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Research Article

Prevalence and Determinants of Anemia among School going Children in Meghalaya

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Abstract

Prevalence of anemia is higher in India compared to the other developed countries and remains one of the major public health problems. The prevalence of anemia in school-aged children alone has been estimated to be as high as 9% even in some industrialized, developed countries. Approximately 40 percent of children are anemic across various African and Asian settings. Children's access to education and to learning can be negatively affected by poor health and nutritional status. It is therefore of some concern that a quarter of all children eligible to be in school are malnourished and that children in developing countries frequently carry an additional burden of infectious diseases. The present paper explores the prevalence, socioeconomic and district wise geographical variations in anemia and tries to find out the main predictors of anemia among school going children in the state of Meghalaya. Present study is based on the fourth round of District Level Household Survey (DLHS-4) pertaining to year 2012-2013.

Bivariate analyses including chi-square tests to determine the prevalence of anemia and logistic regression to understand the determinants of anemia were applied. The findings of the study indicate that almost half of the children were anemic in addition to fewer cases of severe anemic, moderate anemic and mild anemic. It is also found that children aged 6-9 years were suffering more from severe anemia as compared to children aged 15-19 years. A significant correlation between anemia and age was observed. Female children aged 6-9 years were found to be suffering more from severe anemia as compared to children aged 15-19 years. The likelihood to suffering from anemia was found to be less likely in South Garo Hills, West Khasi Hills, RiBhoi, East Khasi Hills and Jaintia Hills districts as compared to West Garo Hills districts. Study concludes that educational status was strongly associated with anemia. It was also observed that as educational status of male children increases the anemia decreases. In terms of prevalence of anemia at district level in the state of Meghalaya, significant variations have been noticed. The results of present analysis highlight the need to develop pragmatic intervention programmes incorporating various strategies to improve dietary intake and bioavailability of iron; nutritional supplementation of iron and folic acid tablets and fortification of edible dietary items with iron. Nutrition and health education programmes may be conducted in schools with teachers and parents' involvement to raise the awareness regarding anemia.

Introduction

The prevalence of anemia is higher in India compared to the other developed countries (EM DeMayer et al., 1995; K Kalaivani, 2009) and remains one of the India's major public health problems. Lack of awareness among mothers about the problem coupled with their low educational status (Rawat CMS et al., 2001), poor nutritional practices and unhealthy food habits, decreased physical activities (WHO, 2014) are added factors associated with lower hemoglobin level in children. Anemia is known to be affecting 305 million (25.4%) school age children globally with an estimated prevalence of 40% in developing countries (Gawarikar R. S. et al., 2002). The prevalence of anemia

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in school-aged children has been estimated to be as high as 9% even in some industrialized, developed countries (Benoist B. et al., 2008). Approximately 40 percent of children are anemic across various African and Asian settings (Alloway R. et al., 2003). Reducing the burden of anemia will make a major contribution towards achieving several developmental goals. India is a large, multi-ethnic country, where the prevalence and determinants of anemia vary across regions and ethnic groups (Hall, Andrew et al. 2001). In India, the prevalence of anemia among school age children is inadequately addressed compared with pre-schoolers and women of child-bearing age (Galal, O. M. et al., 2005; Djokic D. et al., 2010).

Data from the District Levels Household Survey offer an opportunity to investigate the severity and distribution of anemia among school going children at the national level, according to urban and rural areas, and according to state and region and to assess the trends and socioeconomic determinants of the prevalence of anemia. Therefore, the present study was undertaken to explore the prevalence of anemia among school going children according to socioeconomic and demographic variables taking into account the individual, household and community level characteristics. The results of analysis may cast some light on the attention and efforts to be paid to the health and wellbeing of school going children in the education sector planning. The present studies explores the prevalence of anemia, socioeconomic and district wise geographical variation in anemia and assess to find out the main predictors of anemia among school going children in Meghalaya.

