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Prevalence of anaemia among children under five in Northeast India: evidence from NFHS-5 data

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Abstract

Anaemia continues to be a major public health problem throughout the world, particularly among young children in developing countries. In India, more than two-thirds of the under-five children are affected, with a disproportionate load in NE India. The study investigates the prevalence and determinants of childhood anaemia in the region. In the present study, data from the National Family Health Survey (NFHS-5) comprising 26,522 children aged 6–59 months in NE India were used. Haemoglobin <11.0 g/dL was defined as anaemia. Haemoglobin was measured using the HemoCue Hb 201+ analyser. Descriptive, bivariate and multinomial logistic regression analyses were carried out, as well as a spatial analysis using QGIS. Childhood anaemia is still highly prevalent, with significant variation by demographic, nutritional and socio-economic factors. Higher prevalence is seen in younger children, those with poor nutritional status (stunting and underweight), and children with recent morbidity. Strong associations are seen with maternal factors, particularly maternal anaemia and low maternal education. Risk is also increased by household conditions, such as unsafe cooking fuel. Socio-economic disparities remain, with rural and poorer households being more vulnerable. There is marked regional variation, with Assam having the highest burden. The regression results suggest that child age, nutritional status, maternal anaemia, and household environment are important predictors. Childhood anaemia in NE India is influenced by a variety of interconnected factors such as nutrition, maternal health and living conditions. Targeted interventions at the regional level are required to alleviate the burden by improving maternal nutrition, child feeding practices and household environments.

Keywords: anaemia, under-five children, NE India, NFHS-5, iron deficiency

1. Introduction

Anaemia is a significant global public health problem affecting around one-third of the world's population (Dubey, 1994; World Health Organization (WHO), 2025) and is most serious among young children, women of reproductive age and developing countries (Duduveche & Badelita, 2025;

Sheth et al., 2021; World Health Organization (WHO), 2025). Developing countries account for more than 89% of the global anaemia burden (Kassebaum, 2016). In the Southeast Asia region alone, approximately 244 million women and 83 million children are affected (WHO, 2025), with about 50% of cases attributed to iron deficiency (WHO, 2015). Among mothers, anaemia significantly elevates the risk of maternal morbidity and mortality (Daru et al., 2018), and is attributed to iron-deficiency anaemia (WHO, 2015). Additionally, iron deficiency anaemia continues to be highly prevalent across South Asian countries, including India, Bangladesh, and Pakistan, and poses serious health risks for women and children (Harding et al., 2017; Lokeshwar et al., 2010). In India, iron-deficiency anaemia affects over 50% of women and children, constituting a major public health crisis (Natekar et al., 2022).

Iron deficiency, primarily resulting from inadequate dietary intake, continues to be the most common nutritional cause of anaemia worldwide (WHO, 2025). Research in low- and middle-income countries has primarily focused on women of reproductive age and young children because anaemia during pregnancy and early childhood leads to severe adverse outcomes (Alem et al., 2023; Hasan et al., 2022; Wang et a,l., 2025). Among pre-school children, anaemia commonly results from inadequate intake of iron and other micronutrients, such as folate, vitamin A, and vitamin B12, along with infections, including malaria and parasitic infestations (Dey et al., 2013; Pasricha et al., 2010). Studies (Haider et al., 2013; Mireku et al., 2015) show that anaemia is associated with low birth weight, impaired cognitive and motor development, poor school performance, and increased mortality risk among children (Bharati et al., 2019).

Over the past decade, India has been one of the largest contributors to the global burden of childhood anaemia (Pasricha et al., 2010). The National Family Health Survey-5 (2019-21) report indicates that 57% of women aged 15-49 years and over 67% of children aged 6-59 months are anaemic (IIPS & ICF, 2021), with particularly high prevalence observed in Northeast India (NE India) (Duduveche & Badelita, 2025; Jeevan et al., 2025). Notably, the prevalence of childhood anaemia increased from 58.6% in NFHS-4 (2015-16) to 67.1% in NFHS-5, despite economic growth and multiple public health interventions, indicating a worsening public health challenge in the country (Givens et al., 2024; Kumari et al., 2025), with adverse implications for physical growth, cognitive development, and long-term human capital formation (Katzman et al., 1972; Singh et al., 2023; Zhao et al., 2012).

Iron deficiency, maternal anaemia, household food insecurity, poor sanitation, and limited access to healthcare significantly contributed to anaemia (Pasricha et al., 2010). Existing literatures (Ghosh & Desai, 2021; McDonald et al., 2015; Puranik & N, 2022) also consistently identifies low household income, poor maternal education, and rural residence as key predictors of childhood anaemia. Other risk factors include micronutrient deficiency and recurrent infections and parasitic diseases that impair nutrient absorption (Dey et al., 2013). Regional disparities further reflect the influence of uneven socio-economic development and healthcare infrastructure (WHO, 2008). Further, evidence (Habte et al., 2013) indicates that anaemia persists even among children from urban areas, wealthier households, and families with higher educational backgrounds. In contrast, higher maternal education, improved nutritional status, and appropriate birth spacing are associated with a reduced risk of anaemia (Goswami et al., 2020). As such, it has been associated with severe health consequences, such as impaired physical growth, delayed cognitive and motor development, functional disability, poor educational performance, and increased risk of morbidity and mortality (Sally & Cornelius, 2001).

Previous studies (Bharati et al., 2019; Ghosh & Desai, 2021; Jeevan et al., 2025; Singh et al., 2023) have primarily focused on estimating the prevalence of childhood anaemia in India, with some highlighting its disproportionately high burden in the NE India. However, existing literature (Pasricha et al., 2010; Porwal et al., 2021; Raut & Reddy, 2024; Singh et al., 2023) also lacks a comprehensive regional analysis that simultaneously examines child-level, maternal, household, and health-related factors alongside district-level spatial heterogeneity in NE India. Hence, the present study aims to assess the prevalence and spatial clustering of anaemia among children under five across districts of NE India. It further examines the associated socio-demographic, maternal, household, and health-related determinants, and identifies high-prevalence clusters to inform targeted, evidence-based interventions aligned with global 2030 goals. The findings provide important insights for strengthening policy formulation and implementation.

2. Materials and Methods

This study is based on data from the fifth round of the National Family Health Survey (NFHS-5), conducted during 2019-2021 under the aegis of the Ministry of Health and Family Welfare (MoHFW), Government of India. The International Institute for Population Sciences (IIPS), Mumbai, functioned as the nodal agency responsible for implementing all rounds of the NFHS. NFHS-5 provides comprehensive information on population, health, and nutrition indicators at the national, state and union territory (UT), and district levels, covering as many as 707 districts.

