FACTORS AFFECTING ANAEMIA AMONG CHILDREN AGED 6-59 MONTHS IN RURAL INDIA: EVIDENCES FROM NFHS-4 (2015-16)

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Abstract: Anaemia in India is a severe public health problem among younger children of age 6- 59 months. In addition to increased morbidity and poor effects on physical well-being (weakness and/or fatigue), anaemia is linked by delayed cerebral and psychomotor growth and a higher risk of maternal mortality. The present study investigated the anaemia and associated risk factors among children aged 6 to 59 months belong to rural India. The study used data from the fourth round of the National Family Health Survey (NFHS-IV), which was conducted during 2015–16. In the NFHS-IV survey, a total of 259,627 children under 5 were collected from India, out of which a total of 0.18 million rural children were analysed. The study used Stata/MP Version 14.1 for appropriate bivariate and multivariate statistical analysis. Overall, 60 percent of children aged 6–59 months had some degree of anaemia. The severity of anaemia among children show that had 28 percent had mild anaemia, 30 percent had moderate anaemia and 2 percent had severe anaemia. Among children, the prevalence of anaemia in major states was highest in Haryana (73%), followed by Jharkhand (72%) and Madhya Pradesh (70%) and was lowest in Manipur (23%) and Mizoram (25%). The adjusted odds ratio results show that age of the child, sex, meal diversity, mother's BMI and anaemia status, antenatal visits, substance use pattern, education and wealth were significantly associated with anaemia status of the children.

Keywords **- Anaemia, Prevalence, Risk-factors, Under-five, Rural India, NFHS**

I. Introduction

Anaemia, defined as hemoglobin concentration below established cut-off levels (WHO, 2001), is a widespread public health problem with major consequences for human health as well as social and economic development. Although estimates of the prevalence of anaemia vary widely and accurate data are often lacking, it can be assumed that in resource-poor areas significant proportions of young children and women of childbearing age are anaemic. WHO estimates the number of anaemic people worldwide to be a staggering two billion and that approximately 50% of all anaemia can be attributed to iron deficiency (WHO, 2001). The most dramatic health effects of anaemia, i.e., increased risk of maternal and child mortality due to severe anaemia, have been well documented. In addition, the negative consequences of iron deficiency anaemia (IDA) on cognitive and physical development of children, and work productivity of adults are of major concern (Stoltzfu, 2001). Moreover, the high Joint statement by the World Health Organization and the United Nations Children's Fund prevalence of anaemia in surgical patients may increase the risk of postoperative morbidity and mortality (WHO, 2003). Although anaemia has been recognized as a public health problem for many years, little progress has been reported and the global prevalence of anaemia remains unacceptably high. WHO and UNICEF therefore reemphasize the urgent need to combat anaemia and stress the importance of recognizing its multifactorial etiology for developing effective control programs.

In India, anaemia is a severe public health problem among women, adolescent girls and young children. In addition to increased morbidity and adverse effects on physical well-being (weakness and/or fatigue), anaemia is linked by delayed cerebral and psychomotor growth and a higher risk of maternal mortality (WHO, 2017). Poor nutrition, leading to iron deficiency, is the principal factor in more than 60 percent of all anaemia cases (Kassebaum et al., 2016). More than half of all women of reproductive age and children under five years were anaemic (IIPS, 2017). The expected 447 million persons with anaemia, causes India to contribute nearly one quarter to the world-wide burden as calculated by the Global Burden of Disease in 2016 (Kasselbaum, 2016). The present study investigated the anaemia and associated risk factors among children aged 6 to 59 months belong to rural India.

II. Data Source and Methodology

The study used data from the fourth round of the National Family Health Survey (NFHS-IV), which was conducted during 2015–16. The survey collected a sample of 0.6 million (IIPS & ICF, 2017) households from 640 districts in 36 states /union territories, based on the 2011 census. The surveys provide information on important health, nutrition, and demographic indicators of the country.

