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Anaemia Epidemiology among Children of Karimganj District of Assam, India: A Statistical Analysis

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Abstract - Childhood anaemia represents a significant nutritional deficiency worldwide, and has major consequences for health across the lifespan, specifically poor immunity, growth issues, reduced capacity for learning, and lower efficiency at work. However, detecting potential issues at an early age and taking preventative action can help a child develop into a healthy adult. In view of these, the study aims to investigate the incidence of anaemia amongst children of Karimganj District of Assam, India, by developing a probabilistic model on the association of anaemia and some potential risk factors relating to biological, socio-economic, demographic, and dietary characteristics of the study population. The findings indicate that Children in rural areas and of lower age-groups faced an increased risk of anaemia. Higher birth order, low level of maternal education, low level of maternal nutrition, poor socio-economic status of household and non-intake of iron supplements during pregnancy was linked to an increased prevalence of childhood anemia. The findings suggest the necessity of implementing effective preventive strategies to address child anaemia in the study population.

Key Words: Anaemia, Karimganj, Children, Risk factors, Logistic regression, Hosmer–Lemeshow test

INTRODUCTION

Anaemia is a condition that reduces oxygen transporting capacity of blood, and as all human organs and tissues depend on oxygen, so the people with anaemia often feel tired, weak, cold, and short of breath [1,2,3]. World Health Organization (WHO) terms anaemia as a defaming as one-fourth of the total world population is marked by the deficiency of RBCs or hemoglobin; and approximately 50% of these cases are due to iron deficiency [4, 5, 6]. The WHO data from 2019 further indicates that about 40 percent of children aged 6–59 months were affected by anemia globally, and low- and lower-middle-income countries bear the highest burden of childhood anemia, with factors like poverty, lack of education, and rural living increasing the risk. It has been observed that the major cause of all types of anaemia in the world is due to iron deficiency; and young children during first 2 years of life are more vulnerable, primarily due to the substantial iron requirements associated with accelerated growth during this developmental stage. If the iron deficiency persists, it can also result in height and weight disturbances, retardation of behavior and learning capacity [7]. However, by detecting the issues early and implementing preventive strategies can help a child grow into a healthy adult [8,9,10].

The risk factors of anemia, most often cited in the literature, are low family income and low maternal level of education, lack of access to healthcare services, inadequate sanitary conditions, and a diet with poor quantities of iron [11, 12]. According to the National Family Health Survey-5 (NFHS-5) (2019–21), 67.1% of Indian children between the ages of 6–59 months were anaemic, which has seen a substantial rise from NFHS-4 survey. National Family Health Survey (NFHS-5), conducted by Govt. of India during 2019-21, shows high prevalence of childhood anaemia in the study population, a strategically unique geographical location.

Karimganj District is in the southernmost part of Assam, India, and is part of the Barak Valley. The district is a major agricultural hub characterized by its extensive wetlands, forests, and rivers, including the Kushiara and Longai, with the Kushiara serving as an international border with Bangladesh. As per 2011 census of Govt. of India, the district had a population of about 12.25 lakhs with literacy rate 79 percent, and the majority of the population living in rural areas depending on agriculture. The religious diversity constitutes Muslims as the majority population at 56.4 percent, followed by Hindus at 42.5 percent.

Keeping in mind the importance of eradication of childhood anaemia, the study **sought to explore** the relationship of different socioeconomic and demographic risk factors for anaemia in children aged 6-59 months of the region.

DATA AND METHODOLOGY

This study utilizes cross-sectional secondary data sourced from the National Family Health Survey (NFHS-5), conducted by Govt. of India during 2019-21, which was again facilitated by the Demographic and Health Survey (DHS), Govt. of India. The relevant information of 430 children aged 6 to 59 months, who were tested for haemoglobin concentration, was taken for the study. In the study, 82% children lived in rural areas while 18 % lived in urban areas, with overall sex ratio as 1 male: 0.9 female. The data exhibited no outlier and were analyzed using SPSS software.

Using the WHO classification criteria, a hemoglobin concentration of less than 11g/dL was used to diagnose anemia in children. Pearson's Chi-square tests assessed significant association of anaemia with different socio-economic characteristics of the study population, and binary logistic regression was used to fit a predictive model and also to assess the degree of dependence of anaemia on the risk factors taken into the study. In the logistic analysis backward stepwise procedure was used, with reference category as the first category for all the predictors. The goodness of fit of the model was evaluated using the Hosmer-Lemeshow test [13, 14].

The response variable was a dichotomous 'anaemia status' (0 = non anaemic, 1 = anaemic); and the predictors were: age of child in years (0=less than 1, 1=1to less than 2, 2=2 to less than 3, 3=3 to less than 4 and 5=4 to less than 5), birth order of child (1=1 or 2, 2=3 or 4 and 3=5 or above), place of residence (1=urban, 2=rural), religion(1=Hindu, 2=Muslim, 3= Others), wealth index (1=poorest, 2=poorer, 3=middle, 4=richer and 5=richest), maternal anaemia level (0=non-anaemic, 1=anaemic), maternal educational level (0=no education, 1=primary, 2=secondary, 3=higher), father's educational level (0=no education, 1=primary, 2=secondary, 3=higher), iron supplements to mother during pregnancy (0=no, 1=yes) and dietary habit of mother (1= vegetarian, 2= non-vegetarian). Independence of the predictors was justified by Variance Inflation Factors (VIF) under Multicollinearity diagnostic test [15, 16].