The survey adopted a nationally representative design and collected information on 232,920 children aged 0-59 months. Haemoglobin estimation was carried out for children aged 6-59 months in selected households using capillary blood samples. The measurements were obtained using a portable, battery-operated HemoCue Hb 201+ analyser. After excluding observations with missing or flagged values, valid haemoglobin measurements were available for 183,855 children, of whom 28,563 belonged to the NE region of India. The analytical sample for the present study comprised 26,522 living children aged 6-59 months with valid haemoglobin values from the northeastern states. For the present analysis, the sample was restricted to the northeastern states, yielding a final analytical sample of 26,522 living children aged 6-59 months with valid haemoglobin measurements. The Kids Record (KR) dataset was used with formal endorsement from the MEASURE DHS program.

2.1 Outcome Variable

The outcome variable is anaemia status in children aged 6 to 59 months. According to the National Family Health Survey (NFHS), children with haemoglobin levels of less than 11.0 g/dL were classified as anaemic. Anemia was classified into mild (10.0–10.9g/dL), moderate (7.0–9.9g/dL), and severe (less than 7 g/dL). Haemoglobin was corrected for altitude at enumeration areas located higher than 1,000 meters. Acute cases of severe anaemia among children were subsequently referred to the nearest health facilities for clinical evaluation and management. Anaemia status was classified into three mutually exclusive groups for analytic purpose (moderate to severe anaemia, mild anaemia, and not anaemic).

2.2 Independent Variables

A wide selection of explanatory variables was included in the analysis based on existing literature and data availability. For child-level variables (age, sex, type of birth (single or multiple), parity or birth order, size at birth (large/same as average/small), preceding and succeeding birth intervals, recent morbidity indicators

diarrhea and fever in 2 weeks before the survey), and nutritional status indicators stunting, wasting, underweight, overweight for age, and overweight for height. We assessed some household characteristics, type of toilet facility, type of cooking fuel, source of drinking water, place of residence (rural/urban), caste, religion, and wealth quintile and state of residence in the NE region of India. Maternal characteristics comprised age, educational attainment, anaemia status, and body mass index (BMI).

2.3 Methods of Analysis

The analysis was done using the appropriate sampling weight and primary sampling unit and strata adjustment provided in the NFHS-5 dataset, taking into account the complex survey design and potential non-response. For baseline description of the study population and to assess the prevalence of anaemia within each category, descriptive statistics were used. The bivariate comparisons of anaemia status with the explanatory variables used the chi-square test. Multinomial logistic regression analysis was used, the dependent variable being anaemia status that was divided into three categories: (1) moderate to severe anaemia, (2) mild anaemia, and (0) not anaemic (reference category). All of the explanatory variables were assumed to be categorical predictors. The results are presented in terms of Relative Risk Ratios (RRR) along with 95% Confidence Intervals (CI) and corresponding p-values. RRR values above 1 suggest increased risk of suffering from a specific category of anaemia compared to the reference population and RRR values below 1 suggest decreased risk of suffering from a specific category of anaemia compared to the reference population. RRR is close to 1 if there is no difference between groups. All statistical analysis was conducted in STATA version 16 statistical software package and spatial analysis was conducted in QGIS and GeoDa.

3. Results

3.1 Background characteristics

The background characteristics of children under 5 years in NE India is presented in Table 1. There is an age gradient with the prevalence of anaemia rising steadily from the youngest age group (6-11 months) to the oldest (48-59 months) (23.87%). There are few gender differences as male children (50.07%) are marginally more likely to have a prevalence than female children (49.93%). Distribution of anaemia is highly skewed towards single born children (98.89%) and very little multiple births (1.11%). The prevalence of birth order decreases with the first born having the highest prevalence (41.23%), second-born (32.02%) and third or higher order births (26.75%). Perceived size at birth does not represent a simple disadvantage for smaller children, most instances of anaemia are clustered in children who are perceived as ‘average size' or larger (88.47%). The birth spacing patterns also show that birth intervals of <24 months precede 8.47% of births while 41.39% of births are preceded by a birth interval of 24-27 months. By comparison, the birth interval patterns for successions suggest a high prevalence of anaemia for the last-born children (84.21%) and comparatively low proportions in all other birth interval categories.

Table-1: Sample description of under-five children by background characteristics in NE India, NFHS-5 (2019–21)

Variables	Frequency	Percentage
Child age (months)		
6 – 11	2663	10.17

12 – 23	5421	20.60
24 – 35	5870	22.23
36 – 47	6113	23.13
48 – 59	6455	23.87
Sex of child		
Male	13341	50.07
Female	13181	49.93
Birth type		
Single	26205	98.89
Multiple	317	1.11
Child birth order		
First	9721	41.23
Second	7856	32.02
Third & above	8945	26.75
Child size		
Average & above	23250	88.48
Small	2018	8.47
Very Small	328	1.22
Don't Know	926	1.82
Preceding birth interval		
First	9766	41.39
Less than 24 months	3315	8.61
24-47 months	7639	25.24
More than 48 months	5802	24.77
Succeeding birth interval		
Last	21027	84.21
less than 24 months	2052	5.12
24-47 months	3197	9.59
More than 48 months	246	1.08
Had diarrhoea for the last two weeks		
No	24876	93.83
Yes	1646	6.17
Had a fever for the last two weeks		
No	22423	81.98
Yes	4099	18.02
Child stunting		
No	16916	63.73
Yes	9606	36.27
Child wasting		
No	22440	80.93
Yes	4082	19.07
Child underweight		
No	20334	71.71
Yes	6188	28.29

Overweight to age		
No	26230	99.04
Yes	292	0.96
Overweight to height		
No	25224	95.9
Yes	1298	4.1
Toilet facility		
Not improved	3624	20.68
Improved	22898	79.32
Cooking fuel		
Unsafe	16414	62.2
Safe	10108	37.8
Drinking water source		
Not improve	4510	15.61
Improved	22012	84.39
Mother age (years)		
15-24 years	6569	30.53
25-34 years	15156	55.47
35-49 years	4797	14.0
Mother's education level		
No education	4253	15.27
Primary	4711	16.85
Secondary	15633	61.22
Higher	1925	6.66
Mother's anaemia level		
Severe	466	1.96
Moderate	6825	32.07
Mild	6418	26.61
Not Anaemic	12813	39.37
Maternal BMI division		
Too thin	3044	16.05
Normal	19100	69.94
Overweight	4378	14.02
Place of residence		
Urban	3833	14.07
Rural	22689	85.93
Caste		
SC	1832	10.61
ST	16105	27.53
OBC	2740	18.29
Others	5845	43.57
Religion		
Hindu	7680	44.92
Muslim	3859	33.71