Methods

Present study is based on the fourth round of District Levels Household Survey (DLHS-4), conducted during 2012–13. The DLHS is a nationally representative and one of largest ever demographic surveys conducted in India. DLHS-4 adopted a multi-stage stratified systematic sampling design. Detailed information about sampling employed in this survey can be obtained from the report of DLHS-4. The outcome variable in this study was Anemia. Using HemoCue method is considered to be a standard method for hemoglobin measurement by the International Committee for Standardization in Hematology and World Health Organization for field studies (Muratee S., 1990; Gordon N., 2003; Choudhary A., 2006). The present study also used the HemoCue method for estimating hemoglobin level. The hemoglobin levels of >11 mg/dL was considered as any anemia (normal anemia), 10–11 mg/dL as mild anemia, 7–9.9 mg/dL as moderate anemia, and <7 mg/dL as severe anemia (Muratee S., 1990; Gordon N., 2003).

Important Socioeconomic and demographic predictors such as age of children, education of children, family size, religion, social group, wealth quintile, sanitation facilities, drinking water facilities, type of cooking fuel, type of residence and districts were included as predictor variables in the present study. Further socioeconomic and demographic variables are divided into three categories namely individual household and community characteristics. To examine the prevalence and determinants of anemia, present study used both bivariate and multivariate analyses. Chi-square test is used to determine the difference in proportions of anemia across selected individual, household and community background characteristics. Binary logistic regression is applied to understand the net effect of predictor variables on the anemia. The whole analysis was performed using STATA version 13.0 to take into account the survey design (i.e. sampling weights with clustering and strata) and QGIS 3.0 and R for making the geographical variation and graph.

Results (Background characteristics of the respondent)

Table 1 represents the weighted percent distribution of school going children (age 6-19 years) by background characteristics in Meghalaya, India. Among the children, female were more educated as compared to boys. More than two thirds children found to be suffering from low BMI. Majority were belonged to Christian religion and scheduled tribes with regards to the social group. More than two third household were using safe sanitation and almost same household were using safe drinking water. Majority children were belonging to rural areas of the state.

Table 1: Percent distribution of school going children (age 6-19 years) by background characteristics, DLHS-4 (2012-13), in Meghalaya, India

Background characteristics	Male		Female		Total	
	Sample	Weighted proportion	Sample	Weighted proportion	Sample	Weighted proportion
Individuals characteristics						
Age						
6-9	799	37.34	872	36.42	1672	36.86
10-14	875	42.42	1017	43.23	1892	42.83
15-19	420	20.24	472	20.36	893	20.31
Education of children						
Below primary	918	49.09	944	44.5	1864	46.67
Primary	513	28.45	655	31.41	1168	30.01
Middle and above	406	22.47	490	24.1	896	23.32
BMI						
Low	1612	76.51	1638	69.25	3251	72.66
Normal	425	21.08	633	27.38	1059	24.33
Overweight	47	2.41	73	3.37	120	2.01
Household Characteristics						
Family members						
Up to 4 members	448	21.51	516	21.88	964	21.7
5-7 members	833	39.94	944	40.04	1777	39.97
More than 7 members	813	38.55	901	38.08	1716	38.33
Religion						
Non Christian	302	14.58	295	12.74	597	13.6
Christian	1792	85.42	2064	87.26	3858	86.4
Castes/Tribes						
Non ST	159	7.93	156	06.72	315	7.28
Scheduled Tribes	1881	92.07	2150	93.28	4033	92.72
Wealth quintile						
Poorest	424	19.53	467	19.02	892	19.27
Poorer	407	18.76	484	19.65	891	19.22
Middle	412	19.34	480	19.81	892	19.58
Richer	428	20.78	463	20.03	891	20.37
Richest	423	21.59	467	21.48	891	21.55
Sanitation facility						
Unsafe	633	29.93	664	27.78	1298	28.8
Safe	1461	70.07	1697	72.22	3159	71.2
Drinking water						
Unsafe	384	17.71	457	18.83	842	18.32
Safe	1710	82.29	1904	81.17	3615	81.68
Community characteristics						
Type of locality						
Rural	1705	76.22	1903	75.1	3609	75.61
Urban	389	23.78	458	24.9	848	24.39
District						
West Garo Hills	263	12.13	303	12.14	566	12.13
East Garo Hills	242	11.86	290	12.8	533	12.37
South Garo Hills	166	7.598	158	6.513	324	7.019
West Khasi Hills	383	18.12	408	16.98	791	17.51
RiBhoi	364	17.18	399	16.76	764	16.97
East Khasi Hills	349	18.2	422	19.13	771	18.69
Jaintia Hills	327	14.91	381	15.68	708	15.31
Meghalaya	**2094**	**100**	**2361**	**100**	**4457**	**100**

