP- ICMR

The major intervention strategies envisaged in the Tenth Five Year plan for prevention and management of anaemia are:

* improve dietary intake to meet RDA for all macro and micronutrients;
* dietary diversification ensuring inclusion of iron folate rich foods as well as food items that promote iron absorption;
* food fortification, especially introduction of iron and iodine-fortified salt
* health and nutrition education to improve over all dietary intakes and promote consumption of iron and folate-rich foodstuffs; and
* screening for early detection of anaemia among vulnerable groups (such as pregnant women).
* appropriate management of anaemia depending upon its severity, chronicity, physiological status of the individual and the time available for correction of anaemia

Tenth Plan goals were: -

* Screening of children for anaemia wherever required and appropriate treatment of those found anaemic.
* Universal screening of pregnant women for anaemia and appropriate treatment
* Reducing the prevalence of anaemia by 25 per cent in children, pregnant and lactating women and adolescents.

Some of the strategies suggested in the Tenth Five Year Plan have been operationalised in some institutions (screening for anaemia during pregnancy- Delhi) and states (double fortified salt supply through PDS- Chattisgarh and DFS in ICDS food supplementation in Uttarakhand). However, the integrated package of all interventions has not been operationalised in any state. As a result, goals set have not been achieved. It is hoped that the package of interventions will be fully operationalised in the Eleventh Plan so that the goals set in Tenth plan could be achieved by 2012.