Christian	12575	18.39
Others	2408	2.98
Wealth quintile		
Poorest	10106	41.32
Poorer	8424	32.09
Middle	4746	15.5
Richer	2510	8.36
Richest	736	2.72
State		
Sikkim	412	0.5
Arunachal Pradesh	4235	2.07
Nagaland	2474	2.7
Manipur	2593	5.74
Mizoram	1909	2.02
Tripura	1599	7.35
Meghalaya	5242	10.28
Assam	8058	69.35

Source: NFHS-5; Author's calculation

Anaemia prevalence by child health characteristics shows a number of interesting trends. A significantly higher number of anaemic children (93.83%) are found among those with no diarrhoea as opposed to those with diarrhoea (6.17%). Likewise, the proportion of anaemic cases due to children that did not report fever in the previous two weeks is higher (81.98%) compared to those who reported fever (18.02%). From the nutritional status point of view, there is higher percentage of non-stunted children who are anaemic (63.73%) compared to the stunted children (36.27%). The same trend can be seen for wasted and underweight children, as non-wasted child cases (80.93%) and non-underweight case children (71.71%) make up a bigger proportion of all anaemia cases than their respective counter parts. The situation is similar when it comes to children being near all anaemic children being not overweight for age (99.04%) and not overweight for height (95.9%). Further difference in the distribution of anaemia is observed in relation to the domestic environmental conditions. There were relatively more anaemic children in households with improved toilets (79.32%) and improved sources of drinking water (84.39%) while relatively fewer children were anaemic in households that used unsafe cooking fuel when compared with those that used clean cooking fuel (37.8%).

The results show that the prevalence of anaemia among children is significantly different across maternal age groups, highest prevalence of anaemia was found in the children of mothers aged 25-34 years (55.47%) followed by 15-24 years (30.53%) and 35-49 years (14.00%) respectively. There are also differentials in maternal education levels. Children of mothers with secondary education have the highest prevalence of anaemia (61.22%), followed by those of mothers who have primary education (16.85%), no education (15.27%) and higher education (6.66%). With regard to maternal anaemia status, children born from non-anaemic mothers have the highest prevalence (39.37%), followed by moderately anaemic (32.07%), mildly anaemic (26.61%) and severely anaemic mothers (1.96%). There are also some differences in nutritional status of mothers. Children with normal BMI had the highest prevalence of anaemia (69.94%) followed by children whose mothers were underweight (16.05%) and children whose mothers were overweight

(14.02%). The disparities in socio-economic and demographic characteristics further emphasize that there is an uneven distribution. The prevalence of anaemia is much higher in rural areas (85.93%) than in urban areas (14.07%). The highest prevalence is seen among children belonging to the ‘Others' category (43.57%) followed by children from the Scheduled Tribes (ST) 27.53%, Other Backward Classes (OBC) 18.29% and the Scheduled Castes (SC) 10.61%. Likewise, by religion, highest prevalence is observed in Hindu household (44.92%), then Muslim (33.71%), Christian (18.39%) and others (2.98%). It is evident from economic status that the highest prevalence (41.32%) is observed among children from the poorest households followed by poorer households (32.09%), middle (15.50%), richer (8.36%) and richest households (2.72%). Assam has the highest prevalence (69.35%) of anaemia followed by the state of Meghalaya (10.28%), Tripura (7.35%), Manipur (5.74%), Nagaland (2.70%), Arunachal Pradesh (2.07%) and Mizoram (2.02%) respectively with the lowest prevalence in Sikkim (0.50%).

3.2 Association of Childhood Anaemia with Background Characteristics

The association of anaemia among children under 5 years of age with background characteristics is presented in Table 2. The highest prevalence of moderate to severe anaemia was seen in children aged 6--11 months (47.7%) and 12--23 months (39.93%) and decreased gradually with age reaching 19.95% in children aged 48--59 months. However, mild anaemia showed an increasing trend with age, reaching its highest prevalence in children aged 36-47 months (34.73%) which slightly decreased at 48-59 months (34.18%). In a similar manner, the percentage of non-anaemic children increases with age, and is 45.86% in older children, showing greater nutritional adaptation as children get older. It is likely that this age distribution is due to iron depletion in the mother, high growth needs, and low complementary food intake during infancy (Armitage & Moretti, 2019).

Child sex is not statistically associated with anaemia and there is little gender difference between categories. The prevalence of moderate to severe anaemia is comparable between males (29.52%) and females (30.36%) and also mild and non-anaemic proportions are also comparable across the sexes. There is a significant association of anaemia with birth type, however. The prevalence of moderate to severe anaemia was higher in multiple births than singletons children (34.25% vs. 29.89%). The differences in mild anaemia and non-anaemic status by birth type are small. The greater vulnerability may be related to the increased risk of low birth weight and lower haemoglobin stores in multiple births (Stevens et al., 2025).

From the results, there appears to be a statistically significant relationship between birth order and childhood anaemia despite the small differences that exist. The occurrence of moderate and severe anaemia is marginally more common among second order births (30.57%) compared to third order and above (29.93%) and first-order births (29.45%). This could be due to intra-household resource dilution and nutritional depletion of mothers with each birth (Kassebaum et al., 2014). A small difference is also seen in the case of mild anaemia where the highest level is experienced among first-order births (34.45%) compared to second order (33.59%) and higher order (32.56%) births.

Being born small is another factor that shows a significant relationship with anaemia. Children who were noted to be small during birth have a high percentage of moderate to severe anaemia (34.70%), meaning they are vulnerable because of their low birth weight and lack of iron. On the other hand, mild anaemia is found more often in children with average to above-average sizes (34.08%).

Table-2: Association between childhood anaemia and socio-demographic characteristics in NE India, NFHS-5 (2019-21)

Variables	Moderate to severe anaemic	Mild anaemic	Not anaemic	Chi-square
Child age (months)	**29.94**	**33.67**	**36.4**	
6 – 11	47.70	28.77	23.53	0.000*
12 – 23	39.93	33.51	26.55	
24 – 35	29.83	34.40	35.77	
36 – 47	23.62	34.73	41.65	
48 – 59	19.95	34.18	45.86	
Sex of child				0.431
Male	29.52	33.81	36.67	
Female	30.36	33.53	36.12	
Birth type				0.048*
Single	29.89	33.67	36.44	
Multiple	34.25	33.60	32.15	
Child birth order				0.000*
First	29.45	34.45	36.10	
Second	30.57	33.59	35.84	
Third & above	29.93	32.56	37.52	
Child size				0.000*
Average & above	29.48	34.08	36.44	
Small	34.70	31.22	34.08	
Very small	30.98	25.69	43.32	
Don't know	29.30	30.50	40.21	
Preceding birth interval				0.000*
First month	29.52	34.37	36.12	
Less than 24 months	30.04	28.59	41.37	
24-47 months	29.30	33.60	37.10	
More than 48 months	31.25	34.34	34.41	
Succeeding birth interval				0.000*
Last month	31.41	33.79	34.80	
less than 24 months	21.05	33.03	45.92	
24-47 months	22.45	32.63	44.91	
More than 48 months	23.79	36.38	39.86	
Had diarrhoea for the last two weeks				0.000*
No	29.58	33.69	36.73	
Yes	29.94	33.67	31.32	
Had a fever for the last two weeks				0.000*
No	29.11	33.67	37.21	
Yes	33.68	33.65	32.68	
Child stunting				0.000*
No	27.13	33.97	38.89	
Yes	34.86	33.13	32.01	