Differentials in Anemia among school going male children

Table 2 shows the weighted percentage distribution of school going male children (age 6-19 years) classified as having anemia by degree of anemia and by selected background characteristics, Meghalaya, India. Results show that about 3.1% children were severe anemic, 24.3 were moderate anemic, 19.7 were mild anemic and the almost 47.2% children were any anemic. Children age group 6-9 years were more (4.0) suffering from severe anemia as compared to only 1.8% children age group 15-19 years. A significant correlation between anemia and age was observed and its showed statistical significance ($\chi2$=13.114, p=<=0.01, $\chi2$=38.641, p=<=0.01, $\chi2$=4.793, p=<=0.10 and $\chi2$=77.851, p=<=0.01, mild anemia, moderate anemia, severe anemia and any anemia respectively). More than half (55.5%) below primary children had normal anemia as compared to 28.1% children who had completed their education middle and above. The study argue that below primary children may be younger age as compared to middle and above children. Any anemia prevalence in different educational categories showed statistical significance ($\chi2$=88.808, p=<=0.01) while in case of severe anemic education category showed no statically significance $\chi2$=1.608, p=>=0.10). Not much differentials found among religion and caste category. Results indicate that the Sanitation and safe drinking water also effect the anemia prevalence. Children from those household having safe sanitation and safe water facilities have lower prevalence of anemia as compared to their counterpart, household having unsafe sanitation and unsafe water facilities.

Table 2: Weighted percentage distribution of school going male children (age 6-19 years) classified as having anemia by degree of anemia and by selected background characteristics, Meghalaya, DLHS-4 (2012-13), India

Background characteristics	Anemia status by hemoglobin level				
	Mild anemia	**Moderate anemia**	**Severe anemia**	**Any anemia**	**n**
	(10.0-10.9 g/dl)	*(7.0-9-9 g/dl)*	*(< 7g/dl)*	*<11.0 g/dl*	
Individuals characteristics					
Age	$\chi2$=13.114***	$\chi2$=38.641***	$\chi2$=4.793*	$\chi2$=77.851***	
6-9	22.5	31.2	4.0	57.7	799
10-14	20.1	22.2	3.0	45.4	875
15-19	13.8	15.9	1.8	31.5	420
Education of children	$\chi2$=27.252***	$\chi2$=7.869*	$\chi2$=1.608	$\chi2$=88.808***	
Below primary	24.4	27.8	3.4	55.5	918
Primary	17.0	22.8	2.7	42.6	513
Middle and above	12.8	13.1	2.1	28.1	406
BMI	$\chi2$=15.758***	$\chi2$=2.621	$\chi2$=2.207	$\chi2$=34.536***	
Low	21.7	25.6	3.2	50.5	1612
Normal	13.6	19.1	2.1	34.8	425
Overweight	13.1	23.8	5.2	42.1	47
Household Characteristics					
Family members	$\chi2$=3.524	$\chi2$=2.621	$\chi2$=3.034	$\chi2$=3.534	
Up to 4 members	17.7	21.5	4.4	43.6	448
5-7 members	18.9	25.5	2.8	47.2	833
More than 7 members	21.7	24.7	2.7	49.1	813
Religion	$\chi2$=0.216	$\chi2$=2.768	$\chi2$=8.475***	$\chi2$=0.207	
Non Christian	20.7	21.9	5.8	48.4	302
Christian	19.6	24.7	2.7	47.0	1792
Castes/Tribes	$\chi2$=0.001	$\chi2$=34.341***	$\chi2$=11.704***	$\chi2$=0.077	
Non ST	19.7	19.1	7.5	46.4	159
Scheduled Tribes	19.8	25.0	2.7	47.5	1881
Wealth quintile	$\chi2$=1.738	$\chi2$=16.563***	$\chi2$=4.648	$\chi2$=17.214**	
Poorest	19.8	31.6	3.2	54.6	424
Poorer	21.0	24.7	4.6	50.4	407
Middle	20.2	20.5	2.1	42.8	412
Richer	20.2	22.2	3.2	45.5	428
Richest	17.7	22.8	2.6	43.1	423

