Prevalence of Iron-Deficiency Anaemia in India: Results from a Large Nationwide Survey

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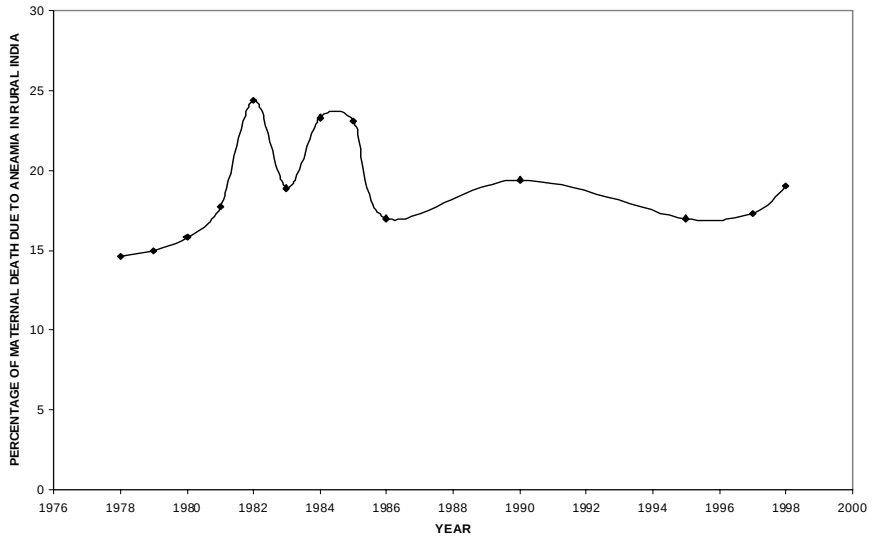
An Overview

Worldwide, Iron-deficiency anaemia is a significant problem and especially in developing countries it is widespread yet the most neglected micronutrient deficiency disorder among children, adolescence girls, and pregnant women. Iron-deficiency anaemia suppresses human productivity. Although a moderate degree of anaemia may not affect every day work, it has massive impact on those engaged in heavy physical activities. The consequences of anaemia among women include reduced energy and capacity for work and poor pregnancy outcome that further enhances maternal mortality (Levin *et al.*, 1993). It is estimated that almost twenty percent of maternal deaths are directly caused by anaemia and causes of another fifty percent of maternal deaths are associated with anaemia in the world (Gillespie, Kevany and Mason, 1991). India is one of the countries with the largest prevalence of anaemia.

Weakness is assumed to be a normal condition during pregnancy and majority of Indian women do not seek treatment for anaemia unless symptoms become severe. Anaemia is attributed to dietary inadequacy due to poor purchasing power, illiteracy, ignorance regarding nutritional value of available cheap food, cultural taboos, superstition, large families etc. (Rao, 1978). In a society where the status of women is poor, women face both covert and overt discrimination within family. Women in India follow the custom of 'eating last' or eating only the food left over after the meals of male members of the family. Nearly 50-80 percent of mothers suffer from anaemia due to iron-deficiency in their diet. Puerperal morbidity is higher among women with hemoglobin (Hb) level below 6.5g/dl compared to women with normal Hb level (United Nations Children Fund-UNICEF-1984). Anaemia is not confined to pregnant women alone but also has effect on other population in the society. For infants, it is caused due to combination of limited iron stores at birth, timing of umbilical cord clamping, timing

and type of complementary food intake and frequency of childhood illness. About 30-40 percent of newborn suffer from low birth weight due to maternal anaemia and malnutrition (Park and Park, 1985). Low level of Hb among children enhances morbidity from various infections, especially children aged between 6-24 months (Stolzfus and Dreyfuss, 1998). Therefore, there is '*Double Burden*' in the society caused by anaemic mother and anaemic children. Moreover, girl children are more prone to severe anaemia than their male counterpart, because with increasing age, the prevalence of anaemia declines among males (Swami, Thakur and Bhatia, 1998). The Hellen Kellar Institute for girls (1996) estimated that 83.9 percent girls of age between 12 and18 years in rural India were found to be anaemic; the level is high among girls with no schooling (92.7 percent). Adolescent girls require continuous replacement of iron during menstruation (Brabin and Brabin, 1992). There is the '*vicious cycle of anaemia'* for women in India since girls are married and enter motherhood with poor iron status at very young ages. Anaemia present from the childhood through adolescence aggravates during pregnancy causing maternal morbidity and premature birth of low birth weight baby (Figure 1).

Figure1
Trends in Maternal Deaths in Rural India Due to Anaemia



Source: India, Registrar General. Several years.

