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Review Article

Determinants of childhood anaemia in India from 2005 to 2021: insights from the last three rounds of India National Family Health Surveys

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ABSTRACT

Anaemia is a global public health problem affecting 800 million women and children globally. Anaemia is associated with perinatal mortality, child morbidity and mortality, mental development, immune competence, susceptibility to lead poisoning, and performance at work. This paper used data from India National Family Health Surveys (INFHS) carried out in 2005-06, 2015-16 and 2019-21 to identify the factors associated with childhood anaemia among children, adjusting for a range of covariates. In NFHS rounds of 3 and 4 after adjusting for standard covariates, in the probit model, it was found according to marginal effects, the probability of children being anaemic in urban areas is lower. Those belonging to the scheduled tribes have a higher probability of being anaemic in the two survey rounds of NFHS-3 and NFHS-4. Literate mothers were found to have a lower probability of anaemia in their children. In NFHS-5, in the binary logit model after adjusting for standard covariates, it was found that those belonging to the scheduled tribes were 1.348 times more likely to be anaemic compared to the scheduled castes. Maternal education was another significant factor determining the likelihood of being anaemic. Literate mothers were less likely to have anaemic children. This study provides crucial insights into the dynamic nature of childhood anaemia in India, utilizing data from three decades of NFHS surveys. It highlights the need for comprehensive interventions addressing socio-economic determinants, education of women, and behaviour change interventions to mitigate the burden of childhood anaemia in India.

Keywords: Anaemia, Childhood anaemia, India, NFHS

INTRODUCTION

Anaemia is a significant public health challenge that impacts approximately 800 million women and children worldwide.[1] It has wide-ranging consequences, including perinatal mortality, child morbidity and mortality, impaired mental development, compromised immune function, increased vulnerability to lead poisoning, and reduced work performance. WHO estimates that globally, 40% of children 6-59 months of age, 37% of pregnant women, and 30% of women 15-49 years of age worldwide are anaemic. Anaemia is defined as the concentration of blood haemoglobin less than 110 g/l for pregnant women and children and less than 120 g/l for non-pregnant women, according to recommendations from the WHO.[2] WHO estimates that globally, 40% of children 6-59 months of age, 37% of pregnant women, and 30% of women 15-49 years of age worldwide are anaemic.[3] Childhood anaemia is influenced by various factors, including socio-economic and demographic aspects of families and parents' knowledge about the adverse effects of anaemia, child-feeding practices, infectious disease, and genetics. Addressing this issue requires the implementation of government initiatives, community-based programs, and education on nutrition and healthcare, all of which are essential in alleviating the

burden of childhood anaemia in the country. The Indian Ministry of Health and Family Welfare has implemented a national iron and folic acid (IFA) supplementation programme under Anemia Mukt Bharat for children and adolescents in conjunction with the deworming programme delivered through community health workers and government schools. For policy planning, the National Family Health Survey (NFHS) provides national estimates of anaemia prevalence among children 6-59 months of age.