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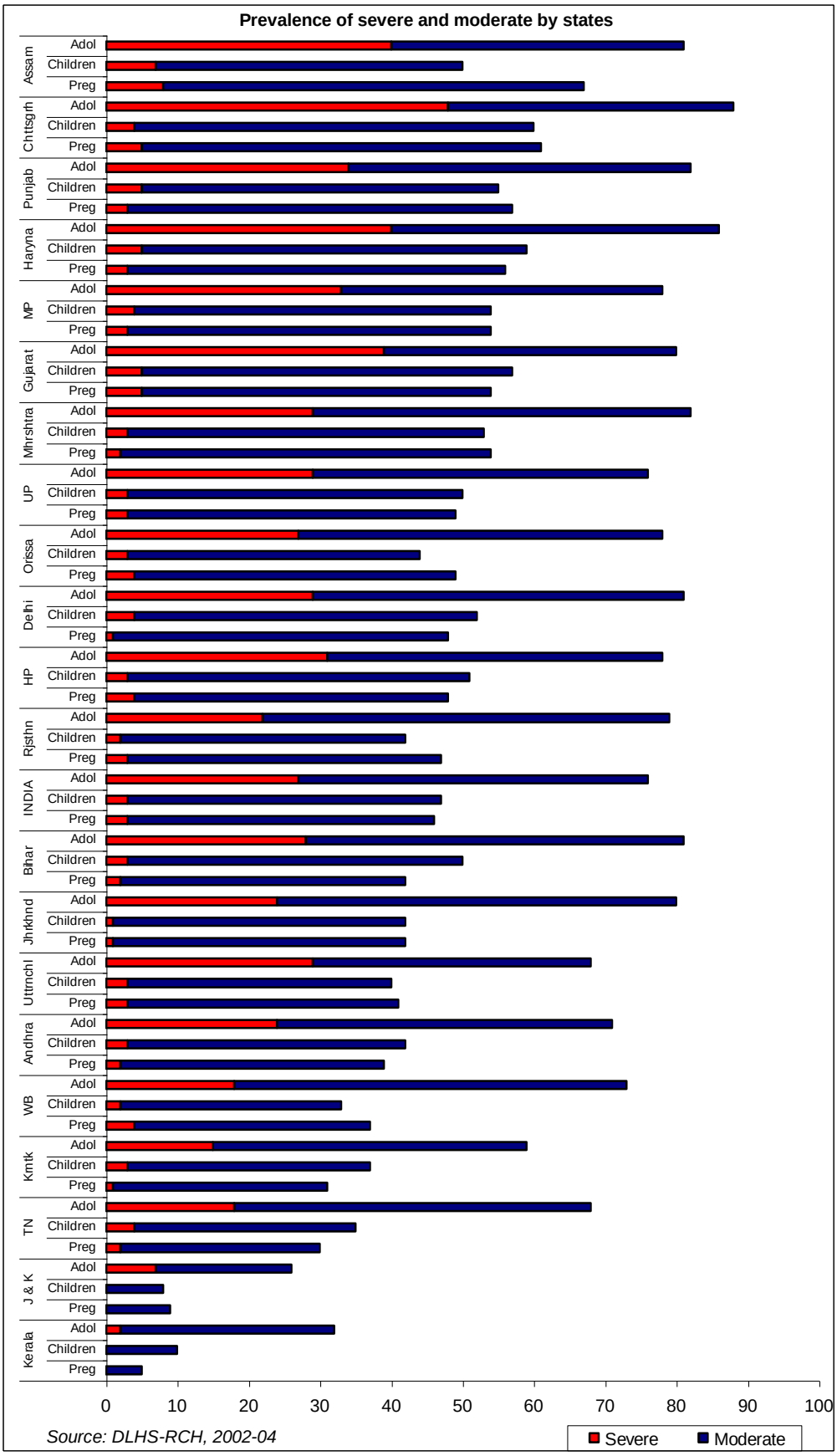
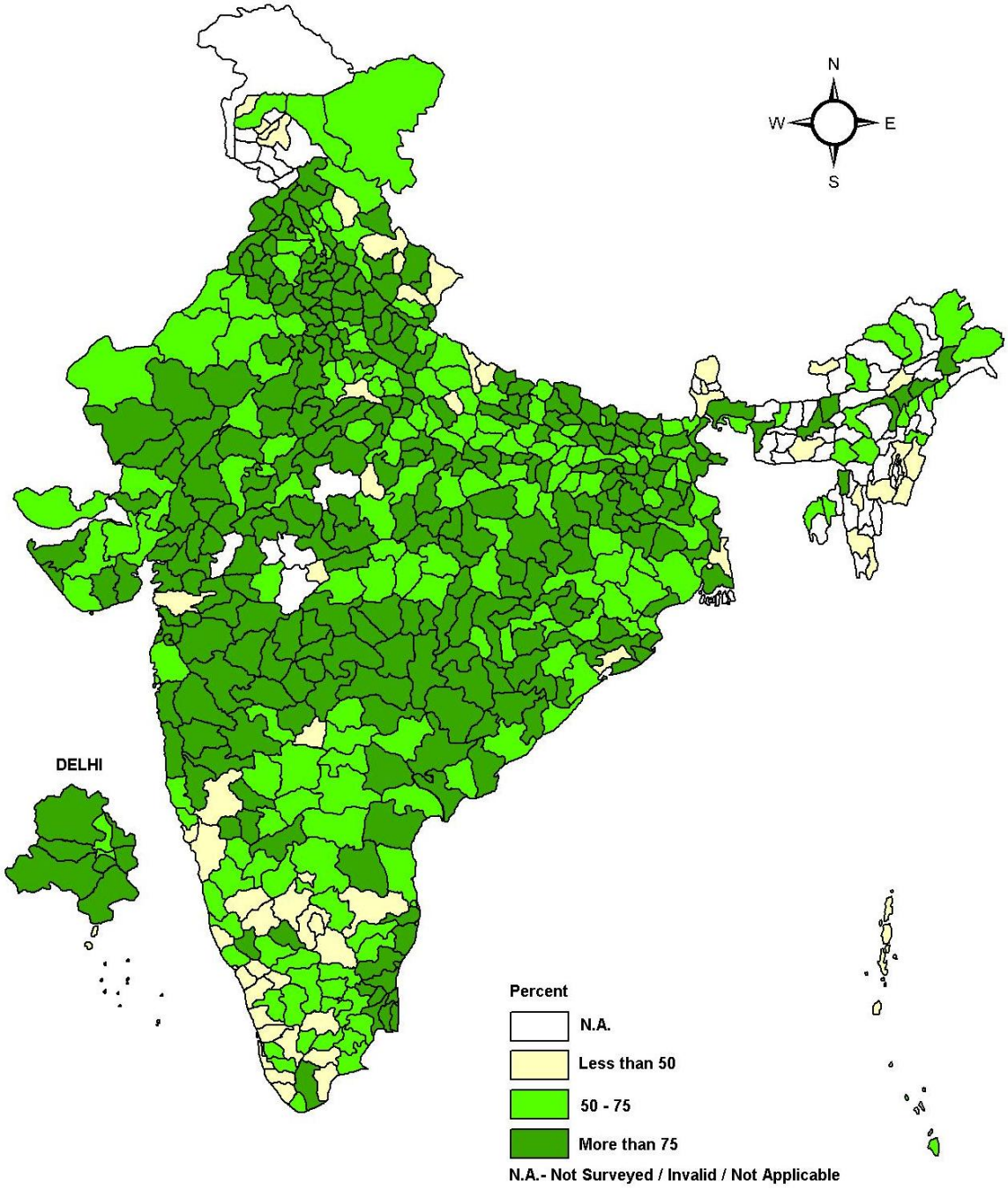
Annexure 7.1.1