Other than clinical factors, there are many other factors attributed as the causes of anaemia in India. An analysis of the National Family Health Survey-2 data for Gujarat showed that the prevalence rate is high among children with illiterate mother, low standard of living, working mother, belonging to Scheduled Caste (SC) and whose mothers are also anaemic (Krishna Mohan, 2003). It is well recognised that unregulated fertility is associated with anaemia; moreover, health hazard increases sharply after the fourth pregnancy. Though anaemia is widely prevalent among women belonging to lower socio-economic strata of the society, it is not rare among the well-to-do classes of the society.

The National Nutrional Anaemia Prophylaxis Programme (NNAPP) was launched in 1972 during the 4th five year plan in India with the aim to curb the prevalence of anaemia. One of the largest nutritional supplement programmes, the Integrated Child Development Services (ICDS) scheme was initiated in 1975 in India to provide nutritious food to pregnant women and children. Further, in 1991, the Government of India introduced policies to control nutritional anaemia through promotion of iron rich food (green leafy vegetables: mustard leaves, bengal gram leaves, clocasia leaves etc., *shepu* or *sowa*, cereals: wheats, *ragi*, *jawar*, *bajara*, pulses: sprouted pulses, and jaggery), provision of iron and folate supplements to high risk groups (all pregnant and lactating women, Intra-Uterine Device (IUD) users, and children between 1-5 years), and identification and treatment to severely anaemic people. The recently launched National Rural Health Mission (NRHM), 2005, undertakes programme once in a month in villages to educate mothers on health and nutrition. In spite of the fact that the Health and Family Welfare Department in India has policies to provide iron supplement to pregnant women to prevent maternal anemia, evaluation from large scale programmes shows that maternal anaemia has not declined significantly. Some plausible reasons are the side effects of the iron pills and also improper utilization of health service and personal beliefs (Fox, 1983; Galloway and Mcguire, 1994).

Objective of the Study

The available evidence clearly shows that anaemia is very widely prevalent in India. However, the degree of severity varies across socio-economic classes. Therefore, this paper seeks to assess the influences of socio-economic and demographic factors on degree of anaemia. This analysis focuses on children (age 0-71 months), adolescent girls (age 10-19 years) and pregnant women.

Data and Methods

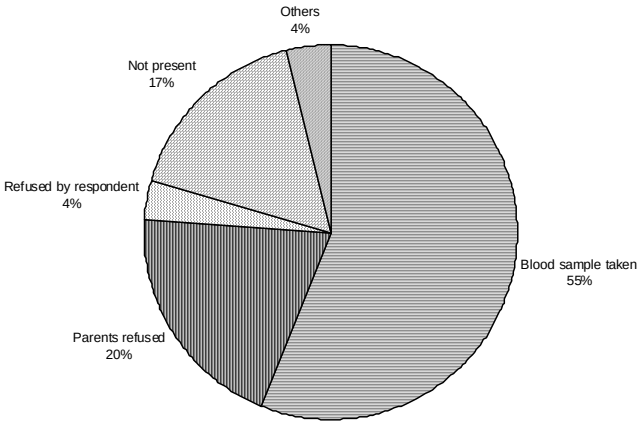
The data for the analysis are taken from the District Level Household Survey under the Reproductive and Child Health programme (DLHS-RCH), 2002-04, conducted by the International Institute for Population Sciences (IIPS), Mumbai in India. The survey covered 620,107 households in the country and contained information on various aspects of reproductive and child health of the residents by interviewing women of reproductive age. Besides, blood samples from all children below six years of age (0-71 months), adolescent girls (10-19 years of age: irrespective of marital status and who were not pregnant at the time of survey), and pregnant women (15-44 years) from selected households were sought to be collected. Information on socio-economic background like place of residence, religion, caste, educational level of woman, household standard of living etc. of the households and respondents was also collected.

A total of 430, 626 children, 311, 793 adolescents, and 41, 112 pregnant women were contacted for obtaining blood samples. The collection of blood samples was done only after an informed consent (from the person and in case of minors, from parent or guardians) was obtained. As expected, there were some refusals and blood samples could be obtained for 56.1 percent children, 58.1 percent adolescent girls, and 58.2 percent of pregnant women in the sample (Figure 2).