Sanitation facility	$\chi2$=6.289**	$\chi2$=13.655***	$\chi2$=0.578	$\chi2$=29.594***	
Unsafe	23.1	29.6	3.6	56.3	633
Safe	18.3	22.1	2.9	43.3	1461
Drinking water	$\chi2$=0.586	$\chi2$=24.737***	$\chi2$=0.366	$\chi2$=21.841***	
Unsafe	21.2	34.4	2.6	58.2	384
Safe	19.4	22.2	3.2	44.8	1710
Community characteristics					
Type of locality	$\chi2$=1.914	$\chi2$=0.162	$\chi2$=0.039	$\chi2$=1.901	
Rural	20.4	24.5	3.1	48.0	1705
Urban	17.6	23.6	3.3	44.5	389
District	$\chi2$=14.129	$\chi2$=114.913***	$\chi2$=18.598*	$\chi2$=119.131	
West Garo Hills	17.7	38.1	6.7	62.6	263
East Garo Hills	23.5	40.6	3.6	67.8	242
South Garo Hills	17.2	23.9	4.0	45.1	166
West Khasi Hills	15.1	25.9	3.5	44.6	383
RiBhoi	24.3	20.5	2.7	47.4	364
East Khasi Hills	18.6	9.1	1.4	29.1	349
Jaintia Hills	21.4	21.3	1.5	44.2	327
Meghalaya	**19.7**	**24.3**	**3.1**	**47.2**	**2094**

Differentials in Anemia among school going female children

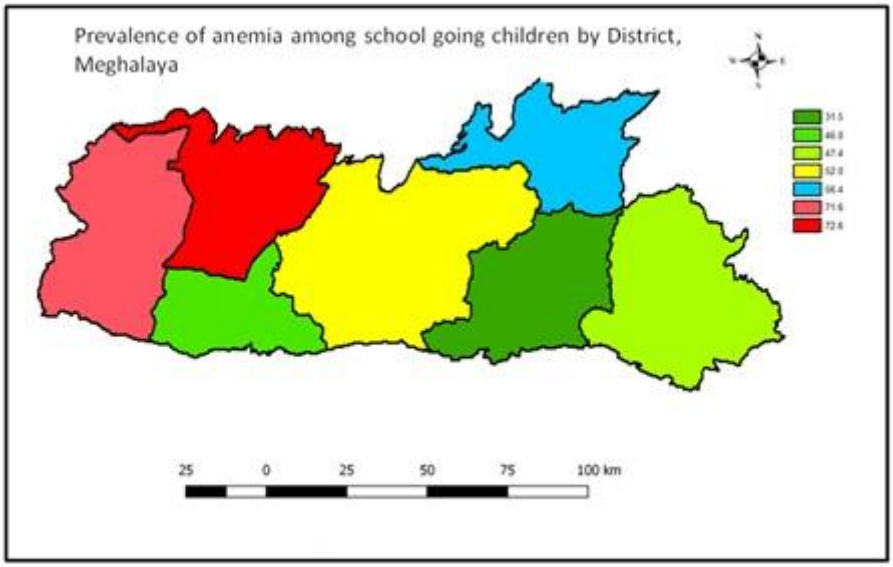
Table 3 shows the weighted percentage distribution of school going female children (age 6-19 years) classified as having anemia by degree of anemia and by selected background characteristics, Meghalaya, India. Results show that about 3.9%, female children were severe anemic, 27.6 were moderate anemic, 21.2% were mild anemic and more than half (52.7%), female children were any anemic. Female children age group 6-9 years were more (4.7) suffering from severe anemia as compared to only 2.8% children age group 15-19 years. A significant correlation between mild anemia, moderate anemia and any anemia and age was observed and it showed statistical significance. However age and severe anemia was not statically significant. Similar to male children, not much differentials found among religion and caste category among female children. Results indicated that the Sanitation and safe drinking water also effect the anemia prevalence. Female children from those household having safe sanitation and safe water facilities have lower prevalence of anemia as compared to their counterpart, household having unsafe sanitation and unsafe water facilities.