The DHS Kids Recode dataset (IAKR74DT) (DHS, 2020) has been used for analysis. Unit of analysis: Child under aged 6-59 months born to a woman interviewed. In the NFHS-IV survey, a total of 259,627 children under 5 were collected from India, of which 0.18 million were from rural areas. The study used Stata/MP Version 14.1 for appropriate bivariate and multivariate statistical analysis. The adjusted odds ratio using three different models were used to assess the risk factors for anaemia among children aged 6-59 months: Model I– Child risk factors, Model II– Maternal risk factors, and Model III– Child, Maternal and Household risk factors. The coding plan of the selected study variables is given in Table 1. Each variable has been carefully constructed using the DHS Statistics-7 (Ver. 2) (Croft et al., 2020) guide. Outcome variables: To examine the factors linked to anaemia among children aged less than 5 years, outcome variables were expressed as dichotomous variables. Explanatory variables: Selected after conducting a detailed literature review (ref.) and only those variables showing association with anaemia. Selected explanatory variables are divided into three levels which included child, maternal and household factors.

III. Results

Table 1 shows the distribution of samples across different variables selected for the study. It shows that among children aged 6-59 months, more than two-thirds (66%) were aged above 24 months and over one-fifth (22%) were aged between 12 and 23 months. More than half were males (52%) and females were 48 percent. Over three-fourths (77%) children had not received iron supplementation and over four-fifths (82%) had no meal diversity. Distribution of mother across different age groups show that only 2 percent were aged below 20 year and over one-half (57%) were aged 25-34 years. About one-quarter (27%) women were underweight (BMI <18.5 kg/m2) and over one-tenth were overweight. Fifty-seven percent of the mothers were anaemic and over one fifth (22%) had no ANC visits. Eleven percent women were using substance and 44 percent had no mass media exposure. Over one-third (36%) women were uneducated, and about 6 percent were educated upto higher-level. Distribution of sample characteristics by caste show that two-fifths (40%), followed by Scheduled tribe (23%) and Scheduled caste (20%). About three-fourth (74%) were belong to Hindu religion, followed by 14 percent Muslims and 8 percent Christian. Distribution of children by wealth show that one-third were from poorest wealth group followed by 28 percent from poor, and only 7 percent were from the richest quintile.

Overall, 60 percent of children aged 6–59 months had some degree of anaemia. The severity of anaemia among children show that had 28 percent had mild anaemia, 30 percent had moderate anaemia and 2 percent had severe anaemia. Among children, the prevalence of anaemia in major states was highest in Haryana (73%), followed by Jharkhand (72%) and Madhya Pradesh (70%) and was lowest in Manipur (23%) and Mizoram (25%) (Table 2).

Table 3 shows the prevalence of anaemia among children aged 6-59 months by background characteristics. It shows that younger children had the higher prevalence of anaemia compared to those in the higher ages. Seventy percent of the children were anaemic in the age group of 6-11 months, which found reduced upto age 54 percent among children above age 24 months. There is no difference in the prevalence of anaemia among children by sex, and iron supplementation. The prevalence of anaemia found to be highest among children belong to younger mothers (65%) compared to those who belong to mothers of age above 35 years (58%). The prevalence of anaemia among children also varies by their mothers BMI. Children belong to underweight women were 63 percent and 53 percent were belong to overweight BMI mothers. Nearly two-thirds (66%) were belong to women had anaemia. The prevalence of anaemia among children by wealth status varies between 53-64 percent.