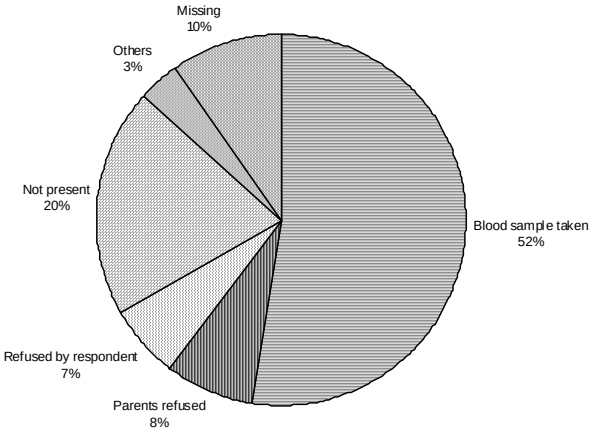
Figure 2

Response Rate of Blood Examination for Anaemia in DLHS-RCH, 2002-04

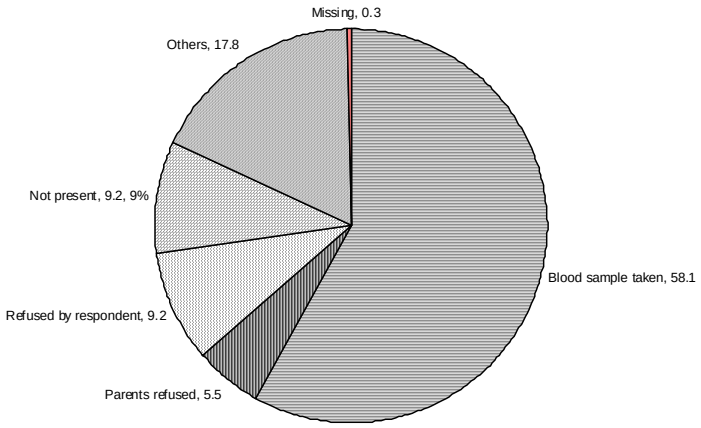
Children (0-71 Months)



Adolescents Girls (10-19 Years)



Pregnant Women (15-44 Years)



***Source**:* Computed from DLHS-RCH, 2002-04 data files.

In principle, non-response could bring in a bias in the results. This would be particularly true if the non-response is selective. In order to see if this is the case, response rates are computed for various socio-economic and demographic groups. These show that in most cases, the response rate is in the range of 50 to 60 percent (Table 1). All socio-economic and demographic variables show only minor variations. Religion, other than Hindu has a lower response rate but the gap is only about 10 points. The only notable departure is seen for children whose mother was not interviewed. Thus, though there is considerable non response for blood samples, it does not appear to be selective and hence, the data have been used for further analysis on anaemia except for 22, 430 children whose mother was not interviewed.

Table 1: Percent of Response of Blood Sample Taken by Selected Background Characteristics in India

Background Characteristics	Children (0-71 Months)		Adolescent Girls (10-19 Years)		Pregnant Women (15-44 Years)	
	Response Rate	Number of Children	Response Rate	Number of Adolescent Girls	Response Rate	Number of Pregnant Women
Residence						
Rural	57.5	308,974	58.5	208,467	58.8	29,904
Urban	52.6	121,652	57.2	103,326	56.7	11,208
Religion						
Hindu	58.5	336,002	60.2	238,712	60.1	32,462
Muslim	48.0	58,984	52.8	44,164	51.2	5,473
Others	47.6	35,593	49.1	28,898	51.3	3,176
Caste						
OBC	56.5	173,279	59.1	120,334	58.5	16,814
SC/ST	57.0	142,454	56.1	97,759	59.7	13,761
Others	54.4	114,845	58.9	93,681	55.8	10,536
Mother's Education						
Non-literate	61.7	190,622	51.7	59,860	57.2	20,221
0-5 years of schooling †	62.2	43,420	59.0	93,951	60.7	5,067
6-10 years of schooling	60.3	90,767	60.3	134,004	60.1	11,358
11 + years of schooling	55.8	33,844	58.1	23,964	55.6	4,439
Mother not interviewed	32.5	71,770	na	na	na	na
Standard of Living						
Low	56.8	219,602	56.4	137,441	58.0	20,597
Medium	56.7	128,569	59.7	100,633	60.3	12,585
High	53.6	82,408	59.0	73,719	55.5	7,930
Sex of the Child						
Male	56.2	223,779	na	na	na	na
Female	56.2	205,747	na	na	na	na
Age of Child (Months)						
0-11	45.4	72,231	na	na	na	na
12-23	56.6	64,138	na	na	na	na
24-47	58.9	140,567	na	na	na	na
48-71	58.5	153,690	na	na	na	na

Table 1: (Continued)