History of Anaemia Control Programs in India: In India, the Anaemia Control programme was launched in 1970 and after 15 years, an evaluation of the programme was carried out by ICMR. Evaluation showed that the programme failed to make any noticeable impact in reducing the incidence of anemia. Later on, the anemia prophylaxis programme was reviewed and renamed as "National Nutritional Anaemia Control Programme" in 1990. Later on in 1997, this programme was made an integral part of the nationwide "Reproductive and Child Health" (RCH) programme. A National Nutrition Policy was adopted in 1993, with the objective of operationalizing multi-sectoral strategies to address the problem of under-nutrition/malnutrition. Based on this, the National Plan of Action on Nutrition 1995 laid out the sectoral Plan of Action for 14 Ministries and Departments of the Government of India. A National Nutrition Mission has been set up to address nutrition issues through a mission mode approach under the oversight of the Ministry of Women and Child Development (MWCD). The Guidelines for Control of Iron Deficiency Anaemia was published in 2013 under the National Iron+ Initiative (NIPI).[4] In April 2018, the Intensified National Iron Plus Initiative (I-NIPI) was launched. In 2018, Anaemia Mukt Bharat strategy was launched to reduce anaemia prevalence in the country in a life cycle approach.[5] It aims to strengthen the existing mechanisms and foster newer strategies for tackling anaemia in six target beneficiary groups through six interventions and six institutional mechanisms and reduce anaemia prevalence both due to nutritional and non-nutritional causes. A literature review was conducted to document earlier studies exploring factors associated with childhood anaemia. Findings from some of the studies are presented here. 47 low-middle income countries (LMICs) data for children under five years between 2010 and 2018 were analysed, and it found that the total prevalence of anaemia was 56.5% (95% CI 56.2, 56.8 and younger children aged 6-35 months were more likely to have anaemia than older children aged 36-59 months (adjusted odds ratio [AOR] 1.38, 95% CI 1.36-1.39, p<0.001)6. The Global Burden of Disease Study estimated the prevalence of anaemia in children under five years of age in India to be 59.7% in 2017.[7] Anaemia prevalence was 40.5% among 1 to 4 year old as per CNNS 2016-18 in India.[8] For policy planning, the National Family Health Survey (NFHS) provides national estimates of anaemia prevalence among children 6–59 months of age.

Study objectives

The objective of this paper was to examine the factors associated with childhood anaemia from 2005-201 using rounds of India's Demographic and Health Survey (DHS), titled the National Family Health Surveys (NFHS), conducted between 2005 and 2021(NFHS-3, 2005-069 NFHS-4, 2015-1610 and NFHS-5, 2019-2111). by adjusting for different socio-demographic characteristics in India.

METHODS

This paper uses data from three rounds of India's Demographic and Health Survey (DHS), titled the National Family Health Surveys (NFHS), conducted between 2005 (NFHS-3, 2005-06, NFHS-4, 2015-16 and NFHS-5, 2019-21) and 2021. NFHS surveys are conducted under the stewardship of the Ministry of Health and Family Welfare (MoHFW), Government of India. MoHFW designated the International Institute for Population Sciences (IIPS), Mumbai, as the nodal agency and funding for NFHS was provided by the United States Agency for International Development (USAID), the United Kingdom Department for International Development (DFID), the Bill and Melinda Gates Foundation (BMGF), UNICEF, UNFPA, the MacArthur Foundation, and the Government of India. ICF provided technical assistance through The DHS Program, which is funded by USAID.

NFHS-3 collected information from a nationally representative sample of 109,041 households, 124,385 women aged 15-49, and 74,369 men aged 15-54. Fieldwork for NFHS-3 was conducted in two phases from November 2005 to August 2006 by eighteen research organisations. In NFHS-4, 28,586 Primary Sampling Units (PSUs) were selected across the country in NFHS-4, of which fieldwork was completed in 28,522 clusters. NFHS-4 fieldwork was conducted from January 20, 2015, to December 4, 2016, by 14 Field Agencies and gathered information from 601,509 households, 699,686 women, and 112,122 men. NFHS-5 fieldwork for India was conducted from June 2019 to April 2021, gathered information from 639,699 households, 724,115 women, and 101,839 men. In all, 30,456 Primary Sampling Units (PSUs) were selected across the country in NFHS-5 drawn from 707 districts as on March 31, 2017, of which fieldwork was completed in 30,198 PSUs.

The unit level datasets were analysed using Stata 17 software, accounting for the survey design. In addition to bivariate analysis, probit regression and multiple logistic regression analyses were performed to control for the effects of other factors, accounting for the survey design. A probit model (also called probit regression) is a way to perform regression for binary outcome variables. Binary outcome variables are dependent variables with two possibilities, like yes/no, positive test result/negative test result or single/ not single. The word "probit" is a

combination of the words probability and unit; the probit model estimates the probability of a value falling into one of the two possible binary (i.e., unit) outcomes. A logistic regression applies maximum likelihood estimation after transforming the dependent variable into a logit variable (the natural log of the odds of the dependent occurring or not). In this way, logistic regression estimates the probability of a certain event occurring. We used NFHS-recommended sample weights for the calculations and analysed data from children aged 6 to 59 months.