Table 4 shows the adjusted odds ratio for anaemic children aged 6-59 months by selected background characteristics in three different models. Model 1 shows the adjusted odds ratio by child level factors, in which it shows that children belong to age above 24 months were 44 percent less likely to be anaemic compared to reference category (6-11 months). Similarly, children who had meal diversity were 33 percent less likely to be anaemic compared to those who do not had meal diversity. Model 2 shows the adjusted odds ratio by maternal characteristics. It show that there is an inverse relationship exist between anaemia among children and mothers age. It significantly reduces with increasing age of the mothers. Children belong to women aged above 35 years were 44 percent less likely to be anaemic compared to those who belong to women aged below 20 years. Similarly, Mothers BMI also had a significant impact on the childhood anaemia. Children belong to women with normal and overweight BMI were 17 percent and 25 percent less likely to be anaemic compared to those who belong to underweight women. It has been found from that the children born to anaemic women were nearly 2 times anaemic compared to reference category. Mass media exposure also lead an impact on the anaemia status of the children. Children belong to women with any mass media exposure were 8 percent less likely to be anaemic. Educational status of the mothers also lead a significant impact on the anaemia status of the children. It shows that children belong to women with higher educated were 37 percent less likely to be anaemic compared to those who belong to uneducated mothers. Among religious groups Christian were 54 percent less likely to be anaemic compared to those who below to Hindu. Children belong to middle, richer were 11 percent and 14 percent less likely to be anaemic compared to those who were in the poorest wealth quintile.

Table 1: Description of selected outcome and independent variables

Variable	Description and Categorization	Analysis coding
Outcome variables		
Anaemia	Anaemic <11.0 (Hemoglobin level in grams/deciliter). Hemoglobin levels are adjusted for altitude in enumeration areas that are above 1,000 meters	Recoded for analysis as: 0 = No 1 = Yes
Explanatory variables		
Age of child (months)	The age of the child present in the month (0-59) is divided into three categories of year.	Recoded for analysis as: 1 = 6 to 11 months 2 = 12 to 23 months 3 = 24 to 59 months
Sex of child	Sex of child as reported in the birth history	Used same coding for analysis: 1 = Male 2 = Female
Iron supplementation	Information on iron supplements is based on the mother's recall.	Recoded for analysis as: 0 = No 1 = Yes
Meal diversity	Dietary diversity is a proxy for adequate micronutrient-density of foods. Minimum dietary diversity means feeding the child food from at least four food groups.	Recoded for analysis as: 0 = No 1 = Yes
Mother's age at birth	The age of the mother at the time of the birth is calculated by subtracting the date of birth of the individual woman respondent from the date of birth of the child.	Recoded for analysis as: 1 = 19 and below 2 = 20 to 24 3 = 25 to 29 4 = 30 to 34 5 = 35 and above
Mother's BMI (kg/m2)	BMI for women age 15–49 years, calculated by dividing weight in kilograms by height in metres squared (kg/m2).	Recoded for analysis as: 1 = Underweight (<18.5) 2 = Normal (18.5–24.9) 3 = Overweight (>25.0)
Maternal anaemia	Anaemic women aged 15-49 years: Mildly anaemic is classified as 10.0-11.9 g/dl for non–pregnant women and 10.0-10.9 g/dl for pregnant women; Moderately/severely anaemic is <10.0 g/dl. Adjusted for altitude and for smoking status. Excludes children whose mother's anaemia status is not known.	Recoded for analysis as: 0 = No 1 = Yes [Yes includes Any anaemic women– Mild/Moderate/Severe]
ANC visits	Number of antenatal visits during pregnancy	Recoded for analysis as: 0 = No visit (0) 1 = Less frequent visits (1–3) 2 = Frequent visits (3+) [No visit includes "No antenatal visit" and "Don't know]
Substance use	The variable is formed using the alcohol and tobacco use by the children's mother.	Recoded for analysis as: 0 = Not using 1 = Using
Mass media exposure	Women regularly exposed to mass media. At least once a week: 1. Newspapers and magazines, 2. Television, 3. Radio, and At least once a month: 1. Cinema	Recoded for analysis as: 0 = No 1 = Yes [Yes includes regularly exposed to any mass media]
Education	Highest educational level No education– Women who never went to school; Primary– Women who did not complete one year of schooling even after going to school and those who completed 1 to 5 years of schooling; Secondary– 6 to 12 years of schooling; and Higher– More than 12 years of schooling.	Used same coding for analysis as: 0 = No education 1 = Primary 2 = Secondary 3 = Higher
Residence	Type of place of residence	Used same coding for analysis as: 1 = Urban 2 = Rural
Caste	The caste or tribe of the head of the household	Recoded for analysis as: 1 = Schedule caste 2 = Schedule tribe 3 = Other backward class 4 = Other [Others include, e.g., None of the above, and Don't know]
Religion	The religion of the head of the household	Recoded for analysis as: 1 = Hindu 2 = Muslim 3 = Other [Others include, e.g., Christian, Sikh, Buddhist/Neo-Buddhist, Jain, Jewish, Parsi/Zoroastrian, No religion, and Other]
Wealth index	Constructed using data on a household's ownership of selected assets via principal components analysis. The household's ownership of a number of consumer items include such as a television and car; dwelling characteristics such as flooring material; type of drinking water source; toilet facilities; and other characteristics that related to wealth status. Each household is assigned a standardized score for each asset, where the score differs depending on whether or not the household owned that asset. These scores are summed by household, and individuals are ranked according to the total score of the household in which they reside. The sample is then divided into population quintiles -- five groups with the same number of individuals in each to create the break points that define wealth quintiles.	Used same coding for analysis as: 1 = Poorest 2 = Poorer 3 = Middle 4 = Richer 5 = Richest