RESULTS AND DISCUSSION

None of the predictors reports any redundancy as the multicollinearity analysis shows no good correlation amongst them. In the study, Overall 61 percent of children were anaemic with mean haemoglobin concentration 10.095 ± 1.562 g/dL. Pearson's Chi-square tests revealed age of child, birth order, religion, wealth index, maternal anaemia level, maternal education, intake of iron supplements by mother during pregnancy and dietary habit of mother were significantly associated with the anaemia (table 1). The findings of binary logistic regression analysis are presented in table 2, and the Hosmer- Lemeshow test value (8.862 with p-value 0.456) indicating that the model fitted the data at an acceptable level. Estimates of parameters showed children aged 1 to 2 years were more likely to be anaemic (OR 1.559, 95% CI 1.448-1.712) than those aged less than 1 year, however as age increased the risks decreased. Such a decline observed from the 24th month onwards is corroborated by other research findings also [17]. The relative odds showed increasing tendency of anaemia with the increasing number in birth order as the children of birth order number 5 or above were at greater risk of anaemia (OR 1.414, 95% CI 1.322-1.448). Rural population did not show any significant vulnerability towards anaemia. About religious categories, Muslim children were at higher risk (O.R. 1.358, 95% CI 1.386-1.470) as compared to Hindu children. Wealth index of household had significant impact on child anaemia, and the findings showed a declining tendency in the risks with the increasing level of wealth index. The estimates revealed significantly lower risk of anaemia among the children of the richest wealth index (O.R. 0.558, 95% CI 0.544-0.662) as compared to those of poorest index. A previous study by Osorio et al (2004) cited that the limited access to iron-rich food is often correlated to low income and to some extent explain the higher risk of anemia among these children. As about parents' education, though father's education did not reveal significant association with child anaemia but maternal education predicted child anaemia significantly as the children of higher educated mothers were less likely to develop anaemia (O.R. 0.639, 95% CI 0.552-0.738). These results align with those of previous studies, which similarly documented that educated parents are more likely to have well paid job and adopt healthier dietary behavior; and mother's level of education, in its turn, influences the practices related to the child's health care. A study by De Pee et al. reported similar results in Palestinian children with risk of anemia twice higher for children from non-educated mothers [18]. Mother's anaemia level had also a strong association with the child anaemia, and the findings showed higher risk of anaemia among children of anaemic mothers in comparison to those of non-anaemic mothers (O.R. 1.763, 95% CI 1.571-1.961). The primary reason may be cited as shared nutritional deficiencies which can transfer from mother to fetus during pregnancy, leading to low fetal iron stores. The study also showed that the consumption of iron supplements and non-veg food during pregnancy reduced the likelihood of anaemia in children to a greater extent (O.R. 0.664, 95% CI 0.608-0.822 and 0.708, 95% CI 0.656-0.765).

CONCLUSION

This study furnishes a comprehensive insight into several socio-economic and demographic factors linked to child anemia in Karimganj, a district located in the North-Eastern corner of India. The in-depth analysis reveals that, there is a serious need for better dietary practice, physical health consciousness, maternal education and economic independence. The findings can offer guidance to Local and State governments in developing policies and plans to combat anemia in children. Many nations, including India, have implemented interventions aimed at reduction of anemia, particularly among the most vulnerable demographics, i.e. pregnant women and children. In fact, the overall prevalence of anemia saw reductions in India between 1990 and 2016, but the problem of the severe condition still persists in the study population and this may be due to the failure to seriously execute National Nutrition Policies. So the findings mandate immediate action to implement comprehensive prevention and treatment measures for anaemia in children prioritizing different background characteristics, such as age, place of residence, parents' education, wealth index, nutrition education, etc.

A limitation of the study was the inability to assess the impact of dietary habit of children on anemia due to concerning lack of data.

CONFLICTS OF INTERESTS

There is no conflict of interests.

FUNDING

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Table 1: Distribution of child anaemia with different characteristics of the study

Characteristics	Mean haemoglobin concentration g/dl [95% CI]	Child Anaemia level		Pearson's χ^2 test (p-value)
		Non Anaemic	Anaemic	
Age of child (years)				
Less than 1	9.82 [9.77-9.86]	21 (31.4%)	45 (68.6%)	
1-2	9.53 [9.49-9.56]	22 (26.9%)	58 (73.1%)	
2-3	9.90 [9.87-9.93]	35 (35.8%)	63 (64.2%)	(<0.001)
3-4	10.34 [10.31-10.37]	53 (48.2%)	57 (51.8%)	
4-5	10.73 [10.70-10.76]	37 (47.9%)	39 (52.1%)	
Gender				
Male	10.09 [10.07-10.11]	86 (37.9%)	141 (62.1%)	(0.067)
Female	10.10 [10.08-10.13]	80 (39.2%)	121 (60.8%)	