The Kernel Density Function for a normality test for the predicted residuals was checked to evaluate whether the residuals follow a logistic distribution or a standard normal distribution. As it follows a standard normal distribution, a probit model was estimated, and the marginal effects could be reported. If it follows a logistic distribution, a logit model could be estimated. As the NFHS-3 and 4 rounds demonstrate a seemingly standard normal distribution and NFHS-5 does not seem to demonstrate a standard normal distribution, probit model was estimated for NFHS-3 and NFHS-4 and a logit model was estimated for NFHS-5. The kernel density estimate plots for the three rounds on the distribution of childhood anaemia is presented in the following three figures:

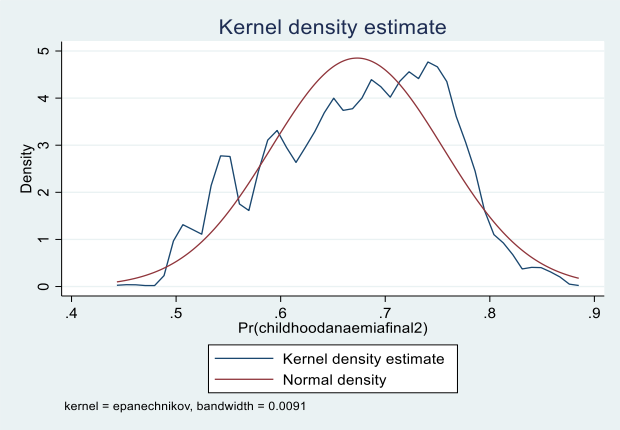

Figure 1: Kernel density estimate (KDE) plot for childhood anaemia in NFHS-3, 2005-06.

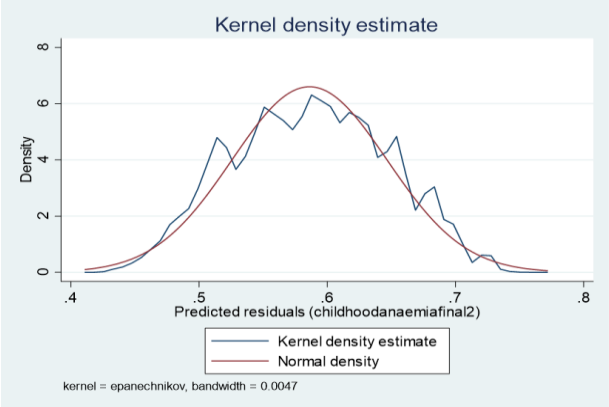

Figure 2: Kernel density estimate (KDE) plot for childhood anaemia in NFHS-4, 2015-16.

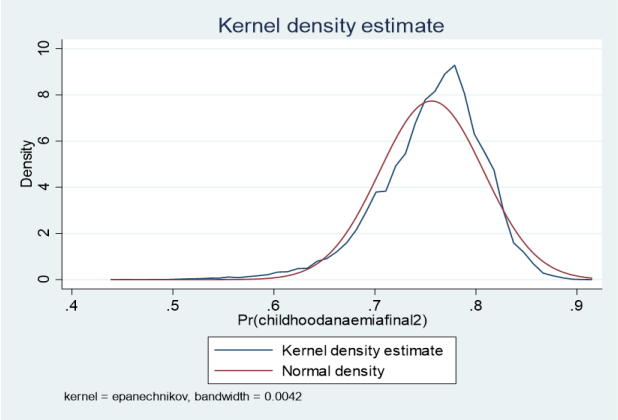

Figure 3: Kernel density estimate (KDE) plot for childhood anaemia in NFHS-5, 2019-21.