Table 2: Percent distribution of children aged 6-59 months living in rural areas by selected characteristics, India, NFHS 2015–16

Background characteristics	Percent	Number
Age of child (months)		
6 to 11	11.5	19,320
12 to 23	22.1	37,228
24 to 59	66.4	1,11,917
Sex of child		
Male	52.0	93,969
Female	48.0	86,710
Iron supplementation		
No	76.8	1,30,225
Yes	23.2	39,289
Meal diversity		
No	82.2	79,225
Yes	17.8	17,196
Mother's age		
19 and below	2.3	4,107
20 to 24	30.1	54,314
25 to 29	38.4	69,305
30 to 34	18.7	33,714
35 and above	10.7	19,239
Mother's BMI (kg/m2)		
Underweight (<18.5)	26.6	47,585
Normal (18.5-24.9)	62.8	1,12,348
Overweight (>25.0)	10.6	19,017
Anaemia among mothers		
No	43.3	77,171
Yes	56.7	1,01,180
Antenatal clinic visits		
No visit (0)	21.5	27,004
Less frequent visits (1-3)	36.7	46,154
Frequent visits (3+)	41.8	52,476
Substance use		
Not using	89.4	1,61,587
Using	10.6	19,092
Mass media exposure		
No	44.1	79,742
Yes	55.9	1,00,937
Mother's educational level		
No education	36.2	65,446
Primary	15.6	28,091
Secondary	42.4	76,589
Higher	5.8	10,553
Caste		
Schedule caste	20.4	35,418
Schedule tribe	23.4	40,646
Other backward class	39.7	68,870
Other	16.5	28,635
Religion		
Hindu	74.3	1,34,151
Muslim	13.6	24,510
Christian	8.2	14,824
Other	4.0	7,194
Wealth index		
Poorest	33.3	60,078
Poor	27.7	50,036
Middle	20.2	36,477
Richer	12.3	22,156
Richest	6.6	11,932
INDIA	**100.0**	**1,80,679**

Table 3: Percentage of children aged 6–59 months belong to rural areas classified as having anaemia by state, India, NFHS 2015–16