Table 3: Percentage of school going female children (age 6-19 years) classified as having anemia by degree of anemia and by selected background characteristics, Meghalaya, DLHS-4 (2012-13), India

Background characteristics	**Anemia status by hemoglobin level**				**n**
	Mild anemia	**Moderate anemia**	**Severe anemia**	**Any anemia**	
	(10.0-10.9 g/dl)	*(7.0-9-9 g/dl)*	*(< 7g/dl)*	*<11.0 g/dl*	
Individuals characteristics					
Age	$\chi2$=1.161	$\chi2$=15.540***	$\chi2$=4.1424	$\chi2$=14.854***	
6-9	21.5	30.5	4.7	56.7	872
10-14	21.9	22.6	3.4	47.8	1017
15-19	19.4	29.6	2.8	51.9	472
Education of children	$\chi2$=0.142	$\chi2$=6.429*	$\chi2$=1.047	$\chi2$=8.581**	
Below primary	21.4	29.2	4.6	55.2	944
Primary	21.5	23.6	3.0	48.2	655
Middle and above	20.6	25.6	3.6	49.9	490
BMI	$\chi2$=3.394	$\chi2$=1.456	$\chi2$=1.076	$\chi2$=2.253	
Low	22.2	27.2	4.2	53.5	1638
Normal	19.2	27.9	3.1	50.2	633
Overweight	16.9	33.3	5.0	55.2	73
Household Characteristics					
Family members	$\chi2$=2.374	$\chi2$=0.047	$\chi2$=1.573	$\chi2$=1.388	

Up to 4 members	19.5	27.8	3.4	50.8	516
5-7 members	20.7	27.4	4.5	52.5	944
More than 7 members	22.8	27.8	3.5	54.0	901
Religion	$\chi2$=0.962	$\chi2$=7.460**	$\chi2$=0.302	$\chi2$=1.933	
Non Christian	19.0	34.2	3.2	56.4	295
Christian	21.5	26.7	4.0	52.1	2064
Castes/Tribes	$\chi2$=0.276	$\chi2$=3.667	$\chi2$=0.481	$\chi2$=3.557	
Non ST	22.7	34.6	2.7	60.0	156
Scheduled Tribes	20.9	27.4	3.8	52.2	2150
Wealth quintile	$\chi2$=0.651	$\chi2$=16.226***	$\chi2$=4.241	$\chi2$=19.539***	
Poorest	21.6	31.2	5.2	58.0	467
Poorer	21.2	31.5	3.1	55.9	484
Middle	20.1	25.4	3.0	48.5	480
Richer	22.1	28.9	4.4	55.4	463
Richest	20.9	21.9	3.7	46.5	467
Sanitation facility	$\chi2$=0.700	$\chi2$=27.646***	$\chi2$=4.212*	$\chi2$=21.187***	
Unsafe	22.3	35.4	2.5	60.3	664
Safe	20.8	24.6	4.4	49.8	1697
Drinking water	$\chi2$=0.012	$\chi2$=13.147***	$\chi2$=0.010	$\chi2$=10.227***	
Unsafe	21.0	34.6	3.9	59.5	457
Safe	21.3	26.0	3.8	51.1	1904
Community characteristics					
Type of locality	$\chi2$=4.692**	$\chi2$=0.031	$\chi2$=10.817***	$\chi2$=0.438	
Rural	22.3	27.7	3.1	53.1	1903
Urban	18.0	27.4	6.1	51.5	458
District	$\chi2$=10.977	$\chi2$=139.748***	$\chi2$=13.455	$\chi2$=179.758***	
West Garo Hills	22.4	44.4	4.8	71.6	303
East Garo Hills	24.1	42.4	6.0	72.6	290
South Garo Hills	16.8	26.7	2.5	46.0	158
West Khasi Hills	20.0	26.3	5.7	52.0	408
RiBhoi	24.4	29.6	2.4	56.4	399
East Khasi Hills	17.2	11.3	2.9	31.5	422
Jaintia Hills	22.4	22.3	2.7	47.4	381
Meghalaya	**21.2**	**27.6**	**3.9**	**52.7**	**2361**