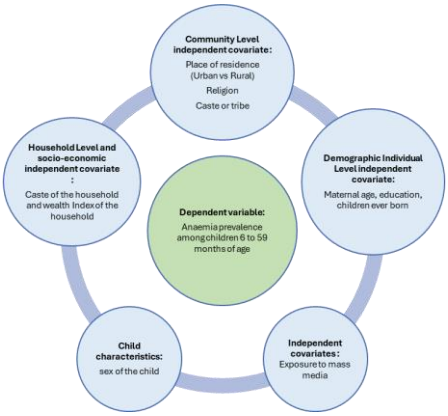

Figure 4: Conceptual framework of factors associated with childhood anaemia.

The dependent variable for these analyses was the prevalence of childhood anaemia. We examined a range of independent and control variables at the individual level (age and literacy of the mother, number of children ever born), household level (religion and caste or tribe of the head of the household, household wealth quintile), and community level (rural versus urban residence) and self-reported exposure to mass media were thought to be associated with the childhood anaemia. The conceptual framework of this analyses is presented below (Figure 4).

RESULTS

Socio-demographic profile of India

India is a progressing nation with a large population of more than 1.4 billion. According to the UNDP's 2023-24 Human Development Report (HDR), India ranked 134 out of 193 countries in 2022, with an HDI value of 0.64412. The annual population growth rate of 1.0% and a low total fertility rate of 2.0 births per woman suggests a progress towards demographic transition and looking forward to reaping the demographic dividend. Health indicators still present a few challenges despite economic progress. Neonatal mortality rates at 24.9, infant mortality

rates at 35.2, and under-five mortality rates at 41.9 per thousand live births remain areas of concern. India has shown a significant decline in the maternal mortality ratio (MMR) which has halved from 212 in 2007-09 to 97 per 100,000 live births in 2018-20. The prevalence of non-pregnant (57.2%) and pregnant (52.2%) women with low haemoglobin levels is high.

Table 1: Demographic profile of India.

Demographic and key health indicators	India
Human development index 2022 (rank)	134
Human development index 2022 (value)	0.644
Population (projected for 1st July 2024) (in millions)	1,404.91
Estimated annual rate of population change (2015-20) (%)	1.0
Population density (per sq. km.)	382
Total fertility rate (births per woman)	2.0
Crude birth rate (per 1000 mid-year total population)	20.0
Neonatal mortality rate (neonatal deaths per 1,000 live births)	24.9
Infant mortality rate (infant deaths per 1,000 live births)	35.2
Under-five mortality rate (under-5 deaths per 1,000 live births)	41.9
Maternal mortality ratio (maternal deaths per 100,000 live births)	97
Non-pregnant women (15-49 years) with blood haemoglobin concentration <120 g/l (%)	57.2
Pregnant women (15-49 years) with blood haemoglobin concentration <110 g/l (%)	52.2

Sources: NFHS surveys, UNDP.

Table 2: Prevalence of childhood anaemia and its confidence limits in the past three rounds of NFHS (2005-2021) in India.

Rounds	Survey years	Number of sample households	Age of children (in months)	Number of sample children (weighted)	Childhood anaemia (%) (<11.0 g/dl)	Confidence limits	
						R-2SE	R+2SE
NFHS-3	2005-06	109,041	6 to 59	42,388	69.5	68.7	70.2
NFHS-4	2015-16	571,660	6 to 59	204,997	58.4	58.2	58.9
NFHS-5	2019-21	636,699	6 to 59	152,752	67.1	66.7	67.5

Table 3: Cross tabulations between the prevalence of childhood anaemia and socio-demographic determinants in the past three rounds of NFHS, 2005-21 in India.