Child wasting				0.000*
No	29.50	33.25	37.25	
Yes	31.79	35.42	32.78	
Child underweight				0.000*
No	27.78	33.86	38.36	
Yes	35.40	33.18	31.42	
Overweight to age				0.040*
No	29.99	33.73	36.28	
Yes	24.79	26.93	48.27	
Overweight to height				0.076
No	29.86	33.58	36.56	
Yes	31.74	35.81	32.45	
Toilet facility				0.000*
Not improved	33.84	36.15	30.01	
Improved	28.92	33.02	38.06	
Cooking fuel				0.000*
Unsafe	31.56	34.80	33.64	
Safe	27.26	31.81	40.93	
Drinking water source				0.000*
Not improved	30.58	31.67	37.75	
Improved	29.82	34.04	36.14	
Mother’s age (years)				0.000*
15-24 years	33.86	33.65	32.49	
25-34 years	29.47	33.90	36.63	
35-49 years	23.22	32.79	43.99	
Mother's education level				0.000*
No education	34.99	34.59	30.42	
Primary	30.74	33.75	35.51	
Secondary	29.30	33.01	37.69	
Higher	22.20	37.39	40.41	
Mother's anaemia level				0.000*
Severe	38.34	33.63	28.03	
Moderate	38.69	33.9	27.41	
Mild	29.51	35.4	35.09	
Not Anaemic	22.68	45.01	32.31	
Maternal BMI division				0.000*
Too thin	35.87	35.04	29.09	
Normal	29.45	33.73	36.83	
Overweight	25.58	31.81	42.61	
Place of residence				0.000*
Urban	24.38	32.63	43.00	
Rural	30.85	33.84	35.31	
Caste				0.000*
SC	33.4	33.35	33.25	

ST	27.02	28.94	44.04	
OBC	32.71	35.22	32.08	
Others	29.77	36.08	34.15	
Religion				0.000*
Hindu	32.95	34.72	32.33	
Muslim	30.54	36.80	32.66	
Christian	22.09	26.11	51.79	
Others	26.06	29.03	44.91	
Wealth quintile				0.000*
Poorest	32.84	35.08	32.08	
Poorer	30.57	32.74	36.69	
Middle	27.73	31.07	41.19	
Richer	21.13	33.56	45.30	
Richest	17.93	38.37	43.70	
State				0.000*
Sikkim	29.78	25.31	44.91	
Arunachal Pradesh	27.36	28.28	44.33	
Nagaland	16.01	27.37	56.62	
Manipur	17.71	25.14	57.15	
Mizoram	22.71	25.36	51.93	
Tripura	30.80	33.35	35.84	
Meghalaya	20.05	24.41	55.55	
Assam	33.15	36.49	30.36	

Significance at <0.05*

Source: NFHS-5; Author's calculation

As indicated in the preceding birth interval, there is a significant relationship between the birth interval and childhood anaemia. Children with birth intervals of more than 48 months have the highest prevalence rate of moderate to severe anaemia (31.25%) followed by children with birth intervals of less than 24 months (30.04%), first children (29.52%) and 24 – 47 months (29.30%). In mild anaemia, first born children have the highest prevalence rate (34.37%) followed by birth intervals of more than 48 months (34.34%) and 24 – 47 months (33.60%) and the least prevalence rate occurs in children with birth intervals of less than 24 months (28.59%). On the other hand, the prevalence of non-anemia is greatest among the children who have had shorter birth intervals before their own birth (less than 24 months), which implies that this category of children has relatively good nutrition outcomes (Conde-Agudelo et al., 2007; Rutstein, 2005).

The association between the succeeding birth interval and anaemia status is statistically significant. Last-born children exhibit a higher prevalence of moderate to severe anaemia (31.41%) compared to those with defined succeeding birth intervals. In contrast, children with shorter succeeding intervals of less than 24 months (21.05%) and 24–47 months (22.45%) show relatively lower prevalence. Mild anaemia is comparatively more prevalent among children with longer succeeding intervals (>48 months). Correspondingly, the proportion of non-anaemic children is highest among those with shorter succeeding intervals, particularly less than 24 months (45.92%) and 24–47 months (44.91%), indicating relatively better nutritional outcomes in these groups.

Children with diarrhoea for the last two weeks also demonstrate a statistically significant association with anaemia status. Children who experienced diarrhoea in the two weeks preceding the survey show a lower proportion of non-anaemic status (31.32%) compared to those without diarrhoea (36.73%), reflecting increased nutritional vulnerability due to nutrient loss and impaired absorption. Recurrent diarrhoeal episodes are known to reduce haemoglobin levels and increase the risk of anaemia (Checkley et al., 2008). However, the prevalence of moderate to severe anaemia and mild anaemia remains broadly similar across both groups, suggesting a more pronounced effect on overall nutritional status rather than specific anaemia categories.

There exists a statistically significant relationship between the presence of fever recently and the status of anaemia. Children who have had a fever recently (in the past two weeks) have a higher rate of moderate to severe anaemia (33.68%) compared to those who have no fever (29.11%), thus showing the harmful effects of diseases and inflammation on haemoglobin production (Duah et al., 2021; Sarna et al., 2020). At the same time, there is no difference in terms of the rate of mild anaemia between both categories of children. The share of children who do not suffer from anaemia is higher for those who do not have fever (37.21%) compared to those who have (32.68%).

Stunting among children is significantly correlated with anaemia. The percentage of anaemia cases among stunted children is significantly higher when compared with non-stunted children. This indicates that there is a correlation between chronic malnutrition and micronutrient deficiency leading to anaemia (Bharati et al., 2019; Dharmaraj et al., 2021). However, the prevalence of mild anaemia is almost similar among both categories of children but the percentage of non-anaemic children is higher among non-stunted children (38.89%) than stunted children (32.01%). These findings highlight the close link between long-term growth failure and poor micronutrient status, particularly iron deficiency.

Child wasting shows a statistically significant association with anaemia status. The prevalence of moderate to severe anaemia is higher among wasted children (31.79%) compared to non-wasted children (29.50%), indicating that acute undernutrition increases clinical and nutritional vulnerability (Posam et al., 2022). Mild anaemia is also relatively higher among wasted children (35.42%) than among non-wasted children (33.25%). Consistently, the proportion of non-anaemic children is lower among wasted children (32.78%) compared to their non-wasted counterparts (37.25%). These findings suggest that acute nutritional deficits and compromised immunity contribute to a higher risk of anaemia.