Background Characteristics	Children (0-71 Months)		Adolescent Girls (10-19 Years)		Pregnant Women (15-44 Years)	
	Response Rate	Number of Children	Response Rate	Number of Adolescent Girls	Response Rate	Number of Pregnant Women
Age of Mother/Girl/Woman (Years)						
10-14	na	na	59.4	169,838	na	na
15-19	57.9	18,837	56.5	141,955	60.9	8,141
20-24	61.7	109,063	na	na	59.8	17,045
25-29	61.4	123,895	na	na	57.1	9,857
30-34	60.5	67,393	na	na	53.7	4,033
35 +	58.7	39,668	na	na	48.4	2,036
Mother not interviewed	32.5	71,770	na	na	na	na
Marital Status						
Not currently married	na	na	59.5	283,361	na	na
Currently married	na	na	43.5	28,387	na	na
Birth Order						
1	58.8	108,359	na	na	na	na
2	61.1	97,111	na	na	na	na
3	61.8	64,258	na	na	na	na
4 +	60.1	98,327	na	na	na	na
Mother not interviewed	31.7	62,571	na	na	na	na
Parity						
No child	na	na	na	na	58.8	13,101
1	na	na	na	na	60.4	10,927
2-3	na	na	na	na	58.1	11,046
4 +	na	na	na	na	53.4	6,038
Total	**56.1**	**430,626**	**58.1**	**311,793**	**58.2**	**41,112**

Source: Computed from DLHS-RCH, 2002-04 data file.

na: Not Applicable.

†: Literate mothers or adolescent or woman with no schooling are also included.

Note: 1. Total number may not add up to total sample size due to do not know and missing case.

2. Included only valid cases.

Data Quality

The survey data examined the hemoglobin level among the study groups. It shows that there were some data entry errors in the data files since some values appeared to be outside the range of the plausible levels (Table 2). It is well recognised that a person with Hb level of zero can not survive; similarly more than 20g/dl Hb level in blood is considered as fatal (Winslow and Monge, 1987; Firkin *et al*., 1989). Therefore, the present paper considers only the hemoglobin level of the respondent more than zero and less than 20.0 g/dl for the analyses. The survey used the cut-off levels of hemoglobin for reckoning the degree of anaemia among the study population according to the UNICEF recommendation (IIPS, 2006).

Table 2: Hemoglobin Level among the Study Population

Hemoglobin Level	Number of Population in Study Groups		
	Children (0-71 months)	**Adolescent Women (10-19 years)**	**Pregnant Women (15-44 years)**
Zero g/dl	185	121	23
More than zero-20.0 g/dl	**215800 (89.3)**	**164750 (91.0)**	**21233 (88.7)**
More than 20.0 g/dl	24729	16103	2666
Missing cases	1011	138	15
Total	**241725**	**181112**	**23937**

Source: Computed from DLHS-RCH, 2002-04 data files.

According to the UNICEF classification, children are considered as mildly anaemic if the Hb level in blood is between 8.0 and 10.99 g/dl. Similarly, with 10.0 to 11.99 g/dl among adolescent girls and 8.0-10.99 g/dl Hb level among pregnant women are considered as mildly anaemic. If the Hb level has dropped below 5.0 g/dl among children, 8.0 g/dl among adolescent girls, and 5.0 among pregnant women, they are considered to be severely anaemic (for reference, see Table 3). The Hb level between

mild and severe anaemia is denoted as moderate anaemia. The present study also follows the same system of classification to categorise the degree of anaemia in the study groups.

Table 3: Level of Hemoglobin for Anaemia According UNICEF

Anaemia Level	Hemoglobin Level		
	Children	Adolescent Girls	Pregnant Women
Mild	8.0-10.99 g/dl	10.0-11.99 g/dl	8.0-10.99 g/dl
Moderate	5.0-7.99 g/dl	8.0-9.99 g/dl	5.0-7.99 g/dl
Severe	Below 5.0 g/dl	Below 8.0 g/dl	Below 5.0 g/dl

Source: IIPS, 2006.

The prevalence of anaemia level has been calculated across different socio-economic classes for each study group on the basis of records with valid hemoglobin level. There are three levels of anaemia: mild, moderate, and severe, along with people who are living with normal hemoglobin level. Normally for dichotomous dependent variable, logistic regression model is used and in case of polytomy, multinomial logistic model is used. In this case, the categories for anaemia status are not merely 'nominal' but 'ordinal', since they represent degree of anaemia: no anaemia, mild, moderate, and severe anaemia. The factors under consideration could influence the degree and hence one should be able to see to what extent a particular factor raises or lowers the degree of anaemia. In such a situation, the ordinal logistic regression model is more appropriate than the multinomial logit and hence was applied to examine the net effect of socio-economic and demographic factors on degree of anaemia. The degrees are ordered as: no anaemia, mild anaemia, moderate anaemia, and severe anaemia. A positive coefficient to an explanatory variable implies that a rise in it raises the degree of anaemia.