Indicators/ covariate	NFHS-3, 2005-06			NFHS-4, 2015-16			NFHS-5, 2019-21		
	Anaemic (<11.0 g/dl)	Not anaemic	P values	Anaemic (<11.0 g/dl)	Not anaemic	P values	Anaemic (<11.0 g/dl)	Not anaemic	P values
Community level									
Place of residence									
Rural	71.62	28.38	0.000	59.63	40.37	0.000	69.16	30.84	0.000
Urban	63.08	36.92		56.12	43.88		64.82	35.18	
Religion									
Hindu	69.80	30.20	0.001	58.85	41.15	0.000	68.38	31.62	0.000
Muslim	69.74	30.26		59.24	49.76		67.65	32.35	
Christian	60.35	39.65		45.78	54.22		53.66	46.34	
Sikh	63.86	36.14		56.60	43.40		71.05	28.95	
Others	70.29	29.71		60.69	39.31		71.68	28.32	
Caste or tribe of the household head									
ST	72.41	27.59	0.000	58.64	41.36	0.000	67.68	32.32	0.000
SC	77.21	22.79		62.10	37.90		72.48	27.52	
OBC	67.78	32.22		51.26	48.74		67.68	32.32	
Others	64.31	35.69		57.24	42.76		71.87	28.14	
Individual level									
Education of the women									
Non-literate	74.47	25.53	0.000	65.03	34.97	0.000	72.66	27.34	0.000
Literate	64.68	35.32		55.87	44.13		66.75	33.25	

Continued.

Indicators/ covariate	NFHS-3, 2005-06			NFHS-4, 2015-16			NFHS-5, 2019-21		
	Anaemic (<11.0 g/dl)	Not anaemic	P values	Anaemic (<11.0 g/dl)	Not anaemic	P values	Anaemic (<11.0 g/dl)	Not anaemic	P values
Demographic									
Sex of the child									
Male	69.15	30.85	0.159	58.49	41.51	0.281	68.00	32.00	0.934
Female	69.99	30.01		58.83	41.17		68.03	31.97	
Age of the mother (in years)									
15-19	81.01	18.99	0.000	65.00	35.00	0.000	79.59	20.41	0.000
20-24	71.31	28.69		61.52	38.48		71.73	28.27	
25-29	67.87	32.13		57.85	42.15		66.88	33.12	
30-34	66.28	33.72		56.09	43.91		65.59	34.41	
35-39	68.74	31.26		55.24	44.76		63.97	36.03	
40-44	65.69	34.31		58.81	41.19		62.31	37.69	
45-49	74.40	25.60		75.89	42.11		63.81	36.19	
Total children ever born									
Have 2 or less than 2 children	67.24	32.76	0.000	57.16	42.84	0.000	67.36	30.76	0.000
Have more than 2 children	71.69	28.31		61.09	38.91		69.24	30.76	
Socio-economic									
Wealth quintile									
Poorest	76.59	23.41	0.000	64.14	35.86	0.000	72.50	27.50	0.000
Poorer	73.66	26.34		59.87	40.13		69.78	30.22	
Middle	69.38	30.62		59.07	40.93		67.62	32.38	
Richer	64.74	35.26		54.47	45.53		64.76	35.24	
Richest	56.60	43.40		51.88	48.12		62.75	37.25	
Communication exposure									
Mass media									
Newspaper									
Does not read newspaper	72.43	27.57	0.000	60.97	39.03	0.000	69.55	30.45	0.000
Reads newspaper	61.45	38.55		53.78	46.22		64.19	35.81	
Radio									
Does not listen to the radio	70.68	29.32	0.000	58.99	41.01	0.000	68.27	31.73	0.000
Listens to radio	67.80	32.20		56.44	43.56		66.10	33.90	
Television									
Does not watch Television	74.13	25.87	0.000	62.23	36.77	0.000	71.37	28.63	0.000
Watches Television	65.62	34.38		56.59	43.41		66.41	33.59	

Table 2 presents the prevalence of childhood anaemia among children aged 6 to 59 months from the last three NFHS rounds in India. NFHS-3 reported a prevalence of 69.5% (CI: 68.7-70.2), while NFHS-4 recorded 58.4% (CI: 58.2-58.9), indicating a reduction. However, NFHS-5 demonstrated an alarming rise to 67.1% (CI: 66.7-67.5).