Underweight status is similarly and significantly associated with anaemia. The prevalence of moderate to severe anaemia is substantially higher among underweight children (35.40%) compared to those with normal weight (27.78%). In contrast, the prevalence of mild anaemia is nearly similar across both groups. The proportion of non-anaemic children is markedly lower among underweight children (31.42%) than among non-underweight children (38.36%). Such a trend shows that lack of adequate energy levels and nutrition predisposes individuals to suffer from anaemia, especially those living in poor economic backgrounds who cannot afford balanced diet and medical treatment (Gebreegziabher et al., 2020).

There exists statistical significance in the relationship between overweight-for-age and anaemia status. Overweight-for-age children have fewer incidences of moderate to severe anaemia (24.79%) when compared with other children (29.99%). There are fewer incidences of mild anaemia amongst overweight children (26.93%) compared with those of non-overweight children (33.73%). The incidence of non-anaemia among overweight children (48.27%) is much higher when compared with those of non-

overweight children (36.28%). It is clear that overweight-for-age acts as a protective factor against anaemia, as a result of more adequate nutrition, which can be facilitated by increased food variety and financial capability within households (Sharma et al., 2026). There is no statistical significance in the relationship between overweight-for-height and anaemia status.

There is a strong link between sanitation facilities and anaemia in children. Those who stay in households having unimproved toilet facilities have a greater prevalence of moderate to severe anaemia (33.84%) than those living in households having improved sanitation facilities (28.92%). Similarly, the mild form of anaemia is more prevalent in children staying in households with unimproved sanitation facilities (36.15%) than those living in households with improved sanitation facilities (33.02%). The percentage of non-anaemic children is also higher in improved sanitation facilities (38.06%) than in unimproved facilities (30.01%).

There exists a statistical significance between the nature of cooking fuels and anaemia among children. The percentage of moderately or severely anaemic children is relatively high (31.56%) among those who are from households that use hazardous fuels compared to those whose households use non-hazardous fuels (27.26%). The same trend occurs when it comes to mildly anaemic children, with a high percentage of mildly anaemic children being observed among children whose households use hazardous fuels (34.80%) as compared to those whose households use non-hazardous fuels (31.81%). However, the percentage of non-anaemic children is relatively high among households that use non-hazardous fuels (40.93%) compared to hazardous fuels (33.64%).

Also, the type of water source has been found to have a significant effect on the status of anaemia. The prevalence rate of moderate and severe anaemia is somewhat higher for children from homes using an unimproved water source (30.58%) as opposed to improved (29.82%). This could be attributed to the higher likelihood of contracting water-borne illnesses and infections that lead to malabsorption of nutrients (Duduveche & Badelita, 2025). On the other hand, there is a higher prevalence rate of mild anaemia among children using improved water source (34.04%) as opposed to unimproved sources (31.61%).

Maternal age has a statistically significant relationship with anaemia in children. The proportion of children suffering from moderate to severe anaemia is the highest amongst the children whose mothers are in the 15 to 24 years category (33.86%) and falls steadily with age until it attains the lowest point amongst the mothers aged 35 to 49 years (23.22%). There is also an observable trend with respect to mild anaemia, with the rate being a little bit higher amongst younger mothers (33.65%) than older mothers (32.79%). This may be linked to early age pregnancies, which are normally characterized by insufficient amounts of iron amongst young mothers to cater to the needs of the unborn fetus and infant (Aggarwal & Saluja, 2022).

Education of the mother also has a significant relationship with childhood anemia. The rate of moderate to severe anemia is greatest in the children of uneducated mothers (34.99%), and it decreases with increasing level of education up to 22.20% for children born to highly educated mothers. It signifies that education has a positive influence on the child's nutrition by enabling proper diet and health care practices (Duah et al., 2021). However, mild anemia is greatest in children of highly educated mothers (37.39%). In contrast, the percentage of non-anemic children is greater for highly educated mothers (40.41%).

It has been proven that maternal anaemia is a predictor of childhood anaemia (Singh et al., 2023). The percentage of childhood moderate to severe anaemia is the highest in case mothers have moderate (38.69%)

and severe (38.34%) anaemia, which signifies a high correlation between generations regarding nutrition status. Meanwhile, the highest percentage of mild anaemia in children belongs to the group of mothers who do not have anaemia (45.01%) while other percentages include those mothers with mild (35.40%), moderate (33.90%) and severe (33.63%) anaemia. Percentage of non-anaemic children is relatively high in children with moderately anaemic mothers (35.09%).

Similarly, Maternal Body Mass Index (BMI) also demonstrates a statistically significant relationship with anaemia among children. The children born from underweight (thin) mothers are seen to have the highest prevalence of moderate to severe anaemia (35.87%), while that from overweight mothers have the lowest prevalence (25.58%). In contrast, the prevalence of mild anaemia is high among children whose mothers are thin when compared to others. On the other hand, good nutritional condition of mothers seems to be helpful to provide enough physiological reserves for fulfilling the iron needs of their children (Gebreegziabher et al., 2020; Ntenda et al., 2019).

There exists a statistically significant relationship between place of residence and anaemia. Anaemia is found to be relatively more prevalent in children from rural areas (30.85%) than children from urban areas (24.38%). Likewise, the presence of mild anaemia is relatively more prevalent in rural areas (33.84%) than in urban areas (32.63%). However, the percentage of non-anaemic children is relatively more in urban areas (43.0%) than in rural areas (35.31%). This difference may be attributed to various factors such as health care availability, sanitary facilities, diet, and socio-economic factors (Sharma et al., 2026).

Caste has a significant relationship with childhood anaemia as well. Moderate to severe anaemia is prevalent in children belonging to SC (33.4%) and OBC (32.71%). On the other hand, anaemia levels are relatively low in ST children (27.02%). Mild anaemia is highly prevalent in the 'other' category of children (36.08%), followed by OBC children (35.22%), SC children (33.35%) and ST children (28.94%). Non-anaemic children have higher proportions in ST children (44.04%) and other caste categories (34.15%). This is because there is inequality in socio-economic factors, dietary intake, and healthcare access amongst the caste groups (Singh et al., 2023).

A statistical relationship between religion and childhood anaemia exists. There is a higher percentage of children with moderate to severe anaemia among Hindu (32.95%) and Muslim religions (30.54%) and lower percentage of children with anaemia among Christian (22.09%). However, there is a higher percentage of children with mild anaemia among Muslim religion (36.80%). The number of non-anaemic children is high among Christians (51.79%) compared to other religions such as Hindu (32.33%) and Muslims (32.66%). The reason for these differences can be attributed to differences in dietary habits among religious groups (Bharati et al., 2019).