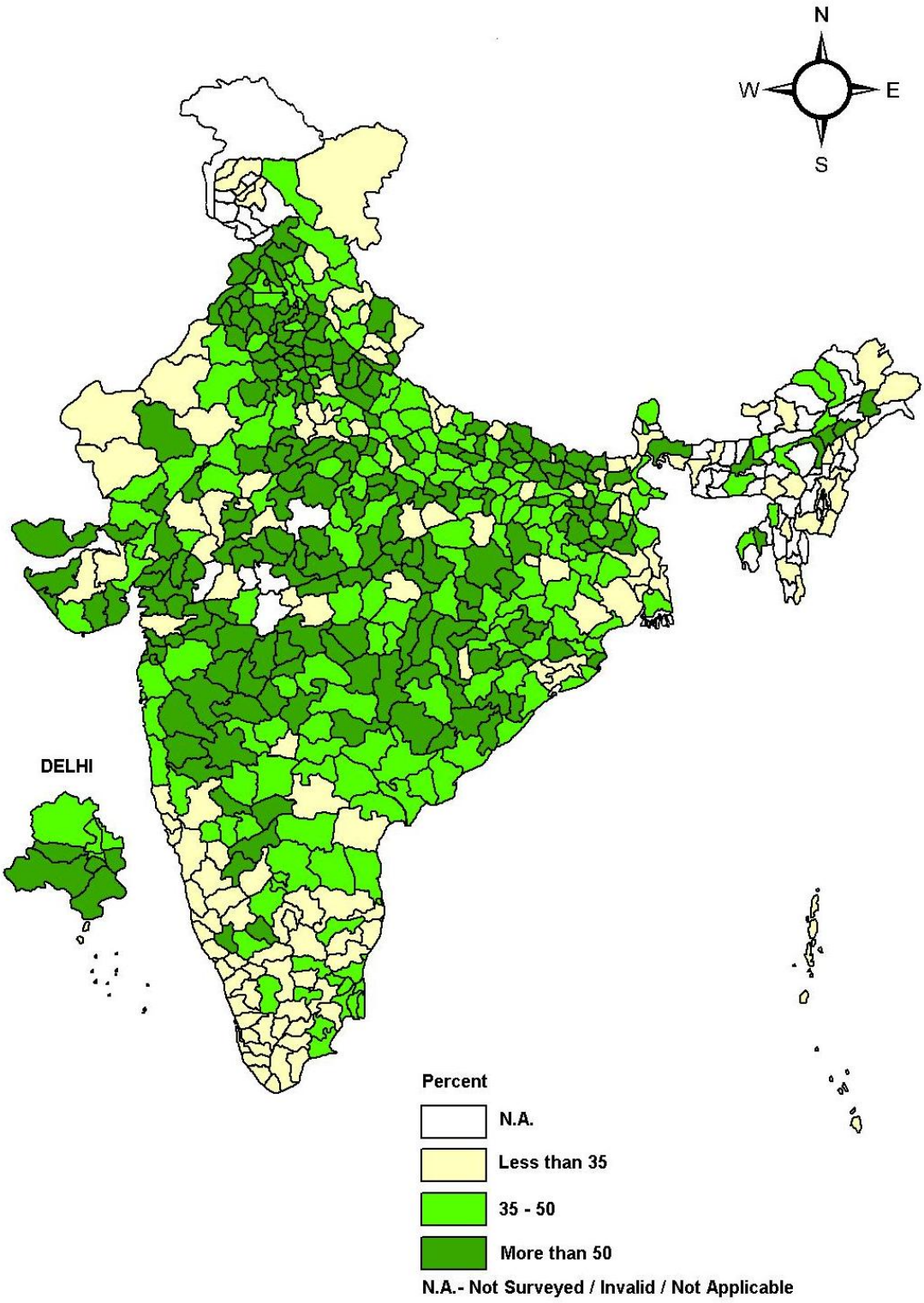


Annexure 7.1.2

Percentage of adolescent girls with moderate and severe anaemia by District, 2002-04