Socio-demographic differentials in the prevalence of anaemia among children in the three NFHS rounds, 2005-21 in India: The analysis of anaemia prevalence among children (6-59 months) across three rounds of NFHS surveys (2005-06, 2015-16, and 2019-21) provides valuable insights. The statistical inferences from the data highlight significant trends and disparities among various demographic and socio-economic factors (Table 3). The prevalence of anaemia varied by place of residence of the family, religion, caste or tribe of the household, wealth quintile of the household and age, education of the mother. Rural areas consistently exhibited higher anaemia rates (60-72%) compared to those residing in urban areas. Scheduled tribes (ST) consistently experienced higher anaemia rates compared to other castes and tribes. Non-

literate women consistently exhibited higher anaemia rates than literate women. Mothers with more than two children consistently experienced higher anaemia rates, indicating the importance of maternal health and nutrition in child anaemia prevention. Exposure to newspapers, radio, and television correlates with lower anaemia rates, as evidenced by statistically significant p-values across all communication channels, emphasising the role of mass media.

Findings from the Probit model for the NFHS-3 and NFHS-4 rounds

Table 4 presents the outcomes of a binary probit model examining the factors associated with the probability of anaemia across in the two National Family Health Survey (NFHS) rounds 3 and 4 conducted in 2005-06 and 2015-16. After adjusting for standard covariates, in the probit model, it was found according to marginal effects, the probability of children being anaemic in urban areas is lesser by 0.42% in NFHS-3 and by 0.18% in NFHS-4. With respect to the religion of the head of the household, the probability of being anaemic is lower among those belonging to the Christian religion in the two rounds of NFHS-3 and NFHS-4. Those belonging to the scheduled tribes have a higher probability of being anaemic in the two survey rounds of NFHS-3 and NFHS-4. Literate mothers were found to have a lower probability of anaemia in their children. Those who had more than two children had a higher probability of anaemia across the two rounds of NFHS-3 and NFHS-4. Female children had a higher probability of being anaemic in the NFHS-3 and NFHS-4 rounds. Those who were exposed to mass media (newspaper, radio, and television) consistently had a lower probability of being anaemic in both the rounds of NFHS-3 and NFHS-4.

Findings from the logit model for the NFHS-5 round

Table 5 presents the outcomes of a binary logit model examining the factors associated with the likelihood of anaemia in the National Family Health Survey (NFHS) round-5 conducted in 2019-21. In the NFHS-5 round, in the binary logit model, after adjusting for standard covariates, it was found that those belonging to Christian religion were less likely to be anaemic (AOR=0.512, 95% CI: 0.449-0.583, p=0.000). Those belonging to the scheduled tribes were 1.240 times (AOR=1.240, 95% CI :1.140-1.348, p=0.000) more likely to be anaemic compared to the scheduled castes. Maternal education was another significant factor determining the likelihood of being anaemic. Literate mothers were less likely to have anaemic children. Those mothers who had more than two children were more likely to have anaemic children. Among the mass media exposure, exposure to newspapers was found to be significant predictor of anaemic status. Those who read newspapers were less likely to have anaemic children.

Table 4: Estimates of a binary probit model in NFHS-3 (2005-06) and NFHS-4 (2015-16) rounds in India dependent variable: prevalence of childhood anaemia.