There is a highly correlated relationship between the economic state of the household and anaemia among children. The incidence of moderate to severe anaemia falls with increasing wealth, ranging from 32.84% in the poorest families to 17.93% in the richest families. This gradient highlights the increased risk of children from poor families who suffer from nutritional deficiency, poor sanitation, and lack of access to medical care (Sharma & Goswami, 2024). On the other hand, mild anaemia is more prevalent in the case of children from rich families. Moreover, the share of non-anaemic children increases significantly with wealth, from 32.08% in the poorest quintile to above 43% in the richer and richest segments.

There is a notable difference in the incidence of childhood anemia in the states of Northeast India. The highest prevalence of moderate to severe anemia is found in Assam (33.15%) and Tripura (30.80%), while comparatively lesser prevalence is seen in Nagaland (16.01%) and Manipur (17.71%). The same trend exists in relation to the prevalence of mild anemia, where the highest prevalence is found in Assam (36.49%), followed by Tripura (33.35%). Conversely, the proportion of non-anaemic children is highest in Manipur (57.15%), followed by Nagaland (56.62%) and Meghalaya (55.55%), indicating relatively better nutritional outcomes in these states. On the contrary, Assam has the minimum percentage of non-anaemic children (30.36%), which indicates higher levels of anaemia prevalence. The states like Sikkim (44.91%), Arunachal Pradesh (44.33%), and Mizoram (51.93%) fall in between this range. These variances between states may be due to the difference in the development of the health care system and other factors (Kumar et al., 2025).

3.3 Multivariate analysis

Table 3 presents the results of the multinomial logistic regression models, highlighting the adjusted effects of child, maternal, and household characteristics on anaemia among children in NE India. Children's age shows a statistically significant association with anaemia status, with both moderate-to-severe and mild anaemia exhibiting lower odds among older children compared to those aged 6–11 months. In contrast, the sex of the child is not significantly associated with anaemia, although female children show a slightly higher likelihood of being anaemic than males. Similarly, birth type does not demonstrate any statistically significant relationship with anaemia status. Birth order is significantly associated with mild anaemia, with children of higher birth orders being less likely to experience mild anaemia compared to first-born children. However, no significant association is observed between birth order and moderate-to-severe anaemia.

Child size at birth does not show a statistically significant association with either moderate-to-severe or mild anaemia overall. Nevertheless, a significant relationship is observed for mild anaemia among children reported as very small at birth. The findings suggest that children of average or above-average size are more likely to be mildly anaemic compared to those reported as very small, possibly reflecting reporting bias or differences in caregiving practices (Bharati et al., 2019; Duah et al., 2021). The preceding birth interval is not significantly associated with moderate-to-severe anaemia; however, a significant association is observed for birth intervals of less than 24 months in relation to mild anaemia. The succeeding birth interval does not show any statistically significant association with anaemia status.

Table-3: Multinomial logistic regression of child anaemia in NE India by selected child, maternal, and household characteristics, NFHS-5 (2019-21)

Variables	Moderate to severe anaemic	p-value	Mild anaemic	p-value
Child age				
6 - 11®	1.00		1.00	
12 – 23	0.70(0.58-0.84)	0.000	0.98 (0.81-1.19)	0.894
24 – 35	0.39(0.32-0.47)	0.000	0.74 (0.61-0.91)	0.003
36 – 47	0.26(0.21-0.32)	0.000	0.66 (0.54-0.81)	0.000
48 – 59	0.19 (0.15-0.24)	0.000	0.57 (0.46-0.70)	0.000
Sex of child				
Male®	1.00		1.00	

Female	1.06 (0.96-1.17)	0.239	1.01 (0.92-1.11)	0.714
Birth type				
Single®	1.00		1.00	
Multiple	0.98 (0.61-1.59)	0.964	1.22(0.71-2.11)	0.471
Child birth order				
First®	1.00		1.00	
Second	1.83 (0.49-6.78)	0.365	0.26 (0.07-0.92)	0.038
Third & above	1.92 (0.51-7.16)	0.327	0.26 (0.07-0.92)	0.037
Child size				
Average & above®	1.00		1.00	
Small	1.17 (0.97-1.42)	0.081	0.94 (0.78-1.13)	0.564
Very small	0.75 (0.49-1.14)	0.184	0.59 (0.38-0.92)	0.020
Don't know	1.08 (0.77-1.51)	0.634	1.03 (0.77-1.37)	0.824
Preceding birth interval				
First®	1.00		1.00	
Less than 24 months	1.81 (0.48-6.77)	0.372	0.26 (0.07-0.93)	0.040
24 – 47	1.05 (0.87-1.27)	0.564	0.85 (0.71-1.03)	0.106
More than 48 months	1.01 (0.87-1.16)	0.852	1.00 (0.87-1.15)	0.987
Succeeding birth interval				
Last®	1.00		1.00	
less than 24 months	0.82 (0.65-1.03)	0.103	0.98 (0.81-1.21)	0.913
24 – 47	0.91 (0.75-1.10)	0.329	0.93 (0.79-1.09)	0.375
More than 48 months	1.13 (0.67-1.89)	0.634	1.10 (0.70-1.73)	0.666
Had diarrhoea last two weeks				
No®	1.00		1.00	
Yes	1.27 (1.05-1.54)	0.011	1.16 (0.97-1.39)	0.096
Had fever last two weeks				
No®	1.00		1.00	
Yes	1.20 (1.04-1.68)	0.010	1.08 (0.95-1.23)	0.203
Child stunting				
No®	1.00		1.00	
Yes	1.48 (0.87-1.20)	0.000	1.19 (1.06-1.34)	0.003
Child wasting				
No®	1.00		1.00	
Yes	1.02 (0.87-1.20)	0.721	1.10 (0.96-1.26)	0.155
Child underweight				
No®	1.00		1.00	
Yes	1.24 (1.08-1.43)	0.002	1.00 (.087-1.14)	0.981
Overweight to age				
No®	1.00		1.00	
Yes	0.64 (0.34-1.54)	0.153	0.52 (0.31-0.88)	0.015
Overweight to height				
No®	1.00		1.00	
Yes	1.12 (0.81-1.54)	0.471	1.23 (0.94-1.61)	0.125