State	Any <11.0 g/dl	Mild 10.0–10.9 g/dl	Moderate 7.0–9.9 g/dl	Severe <7.0 g/dl	Number
A & N Island	50.7	27.6	22.3	0.8	461
Andhra Pradesh	60.5	27.9	30.5	2.1	1589
Arunanchal Pradesh	55.3	29.9	24.3	1.0	3044
Assam	36.7	24.5	11.8	0.4	7249
Bihar	64.1	30.6	32.3	1.3	18779
Chandigarh	NA	NA	NA	NA	NA
Chhattisgarh	41.4	23.7	17.2	0.5	5465
D & N Havelli	87.6	33.7	51.6	2.3	157
Daman & Diu	76.6	40.3	34.9	1.4	123
Goa	41.2	25.8	15.0	0.5	174
Gujarat	64.3	31.6	30.8	1.9	4051
Haryana	73.0	28.3	41.6	3.1	4576
Himachal Pradesh	53.4	22.8	28.2	2.4	2157
Jammu & Kashmir	55.1	21.9	30.6	2.6	5717
Jharkhand	71.6	31.8	38.6	1.1	8137
Karnataka	63.8	32.1	30.7	1.0	4123
Kerala	36.2	22.8	13.0	0.4	1270
Lakshadweep	NA	NA	NA	NA	NA
Madhya Pradesh	70.0	29.8	38.3	1.9	15187
Maharashtra	54.1	27.5	25.8	0.8	5201
Manipur	23.2	16.2	6.7	0.2	3324
Meghalaya	49.1	30.6	17.9	0.5	3051
Mizoram	25.0	15.8	8.2	0.9	2360
Nagaland	28.2	16.2	11.6	0.4	2645
NCT of Delhi	NA	NA	NA	NA	NA
Odisha	45.7	25.0	19.9	0.9	7597
Puducherry	48.7	31.9	16.1	0.7	216
Punjab	57.2	27.9	28.2	1.1	2839
Rajasthan	61.8	27.2	32.7	1.9	10708
Sikkim	53.4	31.8	21.1	0.5	600
Tamil Nadu	52.5	27.3	23.8	1.3	3911
Tripura	49.0	29.8	18.9	0.3	808
Uttar Pradesh	62.8	26.7	34.0	2.2	26108
Uttarakhand	59.5	26.7	30.6	2.2	3455
West Bengal	54.0	31.8	21.6	0.6	3358
Telangana	68.4	24.8	40.1	3.5	1173
INDIA	**59.6**	**28.2**	**29.9**	**1.5**	**159669**

Table 4: Percentage of children aged 6–59 months belong to rural areas classified as having anaemia by selected background characteristics, India, NFHS 2015–16

Background characteristics	Percent	Number
Age of child (months)		
6 to 11	69.1	16971
12 to 23	71.7	35652
24 to 59	54.0	107046
Sex of child		
Male	59.2	82944
Female	60.1	76725
Iron supplementation		
No	60.0	121741
Yes	58.6	36770
Meal diversity		
No	65.7	70347
Yes	62.7	15620
Mother's age		
19 and below	64.8	3320
20 to 24	62.3	47570
25 to 29	58.2	61879
30 to 34	57.9	30107
35 and above	58.3	16793
Mother's BMI (kg/m2)		
Underweight (<18.5)	63.1	42578
Normal (18.5-24.9)	59.1	99909
Overweight (>25.0)	53.0	16793
Anaemia among mothers		
No	51.3	68877
Yes	65.7	90294
Antenatal clinic visits		
No visit (0)	64.9	23687
Less frequent visits (1-3)	63.6	41804
Frequent visits (3+)	58.3	47633
Substance use		
Not using	59.7	143035
Using	58.6	16634
Mass media exposure		
No	63.0	69952
Yes	57.1	89717
Mother's educational level		
No education	65.0	57452
Primary	60.2	24763
Secondary	56.0	68114
Higher	52.1	9340
Caste		
Schedule caste	61.3	31422
Schedule tribe	64.4	35546
Other backward class	59.6	61267
Other	55.6	25304
Religion		
Hindu	60.0	119175
Muslim	59.1	21312
Christian	48.0	12829
Other	60.6	6353
Wealth index		
Poorest	64.0	52659
Poor	59.6	44134
Middle	58.0	32375
Richer	54.2	19802
Richest	53.2	10699
INDIA	**59.6**	**159669**