Limitation of the Study

The data did not provide any information on food intake of respondents at the time of the survey, and therefore hemoglobin level of the population could not be correlated directly with the dietary regime. The study was confined among the selected groups; Though it is recognised that menopausal women are also have high risk of anaemia due to heavy bleeding which limits their social and physical activities (Daffary, 1993), blood samples from this section of women were not collected during the survey, and hence this group could not be studied.

Results and Discussion

Prevalence of anemia is very high among all the study population in India. The results show that more than 95 percent of children, adolescent girls and pregnant women suffer from anaemia. The prevalence is the highest among the adolescents, 97.8 percent. Nearly half of the children are mildly anaemic and 2.9 percent are severely anaemic. More than half of the pregnant women in the country are mildly anaemic and 42.6 percent are moderately anaemic. The situation is the worst for adolescent girls, 27.1 percent of whom are severely anaemic.

Place of residence and sex of the child shows marginal difference in different degrees of anaemia level among children in India (Table 4). The percentage of severely anaemic children declines with increase in mother's educational level, standard of living, age of the mother. Severe anaemia is found to be the highest among children aged between 12 and 23 months. Overall, nearly half of children in the country are either moderately or severely anaemic. This rate is high among children with Scheduled Caste/ Scheduled Tribe (SC/ST) membership, with high birth order, adolescent mother, low standard of living, and among infants.

Table 4: Prevalence of Iron-Deficiency Anaemia among Children (age 0-71 months) by Selected Background Characteristics, India

Background Characteristics	Percentage of Children with Levels of Anaemia		Percentage of Children with any Anaemia	Number of Children
	Severe	Moderate or Severe		
Residence				
Rural	3.0	49.1	96.9	141,483
Urban	2.7	44.9	96.6	51,887
Religion				
Hindu	3.1	49.1	97.0	156,688
Muslim	2.5	44.4	96.4	22,943
Others	2.3	38.6	94.5	13,739
Caste				
OBC	3.0	48.0	96.6	78,975
SC/ST	3.5	53.5	97.8	64,129
Others	2.4	42.7	96.3	50,266
Mother's Education				
Non-literate	3.3	52.2	97.4	103,662
0-5 years of schooling†	2.6	46.8	96.9	23,895
6-10 years of schooling	2.6	43.1	96.2	48,903
11 + years of schooling	2.2	37.7	95.1	16,910
Standard of Living				
Low	3.2	51.7	97.4	98,009
Medium	2.8	45.9	96.7	59,280
High	2.5	40.0	95.4	36,081
Age of Mother (Years)				
15-19	3.9	57.8	98.4	9,532
20-24	3.0	50.0	97.2	59,426
25-29	2.8	46.2	96.7	67,694
30-34	2.8	45.4	96.3	36,142
35 +	2.9	46.0	96.0	20,576
Sex of the Child				
Male	3.0	47.3	96.7	100,958
Female	2.9	48.7	97.0	92,364
Age of Child (Months)				
0-11	3.9	58.3	97.6	26,401
12-23	4.1	61.3	98.1	29,607
24-47	3.2	49.6	97.2	66,455
48-71	1.9	36.9	95.7	70,907
Birth Order				
1	2.7	44.5	96.5	55,268
2	2.9	46.7	96.7	52,003
3	3.0	49.0	96.9	34,808
4 +	3.2	52.0	97.2	51,291
Total	**2.9**	**47.9**	**96.8**	**193,370**

Source: Computed from DLHS-RCH, 2002-04 data files.
†: Literate adolescent with no schooling are also included.

Note: 1. Children with mothers not interviewed are not included in the analysis.
2. Total number may not add up to total sample size due to do not know and missing case.
3. The percentages are computed after applying survey sample weights and the numbers are given is unweighted.

Table 5 shows that there are 97.8 percent adolescent girls are suffering from anaemia in the country. Severe anaemia declines with increase in educational level from 32.8 percent among illiterate to 22.6 percent among adolescent girls with 11 and above years of schooling. Similarly, increase in household standard of living also shows gradual decline in anaemia level among adolescent girls in the country. More than seventy percent of adolescent girls suffered either moderate or severe anaemia. The prevalence of moderate or severe anaemia is high among girls with low standard of living, belong to Hindu religion; SC/ST membership and illiteracy.