Covariates	NFHS-3, 2005-06			NFHS-4, 2015-16		
	Coefficient	SE	dy/dx (SE)	Coefficient	SE	dy/dx (SE)
Community level						
Place of residence						
Rural						
Urban	-0.012	0.029	-0.0042 (0.0100)	0.046	0.015	0.0177 (0.0056)
Religion						
Hindu						
Muslim	0.018	0.036	0.0062 (0.0123)	0.013	0.015	0.0051 (0.0057)
Christian	-0.173	0.059	-0.0624 (0.0219)	-0.281	0.032	-0.1112 (0.1258)
Sikh	0.028	0.055	0.0095 (0.0189)	0.063	0.032	0.0242 (0.0122)
Others	-0.001	0.068	-0.0003 (0.0235)	0.054	0.058	0.0209 (0.0222)
Caste or tribe of the household head						
Scheduled caste						
Scheduled tribe	0.113	0.043	0.0372 (0.0140)	0.053	0.017	0.0205 (0.0066)
No caste or tribe	-0.051	0.027	-0.0178 (0.0094)	-0.184	0.031	-0.0727 (0.0124)
Do not know	-0.196	0.109	-0.0703 (0.0407)	-0.073	0.077	-0.0286 (0.0305)
Individual level: education of the mother						
Non-literate						
Literate	-0.102	0.026	-0.0355 (0.0090)	-0.171	0.011	-0.0661 (0.0042)
Demographic						
Age group of the mother (in years)						
15-19						
20-24	-0.277	0.051	-0.0838 (0.0141)	-0.098	0.031	-0.0364 (0.0114)

Continued.

Covariates	NFHS-3, 2005-06			NFHS-4, 2015-16		
	Coefficient	SE	dy/dx (SE)	Coefficient	SE	dy/dx (SE)
25-29	-0.390	0.052	-0.1225 (0.0144)	-0.220	0.031	-0.0833 (0.0114)
30-34	-0.480	0.054	-0.1549 (0.0583)	-0.298	0.033	-0.1142 (0.1197)
35-39	-0.461	0.062	-0.1479 (0.0191)	-0.365	0.035	-0.1407 (0.0131)
40-44	-0.570	0.083	-0.1887 (0.0287)	-0.327	0.041	-0.1256 (0.0157)
45-49	-0.399	0.131	-0.1255 (0.0452)	-0.401	0.060	-0.1548 (0.2319)
Total children ever born						
Have 2 or less than 2 children						
Have more than 2 children	0.094	0.023	0.0327 (0.0078)	0.074	0.010	0.0288 (0.0039)
Sex of the child						
Male						
Female	0.022	0.018	0.0077 (0.0061)	0.000	0.008	0.0000 (0.0031)
Socio-economic covariates						
Wealth quintile						
Poorest						
Poorer	-0.048	0.032	-0.0159 (0.0105)	-0.056	0.012	-0.0217 (0.0047)
Middle	-0.126	0.034	-0.0423 (0.0112)	-0.040	0.014	-0.0155 (0.0056)
Richer	-0.193	0.036	-0.0661 (0.0123)	-0.127	0.017	-0.0494 (0.0065)
Richest	-0.317	0.043	-0.1119 (0.0152)	-0.151	0.021	-0.0588 (0.0081)
Communication exposure						
Mass media						
Newspaper						
Do not read the newspaper						
Reads newspaper	-0.060	0.027	-0.0209 (0.0094)	-0.034	0.012	-0.0132 (0.0045)
Radio						
Do not listen to the radio						
Listens to radio	0.001	0.021	-0.0051 (0.0074)	-0.009	0.013	-0.0034 (0.0052)
Television						
Do not watch television						
Watches television	-0.041	0.026	-0.0143 (0.0090)	-0.040	0.011	-0.0156 (0.0043)

Table 5: Estimates of a binary logit model in NFHS-5 (2019-21) in India dependent variable: prevalence of childhood anaemia.

Covariates	NFHS-5, 2019-21				
	Coefficient	Adjusted odds ratio (AOR)	95% confidence		
			Lower interval	Upper interval	P values
Community level					
Place of residence					
Rural					
Urban	-0.009	0.991	0.930	1.055	0.773
Religion					
Hindu					
Muslim	-0.073	0.930	0.870	0.993	0.031
Christian	-0.670	0.512	0.449	0.583	0.000
Sikh	0.297	1.346	1.165	1.555	0.000
Others	0.257	1.292	1.014	1.648	0.047
Caste or tribe					
Scheduled caste					
Scheduled tribe	0.215	1.240	1.140	1.348	0.000
No caste or tribe	0.014	1.014	0.901	1.142	0.817
Individual level: education of the mother					
Non-literate					
Literate	-0.160	0.852	0.802	0.905	0.000

Continued.