Toilet facility				
Not improved®	1.00		1.00	
Improved	0.90 (0.76-1.05)	0.211	0.91 (0.79-1.03)	0.157
Cooking fuel				
Unsafe®	1.00		1.00	
Safe	0.93 (0.80-1.08)	0.352	0.81 (0.71-0.93)	0.003
Drinking water source				
Not improve®	1.00		1.00	
Improved	1.11 (0.94-1.31)	0.191	1.14 (0.99-1.31)	0.059
Mother's age (years)				
15 – 24 years®	1.00		1.00	
25 – 34 years	0.98 (0.86-1.12)	0.787	1.04 (0.93-1.18)	0.436
35 – 49 years	0.73 (0.59-0.89)	0.002	0.93 (0.78-1.12)	0.491
Mother's education level				
No education®	1.00		1.00	
Primary	0.79 (0.67-0.93)	0.005	0.91 (0.77-1.08)	0.305
Secondary	0.71 (0.61-0.83)	0.000	0.83 (0.72-0.96)	0.014
Higher	0.74 (0.56-0.97)	0.034	1.05 (0.82-1.35)	0.644
Mother's anaemia level				
Not Anaemic®	1.00		1.00	
Severe	2.60 (1.81-3.73)	0.000	1.65 (1.15-2.35)	0.006
Moderate	2.32 (2.02-2.66)	0.000	1.50 (1.33-1.69)	0.000
Mild	1.42 (1.25-1.62)	0.000	1.24 (1.11-1.39)	0.000
Maternal BMI division				
Too thin®	1.00		1.00	
Normal	0.90 (0.77-1.05)	0.214	0.91 (0.78-1.05)	0.208
Overweight	0.95 (0.78-1.16)	0.647	0.86 (0.71-1.04)	0.136
Place of residence				
Urban®	1.00		1.00	
Rural	1.00 (0.81-1.24)	0.957	0.94 (0.81-1.11)	0.528
Caste				
ST®	1.00		1.00	
SC	0.81 (0.64-1.01)	0.072	0.85 (0.69-1.05)	0.143
OBC	0.72 (0.59-0.88)	0.002	0.86 (0.71-1.03)	0.100
Others	0.68 (0.54-0.85)	0.001	0.82 (0.67-1.01)	0.058
Religion				
Hindu®	1.00		1.00	
Muslim	0.91 (0.73-1.01)	0.410	1.02 (0.85-1.22)	0.796
Christian	1.01 (0.81-1.25)	0.957	0.95 (0.78-1.16)	0.683
Others	1.30 (1.03-1.64)	0.027	1.214 (0.97-1.51)	0.077
Wealth quintile				
Poorest®	1.00		1.00	
Poorer	0.94 (0.81-1.08)	0.405	0.94 (0.82-1.06)	0.347
Middle	0.84 (0.69-1.03)	0.108	0.89 (0.74-1.06)	0.201

Richer	0.65 (0.50-0.86)	0.003	0.91 (0.72-1.15)	0.471
Richest	0.65 (0.41-1.06)	0.086	1.09 (0.76-1.56)	0.625
State				
Assam®	1.00		1.00	
Sikkim	0.77 (0.47-1.23)	0.282	0.51 (0.33-0.78)	0.002
Arunachal Pradesh	0.55 (0.44-0.68)	0.000	0.54 (0.44-0.65)	0.000
Nagaland	0.23 (0.18-0.31)	0.000	0.40 (0.32-0.51)	0.000
Manipur	0.37 (0.30-0.45)	0.000	0.44 (0.36-0.53)	0.000
Mizoram	0.46 (0.34-0.63)	0.000	0.45 (0.35-0.58)	0.000
Tripura	0.73 (0.59-0.91)	0.005	0.79 (0.67-0.93)	0.007
Meghalaya	0.21 (0.17-0.27)	0.000	0.32 (0.25-0.39)	0.000

Significance at <0.05*

Source: NFHS-5; Author's calculation

The occurrence of diarrhoea in the two weeks preceding the survey shows a statistically significant association with moderate-to-severe anaemia. Children who experienced diarrhoea are more likely to suffer from moderate-to-severe anaemia compared to those who did not. However, no significant association is observed between diarrhoeal status and mild anaemia. Similarly, the presence of fever in the preceding two weeks is significantly associated with moderate-to-severe anaemia. Children who had a fever are more likely to be moderately to severely anaemic (OR = 1.20) compared to those without fever, whereas the association with mild anaemia is not statistically significant.

Child nutritional status also demonstrates important associations. Stunting is significantly associated with both moderate-to-severe and mild anaemia, with stunted children having higher odds of moderate-to-severe anaemia (OR = 1.48) as well as mild anaemia (OR = 1.19). In contrast, wasting does not exhibit any statistically significant association with anaemia. Underweight status is significantly associated with moderate-to-severe anaemia, with underweight children being more likely to experience moderate-to-severe anaemia compared to children with normal weight (OR = 1.24). However, its association with mild anaemia is not statistically significant. Overweight-for-age is not significantly associated with moderate-to-severe anaemia; however, a significant association is observed for mild anaemia, with overweight children being less likely to be mildly anaemic compared to their non-overweight counterparts. Overweight-for-height does not show any statistically significant association with anaemia.

Among household-level factors, toilet facilities are not significantly associated with children's anaemia status. The type of cooking fuel does not show a significant association with moderate-to-severe anaemia; however, it is significantly associated with mild anaemia, with children from households using clean cooking fuel being less likely to be mildly anaemic. Drinking water sources are not significantly associated with either form of anaemia. Maternal age does not exhibit a statistically significant association with moderate-to-severe anaemia overall; however, children of mothers aged 35–49 years are significantly less likely to experience moderate-to-severe anaemia compared to the reference group. No significant association is observed between maternal age and mild anaemia.

Maternal education shows a significant association with moderate-to-severe anaemia. Children of mothers with no formal education are more likely to suffer from moderate-to-severe anaemia compared to those

whose mothers have higher levels of education. In contrast, maternal education is generally not significantly associated with mild anaemia, except for secondary education, which shows a significant relationship. Maternal anaemia status demonstrates a strong and statistically significant association with both moderate-to-severe and mild anaemia among children. Children of mothers who are severely anaemic have substantially higher odds of experiencing moderate-to-severe anaemia (OR = 2.60) compared to those whose mothers are not anaemic. Similarly, these children are more likely to suffer from mild anaemia (OR = 1.65). Maternal body mass index (BMI) is not significantly associated with either form of anaemia in children. Likewise, place of residence does not show any statistically significant association with children's anaemia status.

Caste is significantly associated with moderate-to-severe anaemia, except for SC. Children belonging to the ST exhibit a higher likelihood of experiencing moderate-to-severe anaemia compared to other caste groups. However, caste does not show a statistically significant association with mild anaemia among children. Religion is generally not significantly associated with anaemia. An exception is observed for children belonging to "other" religious categories, who show higher odds of moderate-to-severe anaemia (OR = 1.30) compared to the reference group. No significant association is found between religion and mild anaemia. Household wealth quintile does not demonstrate a statistically significant association with either form of anaemia overall; however, children from richer households exhibit lower odds of moderate-to-severe anaemia (OR = 0.65) compared to the reference category. At the regional level, a statistically significant association is observed with both moderate-to-severe and mild anaemia (with the exception of Sikkim in the case of moderate-to-severe anaemia). The findings further indicate that children in Assam have higher odds of anaemia compared to those in other northeastern states of India.