Table 5: Adjusted odds ratio (aOR) for children aged 6-59 months belong to rural areas classified as having anaemia by selected background characteristics, India, NFHS 2015–16

Background characteristics	Model 1				Model 2				Model 3			
	aOR	Sig	[95% CI]		aOR	Sig	[95% CI]		aOR	Sig	[95% CI]	
Age of child (months)												
6 to 11 ®	1.00		.	.					1.00		.	.
12 to 23	1.16	***	1.12	1.21					1.14	***	1.09	1.19
24 to 59	0.56	***	0.54	0.59					1.00		.	.
Sex of child												
Male ®	1.00		.	.					1.00		.	.
Female	0.99		0.96	1.01					0.92	***	0.88	0.96
Iron supplementation												
No ®	1.00		.	.					1.00		.	.
Yes	0.97	*	0.94	1.00					0.96		0.92	1.01
Meal diversity												
No ®	1.00		.	.					1.00		.	.
Yes	0.77	***	0.74	0.80					0.89	***	0.85	0.94
Mother's age												
19 and below ®					1.00		.	.	1.00		.	.
20 to 24					0.96		0.88	1.04	1.09	*	0.99	1.20
25 to 29					0.77	***	0.71	0.84	1.04		0.94	1.15
30 to 34					0.67	***	0.62	0.73	0.99		0.89	1.11
35 and above					0.56	***	0.51	0.61	0.91		0.80	1.03
Mother's BMI (kg/m2)												
Underweight (<18.5) ®					1.00		.	.	1.00		.	.
Normal (18.5-24.9)					0.83	***	0.81	0.86	0.87	***	0.83	0.91
Overweight (>25.0)					0.75	***	0.72	0.78	0.87	***	0.80	0.94
Anaemia among mothers												
No ®					1.00		.	.	1.00		.	.
Yes					1.96	***	1.91	2.01	1.85	***	1.77	1.92
Antenatal clinic visits												
No visit (0) ®					1.00		.	.	1.00		.	.
Less frequent visits (1-3)					1.02		0.98	1.05	1.00		0.94	1.06
Frequent visits (3+)					0.95	***	0.91	0.98	0.92	***	0.87	0.98
Substance use												
Not using ®					1.00		.	.	1.00		.	.
Using					0.70	***	0.67	0.73	0.77	***	0.72	0.83
Mass media exposure												
No ®					1.00		.	.	1.00		.	.
Yes					0.92	***	0.89	0.94	0.98		0.93	1.03
Mother's educational level												
No education ®					1.00		.	.	1.00		.	.
Primary					0.75	***	0.72	0.78	0.85	***	0.79	0.90
Secondary					0.64	***	0.62	0.66	0.74	***	0.70	0.78
Higher					0.63	***	0.60	0.67	0.70	***	0.64	0.77
Caste												
Schedule caste ®									1.00		.	.
Schedule tribe									1.10	***	1.03	1.18
Other backward class									0.93	**	0.88	0.99
Other									0.85	***	0.79	0.91
Religion												
Hindu ®									1.00		.	.
Muslim									1.05		0.98	1.13
Christian									0.46	***	0.42	0.50
Other									1.02		0.92	1.13
Wealth index												
Poorest ®									1.00		.	.
Poor									0.93	**	0.88	0.98
Middle									0.89	***	0.83	0.95
Richer									0.86	***	0.80	0.94
Richest									0.91	*	0.82	1.00

Note. ®- Reference category; aOR- Adjusted odds ratio; Sig- Significance level at 0.05; *** p<0.01, ** p<0.05, * p<0.1

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