Table 5: Prevalence of Iron-Deficiency Anaemia among Adolescent Girls (age 10-19 years) by Selected Background Characteristics, India

Background Characteristics	Percentage of Adolescent Girls with Levels of Anaemia		Percentage of Adolescent Girls with any Anaemia	Number of Adolescent Girls
	Severe	Moderate or Severe		
Residence				
Rural	27.0	75.6	97.9	111,046
Urban	24.5	73.5	97.9	53,704
Religion				
Hindu	26.8	75.9	98.1	130,418
Muslim	24.0	71.9	97.5	21,599
Others	20.8	64.8	95.4	12,724
Caste				
OBC	25.7	73.6	97.6	64,702
SC/ST	30.0	78.6	98.3	49,396
Others	23.5	73.4	98.0	50,643
Women's Education				
Non-literate	32.8	80.5	98.3	27,698
0-5 years of schooling†	26.0	76.8	98.3	50,459
6-10 years of schooling	24.3	72.5	97.7	73,769
11 + years of schooling	22.6	69.1	96.7	12,816
Standard of Living				
Low	28.6	78.4	98.3	69,928
Medium	24.4	72.5	97.6	55,000
High	23.9	71.5	97.5	39,822
Age of Girl (Years)				
10-14	25.4	74.9	98.1	91,599
15-19	27.0	74.8	97.7	73,151

Table 5: (Continued)

Background Characteristics	Percentage of Adolescent Girls with Levels of Anaemia		Percentage of Adolescent Girls with any Anaemia	Number of Adolescent Girls
	Severe	Moderate or Severe		
Marital Status				
Not currently married	25.8	74.4	97.9	153,516
Currently married	30.1	80.1	98.2	11,207
Total	**26.1**	**74.8**	**97.8**	**164,750**

Source: Computed from DLHS-RCH, 2002-04 data files.

†: Literate adolescent with no schooling are also included.

Note: 1. Total number may not add up to total sample size due to do not know and missing case.

2. The percentages are computed after applying survey sample weights and the numbers are given is unweighted.

The prevalence rate of anaemia, irrespective to its severity, is 96.2 percent among pregnant women in the country (Table 6). Overall, 2.8 percent of pregnant women are severely anaemic in India. The prevalence rate of severe anaemia falls sharply with rise in educational level and standard of living. Rural women are more severely anaemic than their urban counter part. The overall picture shows that more than forty percent of pregnant women belonging to Hindu religion, SC/ST community, illiterate, and with low standard of living and high parity suffer from moderate or severe anaemia.

Table 6: Prevalence of Iron-Deficiency Anaemia among Pregnant Women (age 15-44 years) by Selected Background Characteristics, India

Background Characteristics	Percentage of Pregnant Women with Levels of Anaemia		Percentage of Pregnant Women with any Anaemia	Number of Pregnant Women
	Severe	Moderate or Severe		
Residence				
Rural	3.3	43.1	96.9	15,569
Urban	1.2	38.0	95.1	5,664

Table 6: (Continued)

Background Characteristics	Percentage of Pregnant Women with Levels of Anaemia		Percentage of Pregnant Women with any Anaemia	Number of Pregnant Women
	Severe	Moderate or Severe		
Religion				
Hindu	3.1	43.4	96.6	17,251
Muslim	0.8	35.8	95.7	2,533
Others	1.6	31.8	95.4	1,449
Caste				
OBC	2.5	37.7	95.7	8,739
SC/ST	3.5	48.1	97.2	7,222
Others	1.9	39.1	96.3	5,272
Women's Education				
Non-literate	4.1	50.7	97.7	10,104
0-5 years of schooling†	2.7	43.4	97.0	2,740
6-10 years of schooling	1.9	37.0	95.3	6,146
11 + years of schooling	1.1	30.2	95.7	2,238
Standard of Living				
Low	4.0	48.1	97.5	10,435
Medium	1.9	39.0	95.6	6,824
High	1.5	33.8	95.6	3,974
Age of Woman (Years)				
15-19	2.8	42.7	96.5	4,391
20-24	2.5	40.3	96.2	9,063
25-29	2.4	41.1	96.3	4,966
30-34	3.1	44.0	96.6	1,923
35 +	3.9	47.3	96.7	890
Parity				
No child	2.0	35.0	95.7	6,899
1	2.6	41.4	96.2	5,827
2-3	3.8	49.7	97.2	5,633
4 +	2.4	55.0	99.0	2,874
Total	**2.6**	**41.5**	**96.2**	**21,233**

***Source**:* Computed from DLHS-RCH, 2002-04 data files.

†: Literate adolescent with no schooling are also included.