4. Discussions

The results show that there exists an intricate connection of biological, behavioral, and situational determinants for anaemia in children aged between 6 and 59 months. Age stands out as one of the important determinants of anaemia (Table 2). The high prevalence of moderate to severe anaemia among younger children, especially those under two years old, indicates greater physiological vulnerability of the young child. It is at this stage where rapid growth occurs, depletion of iron reserves from the mother, and poor complementary feeding practices make children susceptible to anaemia (Gebreegziabher et al., 2020; Liu et al., 2024). Bivariate findings have shown that anaemia decreases as the age of the child increases, but regression analysis reveals that young children are still at greater risk of developing moderate/severe and mild anaemia, which supports the results from prior research (Ntenda et al., 2019). The relationship between child sex and anaemia is not statistically significant; however, females show slightly higher prevalence. The above result is supported by prior studies that show minimal differences due to gender in childhood anaemia (Kassebaum et al., 2014). In the same manner, type of birth is not significantly associated with the dependent variable (Table 3), despite the increased risk seen in multiple births from the descriptive analysis, which might be due to low birth weight and low iron stores (Stevens et al., 2025).

There is a significant relationship between anaemia and birth order, whereby the first-born are more susceptible compared to other children born later. This could be due to inexperience on the part of mothers, lack of knowledge about childcare practices as well as biological factors like maternal depletion (Aggarwal & Saluja, 2022). Nonetheless, the effect of this association is fairly small, implying that there are other determinants which play a dominant role. Child's birth size is inconclusive; whereas lower birth sizes

correlate with greater anaemia prevalence during the descriptive analysis, the results from regression analysis reveal little significance because of reporting bias and/or better care given to risk infants (Bharati et al., 2019; Duah et al., 2021). There are no clear relationships with regards to the birth interval variables, where the shorter preceding birth intervals (<24 months) have some degree of significance. In the same vein, no relationship can be seen in the case of the subsequent birth spacing, calling for additional research in this regard. Morbidity status is not very conclusive, as although diarrhoea and fever seem to have a bearing on anaemia according to bivariate analysis, regression results indicate no such relationship. However, previous literature makes it clear that repeated infections hinder nutrition and lower haemoglobin levels (Checkley et al., 2008; Sarna et al., 2020).

Nutrition is identified as the most important determinant of child anaemia. Being stunted is significantly related to both severe-moderate and mild anaemia, pointing out the importance of chronic malnutrition and micronutrient deficiencies (Dessie et al., 2024; Prendergast et al., 2015). However, being wasted is not significantly associated with anaemia, implying that acute malnutrition is a less influential determinant. The relationship between being underweight and severe-moderate anaemia is significant, showing the influence of chronic energy deficiency (Nisar et al., 2013). Nevertheless, being overweight is protective against anaemia probably due to higher nutrition status and financial condition of the families (Dessie et al., 2024). Despite the lack of any correlation between sanitation and drinking water in the regression analysis, unsafe cooking fuel usage correlates significantly with an increased prevalence of anaemia. This might be caused by the indoor air pollution making one more vulnerable to developing respiratory infections that have secondary effects on nutrition and haemoglobin level (Akindutire et al., 2025).

Factors related to the mother greatly affect child health outcomes. Maternal education shows a relationship with moderate and severe anaemia because children whose mothers are uneducated are at higher risk owing to malnutrition and low health literacy levels (Duah et al., 2021). Maternal anaemia is highly inter-generational because children born to anaemic mothers are at higher risk of having anaemia as a result of the biological aspect and similar environment (Baker & Greer, 2010; Sharma & Goswami, 2024). On the contrary, maternal age and body mass index do not show any significance and thus affect children indirectly through other socio-economic variables. Socio-economic variables show significant differences. There is a strong relationship between caste and anaemia, moderate to severe anaemia in specific, given socio-economic disparities, lack of healthcare access, and malnutrition (Raut & Reddy, 2024). There is no statistical association between religion and anaemia. Wealth only displays weak significance in the regressions while descriptive analysis shows that poverty-prone households are more vulnerable to anaemia (Dessie et al., 2024). Geographical variability is a very important determinant of anaemia outcomes, where Assam has shown the highest level of prevalence of both moderate and severe anaemia as well as mild anaemia. This could be due to differences in health care systems, nutrition interventions, and socio-economic development between states (Kumar et al., 2025; Milner et al., 2020), among other reasons.

5. Conclusions

This study sheds light on the burden and multiple determinants of childhood anaemia among 6-59-month-old children in NE India. Anaemia is found to be a considerable public health issue due to a complex interaction of multiple factors like demographic factors, nutritional factors, maternal factors, family factors and regional factors. Age is a major determinant which is associated with a greater risk of moderate anaemia and total anaemia due to nutritional problems at an early age. On the other hand, child sexual activities and

mode of birth show little relation, although birth order has some level of influence with first-borns slightly more vulnerable. Nutrition is very important in the case of anaemia results. Stunting is highly related to both moderate and overall anaemia, which means chronic malnutrition and deficiency of nutrients. Being underweight is significantly related to moderate anaemia, while there is no relationship for wasting. On the contrary, overweight-for-age is positively correlated with anaemia. Maternal variables highlight the generation-to-generation effect of anaemia. Maternal education decreases the chances of moderate anaemia, while maternal anaemia condition stands out as one of the best predictors of anaemia in children. On the other hand, maternal age and BMI have no constant effect on anaemia.

There is a selectivity in household and environmental factors. Unsafe cooking fuel was found to be strongly correlated with anaemia, while sanitation and drinking water did not demonstrate any association even in adjusted analysis. Economic inequality continues to exist, with caste differentials suggesting that ST children are more vulnerable. The geographical inequalities were found to be present, with Assam being the worst-affected state, while Manipur and Nagaland performed better. As such, the severe health effects associated with poor physical development, delayed mental and motor development, disabilities, low educational achievement and other morbidities that can be developed due to these factors (Sally & Cornelius, 2001; Zimmermann & Hurrell, 2007), it becomes very important to determine the prevalence and predictors of anaemia among children in NE India and India as a whole. These results emphasize the necessity to improve public knowledge and carry out specific interventions from various angles in order to tackle childhood anemia in the region. In addition, these results call for a longitudinal and mixed methods study to be carried out in order to gain an insight into the causative pathways and context that affect childhood anemia. There is a need to focus more on nutritional intake, cultural practices, and health care utilization in future research efforts.

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