Place of residence				
Urban	10.29 [10.26-10.32]	30 (38.4%)	48 (61.6%)	(0.078)
Rural	10.04 [10.02-10.05]	138 (39.6%)	214 (60.4%)	
Religion				
Hindu	10.08 [10.06-11.00]	114 (42.8%)	153 (57.2%)	(<0.001)
Muslim	10.14 [10.10-10.17]	47 (32.6%)	98 (67.4%)	
Other	10.06 [9.97-10.16]	07 (38.9%)	11 (61.1%)	
Wealth index				
Poorest	9.85 [9.86-9.92]	26 (28.6%)	65 (71.4%)	
Poorer	9.95 [9.92-9.99]	43 (32.6%)	89 (67.4%)	
Middle	10.08 [10.04-10.11]	48 (38.1%)	73 (61.9%)	(<0.001)
Richer	10.25 [10.21-10.28]	29 (44.9%)	37 (56.1%)	
Richest	10.53 [10.49-10.57]	10 (55.6%)	08(44.4%)	
MAL				
Non-Anaemic	10.42 [10.40-10.45]	71 (43.1%)	94 (56.9%)	(<0.001)
Anaemic	9.88 [9.86-9.90]	97 (36.6.2%)	168 (63.4%)	
ISMP				
No	9.65 [9.63-9.67]	11 (13.5%)	71 (86.5%)	(<0.001)
Yes	10.44 [10.42-10.46]	155 (44.6%)	193 (55.4%)	
Birth order				
1 or 2	10.28 [10.22-10.31]	87 (41.8%)	121 (58.2%)	
3 or 4	10.14 [10.11-10.17]	63 (37.3%)	106 (62.7%)	(<0.001)
5 or above	9.91 [9.87-9.95]	18 (33.9%)	35 (66.1%)	
Mother's education				
No education	9.92 [9.89-9.94]	21 (22.9%)	71 (77.1%)	
Primary	10.11 [10.07-10.15]	44 (33.8%)	86 (66.2%)	(<0.001)
Secondary	10.30 [10.27-10.32]	43 (44.7%)	74 (63.3%)	
Higher	10.62 [10.55-10.68]	60 (66.1%)	31 (33.9%)	
Father's education				

No education	9.88 [9.85-9.90]	12 (24.9%)	14 (59.1%)	(0.068)
Primary	10.08 [10.04-10.12]	54 (28.9%)	60 (61.1%)	
Secondary	10.15 [10.13-10.18]	57 (32.1%)	106 (64.9%)	
Higher	10.51 [10.46-10.55]	54 (41.5%)	77 (58.5%)	
DHM				
Vegetarian	10.02 [10.00-10.06]	18 (30.0%)	42 (70.0%)	(0.022)
Non-vegetarian	10.13 [10.10-10.15]	150 (40.3%)	221 (59.7%)	
Key for acronyms: CI: Confidence Interval; MAFB: Mother's age at first birth; MAL: Mother's anaemia level; ISMP: Iron supplements to mother during pregnancy; DHM: Dietary habit of mother.				

Table 2: Estimates of parameters in binary logistic regression model

Predictors	p-value	O.R.	95% C.I. for O.R.	
			L.B.	U.B.
Age of child (in years)	<0.001			
Less than 1*				
1-2	<0.001	1.559	1.448	1.712
2-3	<0.001	0.690	0.624	0.762
3-4	<0.001	0.370	0.335	0.410
4-5	<0.001	0.237	0.213	0.263
Sex of child				
Male*				
Female	0.808	0.982	0.948	1.051
Birth order of child	0.011			
1 or 2*				
3 or 4	0.001	1.201	1.086	1.242
5 or above	0.001	1.414	1.322	1.448
Place of residence				
Urban*				
Rural	0.488	1.088	0.988	1.192

Religion		0.002		
Hindu*				
Muslim	0.002	1.382	1.366	1.470
Others	0.612	1.046	0.879	1.244
Wealth Index	<0.001			
Poorest*				
Poorer	0.016	0.893	0.815	0.979
Middle	<0.001	0.798	0.725	0.878
Richer	<0.001	0.738	0.665	0.818
Richest	<0.001	0.558	0.544	0.662
Mother's anaemia level				
Non-anaemic*				
Anaemic	<0.001	1.763	1.671	1.811
Mother's education	<0.001			
No education*				
Primary education	0.027	0.902	0.823	0.988
Secondary education	<0.001	0.819	0.754	0.889
Higher education	<0.001	0.639	0.552	0.738
Father's education	0.087			
No education*				
Primary education	0.350	0.955	0.866	1.052
Secondary education	0.020	0.905	0.832	1.085
Higher education	0.027	0.866	0.763	0.984
Iron supplements to mother				
No*				
Yes	<0.001	0.664	0.608	0.822
Dietary habit of mother				
Vegetarian*				
Non-vegetarian	<0.001	0.708	0.656	0.765

Constant	<0.001			
* Reference category	*Hosmer and Lemeshow Test value for the final step :8.862 (p-value 0.456)*			

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