Note: 1. Total number may not add up to total sample size due to do not know and missing case.

2. The percentages are computed after applying survey sample weights and the numbers are given is unweighted.

The preceding discussion was based primarily on differentials. Multivariate analysis, using ordinal regression analysis allows us to assess net influences of various factors on the degree of anaemia after other factors are controlled. Results of ordinal logistic regression show that of number of socio-economic and demographic factors have significant net influence on degree of anaemia in all the three population groups (Table 7). The severity of anaemia is significantly higher among urban children than rural possibly due to difference in their food intake. That degree of anaemia is higher among female children than male disclosed the existence of son preference and gender discrimination at food plate in that Indian society. Children with SC/ST membership have higher degree of anaemia than other children plausibly due to not being aware of the symptom of anaemia. Further, severity of anaemia rises with age among children in India. It shows that the supplement of nutritious food after six months of exclusive breast feeding might not have been introduced to keep anaemia at bay. Appropriate supplement of iron rich diet helps in growth of children and increases immunity. Children with higher birth order also show higher degree of anaemia perhaps due to low nutritional status of mother on account of frequent childbearing. On the other hand, for children belonging to religions other than Hindu, severity of anaemia is low. Proper care and availability of iron rich diet may have helped to keep the incidence of severe anaemia low at higher standard of living. The awareness of proper feeding practices for infant and young children with adequate supplement of iron is plausibly higher among educated mother which translates into lower degree of anaemia for their children. Similarly, older mothers are more experienced with child's nutrition and it may be the key factor to keep the degree of anaemia low.

Table 7: Results of Ordinal Logistic Regression on Prevalence of Iron-Deficiency Anaemia among Children, Adolescent's Girls and Pregnant Women in India

Background Characteristics	Children (0-71 Months)		Adolescent Girls (10-19 Years)		Pregnant Women (15-44 Years)	
	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Residence						
Rural (RC)						
Urban	0.037**	0.011	0.037**	0.011	-0.013	0.034
Religion						
Hindu (RC)						
Muslim	-0.180**	0.014	-0.218**	0.014	-0.247**	0.042
Others	-0.082**	0.022	-0.169**	0.021	-0.079	0.063
Caste						
OBC (RC)						
SC/ST	0.133**	0.011	0.168**	0.012	0.190**	0.033
Others	-0.056**	0.011	-0.030**	0.011	0.017	0.035
Mother's Education						
Non-literate (RC)						
0-5 years of schooling †	-0.122**	0.015	-0.159**	0.015	-0.139**	0.043
6-10 years of schooling	-0.252**	0.012	-0.294**	0.014	-0.315**	0.036
11 + years of schooling	-0.402**	0.020	-0.431**	0.023	-0.419**	0.057
Standard of Living						
Low (RC)						
Medium	-0.069**	0.011	-0.111**	0.012	-0.046	0.034
High	-0.115**	0.016	-0.078**	0.015	-0.021	0.048
Sex of the Child						
Male (RC)			na	na	na	na
Female	0.034**	0.009	na	na	na	na
Age of Child (Months)						
24-47 (RC)			na	na	na	na
0-11	0.285**	0.015	na	na	na	na
12-23	0.435**	0.014	na	na	na	na
48-71	-0.475**	0.011	na	na	na	na

Table 7: (Continued)

Background Characteristics	Children (0-71 Months)		Adolescent Girls (10-19 Years)		Pregnant Women (15-44 Years)	
	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
Age of Mother/Girl/Woman (Years)						
10-14 (RC)	na	na			na	na
15-19	0.218**	0.022	0.080**	0.011	0.098**	0.037
20-24	0.102**	0.012	na	na	-0.072	0.038
25-29 (RC)			na	na		
30-34	-0.101**	0.014	na	na	-0.181**	0.057
35 +	-0.168**	0.017	na	na	-0.214**	0.083
Marital Status						
Not currently married (RC)	na	na			na	na
Currently married	na	na	0.108**	0.018	na	na
Birth Order						
2 (RC)			na	na	na	na
1	-0.075**	0.012	na	na	na	na
3	0.100**	0.014	na	na	na	na
4 +	0.236**	0.015	na	na	na	na
Parity						
No child (RC)	na	na	na	na		
1	na	na	na	na	0.224**	0.036
2-3	na	na	na	na	0.436**	0.042
4 +	na	na	na	na	0.590**	0.061
μ^1	-3.491**	0.02	-4.027**	0.022	-3.218**	0.054
μ^2	-0.019	0.016	-1.368**	0.015	0.260**	0.043
μ^3	3.447**	0.02	0.789**	0.014	3.681**	0.058
Cases included in analysis	**193873**		**164891**		**21326**	
-2 log likelihood	**79892.17**		**10316.56**		**9487.51**	
Nagelkerke R^2	**0.057**		**0.014**		**0.032**	

Source: Computed from DLHS-RCH, 2002-04.