Percentage of children with moderate and severe anaemia by District, 2002-04



Annexure 7.1.4

NNMB 2002 Distribution (%) of pregnant women according to receipt of IFA tablets

Particulars	States								
	Kerala	Tamil Nadu	Karnataka	Andhra Pradesh	Mahara-shtra	Madhya Pradesh	Orissa	West Bengal	Pooled
N	143	258	284	330	299	212	269	187	**1982**
Received IFA tablet	38.5	62.4	68	48.5	77.3	54.2	72.9	70.6	**62.7**
IFA tablets distributed by									
AWW	3.5	1.6	3.2	6.4	2	9.9	24.9	4.8	**7.2**
MPHW (F)	5.6	41.5	29.6	38.5	60.9	41.5	43.1	20.9	**37.9**
MPHS (F)	0	2.3	24.6	1.8	1.7	2.4	0	43.3	**8.7**
MO-PHC	21	8.9	9.5	1.5	8.4	0.5	4.1	1.1	**6.3**
Others	8.4	8.1	1.1	0.3	4.3	0	0.7	0.5	**2.7**
Place of distribution of IFA Tablets									
Home	3.5	5	27.5	13.9	10.4	6.6	26	2.7	**13.2**
AWC	1.4	7.8	9.2	12.4	20.1	32.5	16	4.3	**13.6**
Sub-Centre	2.8	31	11.6	13.6	22.1	11.8	13	62.6	**20.4**
PHC	21.7	10.9	17.6	7.3	19.4	1.9	11.2	0.5	**11.4**
Others	9.1	7.8	2.1	1.2	5.3	1.4	6.7	0.5	**4.1**
Frequency of supply of IFA tablets									
Weekly	1.4	1.6	1.1	2.1	1	0	0.4	0	**1.1**
Fortnightly	0.7	1.6	1.8	2.7	6.7	0	0.4	1.6	**2.2**
Monthly	21.7	34.9	46.8	30.6	37.5	26.4	12.6	68.4	**34.6**
At a time	7	24	12.7	12.1	23.7	26.4	58.7	0.5	**21.9**
Irregular	7.7	0.4	5.6	0.9	8.4	1.4	0.7	0	**3.1**
No. of IFA Tablets received each time									
10	1.4	2.3	1.1	1.8	1	0	0.4	0	**1.1**
20	0	1.9	2.1	2.4	3.7	0.5	0.4	1.6	**1.8**
30-60	22.4	41.1	48.6	32.4	51.7	30.7	21.5	68.4	**40**
61-90	7	16.3	10.6	10	14.7	18.4	48	0.5	**16.6**
>90	7.7	0.8	5.7	0.9	3.4	4.7	2.6	0	**3**

Annexure 7.1.4

Distribution (%) of Pregnant women according to number of IFA tablets received

Particulars	States								
	Kerala	Tamil Nadu	Karnataka	Andhra Pradesh	Mahara shtra	Madhya Pradesh	Orissa	West Bengal	**Pooled**
N	**143**	**258**	**284**	**330**	**299**	**212**	**269**	**187**	**1982**
Received IFA tablet	38.5	62.4	68	48.5	77.3	54.2	72.9	70.6	62.7
Total number of IFA Tablets received									
10-30	1.4	5.5	1.5	4.2	2.7	0.5	0.8	1.1	2.5
30-59	10.5	24.1	11.4	13.6	23.8	14.3	17.5	27.8	17.9
60-89	8.4	10.9	15.3	16.1	16.4	7.1	3.7	24.1	13.0
>90	18.2	22.1	40.2	14.5	34.1	34.5	50.9	17.6	29.8