Covariates	NFHS-5, 2019-21				
	Coefficient	Adjusted odds ratio (AOR)	95% confidence		
			Lower interval	Upper interval	P values
Demographic					
Age of the mother (in years)					
15-19					
20-24	-0.255	0.775	0.681	0.881	0.000
25-29	-0.390	0.667	0.595	0.770	0.000
30-34	-0.472	0.624	0.543	0.716	0.000
35-39	-0.598	0.550	0.472	0.641	0.000
40-44	-0.779	0.459	0.361	0.584	0.000
45-49	-0.434	0.648	0.422	0.994	0.047
Total children ever born					
Have 2 or less than 2 children					
Have more than 2 children	0.163	1.177	1.119	1.239	0.000
Sex of the child					
Male					
Female	-0.070	0.932	0.894	0.972	0.001
Socio-economic					
Wealth quintile					
Poorest					
Poorer	-0.040	0.961	0.904	1.022	0.205
Middle	-0.063	0.939	0.876	1.007	0.079
Richer	-0.160	0.852	0.789	0.919	0.000
Richest	-0.234	0.791	0.721	0.869	0.000
Communication exposure					
Mass media					
Newspaper					
Do not read a newspaper					
Reads newspaper	-0.081	0.922	0.875	0.971	0.002
Radio					
Do not listen to the radio					
Listens to the radio	-0.026	0.974	0.906	1.048	0.480
Television					
Do not watch television					
Watches Television	-0.046	0.955	0.907	1.005	0.077

DISCUSSION

The analyses of childhood anaemia prevalence in India across NFHS rounds (2005-06, 2015-16, and 2019-21) reveals several significant insights. The prevalence of childhood anaemia has seen fluctuations over the years. This fluctuation highlights the need for continuous monitoring and targeted interventions to address anaemia effectively. The analysis uncovers significant disparities in anaemia prevalence across various socio-demographic factors and indicates the intersectionality of socio-economic factors with health outcomes. Maternal education is strongly associated with the lower likelihood of prevalence of anaemia, which is corroborated by earlier studies as well.[13,14] The binary probit and logit models provide valuable insights into the association between various covariates and the probability and likelihood of childhood anaemia.

Policymakers and implementers could prioritize interventions targeting vulnerable populations, including rural, scheduled tribes and minority communities. Efforts to improve maternal education and access to healthcare services can help mitigate the burden of childhood anaemia. Community-based health education programs should emphasize the importance of maternal and child nutrition, including iron supplementation and breastfeeding practices. Mass media campaigns can play a crucial role in disseminating information and promoting healthy behaviour related to anaemia prevention and management.

CONCLUSION

The study provides crucial insights into the evolving landscape of childhood anaemia in India over the last decade and a half, utilizing data from the National Family Health Surveys (NFHS). Childhood anaemia remains a

significant public health concern, with wide-ranging consequences including perinatal mortality, child morbidity and mortality, impaired mental development, compromised immune function, and reduced work performance. The analysis reveals several key findings regarding the correlates of childhood anaemia in India. Firstly, there is a noticeable shift in the prevalence of anaemia over time, with a decline from NFHS-3 to NFHS-4 followed by a concerning rise in NFHS-5. Maternal education emerges as a significant determinant, with literate mothers demonstrating a lower likelihood of anaemia in their children. Addressing this multi-factorial issue requires comprehensive interventions targeting vulnerable populations, promoting maternal and child health literacy, improving access to healthcare services, and implementing effective nutrition programs. Collaboration between government agencies, healthcare providers, community organizations, and other stakeholders is essential to develop and implement evidence-based strategies aimed at reducing the prevalence of childhood anaemia and improving the overall health and well-being of children in India.

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