RC: Reference Category.

†: Literate mothers or adolescent or woman with no schooling are also included.

**: Significant level at 1 percent.

*: Significant level at 5 percent.

na: Not Applicable.

Note: 1. Children with mothers not interviewed are not included in the analysis.

The study also reveals that severity of anaemia is higher among adolescent girls belonging to urban areas than rural areas. Further, degree of anaemia is higher among currently married adolescent girls compared to those not currently married because these adolescent married women are physically immature to enter active reproductive life. Besides, they must make adjustments of living away from maternal home and post marital household diet. The results show that older adolescents (15-19 years) are more anaemic than younger adolescents (10-14 years) which could be due to higher physical activity assigned to older adolescents. On the other hand, awareness increases with educational level and degree of anaemia decreases with increase in years of schooling as well as rise in standard of living due to availability of proper nutritious food among adolescent girls.

Among pregnant women, the degree of anaemia rises with parity because consecutive child birth leads to excessive blood loss and frequent pregnancy experience without appropriate diet, the well recognised maternal depletion factor. But severity of anaemia varies with age, with a 'U'- shaped relationship. Results show that severity is low in prime child bearing ages because the physical condition is suitable for child birth whereas complications related to pregnancy may rise with age and hence lower the Hb level. Educational level plays an important role to curb the degree of anaemia among pregnant women. Education increases the awareness regarding proper nutrition during pregnancy (possibly including consumption of Iron and Folic Acid tablet) to keep Hb at normal level. That the degree of anaemia is significantly lower among Muslim pregnant women compared to Hindus may be due to difference in food intake between these two religious communities. Degree of anaemia is higher among women who belong to scheduled castes, which poses the question on implementation of programmes for socially deprived sections. Standard of living and place of residence do not show any significant effect on degree of anaemia among pregnant women in the country.

Conclusions

The study shows that the prevalence of any anaemia is very high in India; especially prevalence rate of severe anaemia is high among adolescent girls. Contrary to common perception, anaemia not only affects the lower strata as such, but has its mark on well off sections of the society as well though at lower level. The degree of anaemia

varies with education and standard of living, i.e., severe anaemia is low among highly educated and people with high standard of living. For pregnant women, frequent childbirth increases the degree of anaemia. Moreover, early entry to sexual union and motherhood also raises the severity of anaemia among women.

The estimates from DLHS-RCH, 2002-04 data in the present study clearly show that the NNAPP in operation since 1972 in the country has unfortunately failed to fulfill its promise to achieve the desired results. The prevalence rate of anaemia is alarming for adolescent girls; in addition, almost thirty percent of them are severely anaemic. For adolescent girls, implementation of policies may be difficult because they are not easily identified and covered like pregnant women or children where continuous monitoring is possible through several maternal and child health care programmes. Therefore, there should be a strategic shift in programmes to broaden the coverage of public programmes to adolescent girls also to control anaemia. Besides, anaemia control programme needs to be implemented more efficiently in poor performing states. Iron-deficiency anaemia lowers overall productivity but policy makers do not view this seriously as an adverse effect on sustainable economic growth on the nation. Integrated strategies are required with each intervention clearly related to particular groups at risk. However, economic constraints to dietary improvement are one of the primary barriers to a food based approach to alleviating anaemia in a developing country like India. Screening for anaemia, treatment of anaemic women and children and availability of cheap and nutritious food, salt with iron fortification are the key to reduce anaemia. Iron fortified salt, supported by UNICEF, Food and Nutritional Board, and the Tamil Nadu state government, currently is consumed by all segments of the population in Tamil Nadu. Even food cooked in cast iron utensils improves iron content in diet. Anaemia behaves as a silent killer to reduce the immune power of human body and enhances the risk of further infections. Anaemia is curable if diagnosed early, otherwise it may be fatal. There are motivational problems among people because it is not a dramatic illness. Therefore, health workers should motivate the target population to introduce more iron rich food in the daily diet. Anaemic babies are retrospective marker of the nutritional status of women of the country. Improving mother's health and reducing child malnutrition are major challenges to human development in this millennium. Well nourished and healthy children will be healthier in their adolescence and more

productive ages and also will give birth to healthier babies tomorrow contributing to human development in the present and future generation.

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