Figure 1: District wise prevalence of Anemia among school going children in Meghalaya



Determinants of Anemia

Table 4 demonstrates the results of the binary logistic regression model to examine the effect of individuals household and community characteristics on any anemia among male and female separately for Meghalaya, India. Findings show that age group, education and district were found to be statistically determinants of any anemia in Meghalaya. Older age group 10-14 years and 15-19 years male children were found to less likely (OR=0.754 CI=0.592-0.961 and OR=0.662 CI=0.438-1.001, respectively), to suffer from anemia than younger age group 6-9 years. Similarly, lower educational status was strongly associated with anemia, it was also observed that as educational status of male children increases the anemia decreases. Male children with primary but below middle and middle or more education were found less likely (OR=0.728 CI=0.552-0.960) and (OR=0.455 CI=0.273-0.758), to have anemia as compared to below primary children. With regards to district of Meghalaya, the likelihood to suffer from anemia was found to be less likely in South Garo Hills, West Khasi Hills, RiBhoi, East Khasi Hills and Jaintia Hills districts as compared to West Garo Hills.

Table 4. Adjusted odds-ratio to examine the effect of individuals household and community characteristics on any anemia among male and female in Meghalaya,DLHS-4 (2012-13), India

Background characteristics	Any anemia			
	Male		Female	
	Odds Ratio	95% C.I.	Odds Ratio	95% C.I.
Individuals characteristics				
Age				
6-9#	-	-	-	-
10-14	0.754**	[0.592-0.961]	0.792*	[0.604-1.039]
15-19	0.662*	[0.438-1.001]	0.850	[0.546-1.325]
Education of children				
Below primary#	-	-	-	-
Primary	0.728**	[0.552-0.960]	0.999	[0.743-1.344]
Middle and above	0.455***	[0.273-0.758]	1.079	[0.732-1.592]
BMI				
Low#	-	-	-	-
Normal	0.777*	[0.568-1.064]	0.975	[0.702-1.354]
Overweight	1.077	[0.523-2.218]	0.944	[0.581-1.533]
Household Characteristics				
Family members				
Up to 4 members#	-	-	-	-
5-7 members	0.948	[0.702-1.278]	1.035	[0.769-1.391]
More than 7 members	1.002	[0.711-1.412]	0.961	[0.727-1.269]
Religion				
Non Christian#	-	-	-	-
Christian	0.747	[0.406-1.375]	1.113	[0.749-1.654]
Castes/Tribes				
Non ST#	-	-	-	-
Scheduled Tribes	1.958	[0.824-4.649]	0.836	[0.375-1.866]
Wealth quintile				
Poorest#	-	-	-	-
Poorer	0.874	[0.614-1.245]	1.109	[0.764-1.610]
Middle	0.774	[0.540-1.110]	0.831	[0.563-1.226]
Richer	0.832	[0.560-1.238]	1.133	[0.751-1.709]
Richest	0.752	[0.473-1.194]	0.741	[0.498-1.101]
Sanitation facility				
Unsafe#	-	-	-	-
Safe	1.054	[0.767-1.449]	0.949	[0.695-1.296]
Drinking water				
Unsafe#	-	-	-	-

Safe	0.907	[0.645-1.275]	1.007	[0.707-1.433]
Community characteristics				
Type of locality				
Rural[#]	-	-	-	-
Urban	1.394	[0.918-2.117]	1.212	[0.898-1.634]
District				
West Garo Hills[#]	-	-	-	-
East Garo Hills	1.018	[0.564-1.838]	1.078	[0.597-1.947]
South Garo Hills	0.366**	[0.158-0.848]	0.331***	[0.160-0.683]
West Khasi Hills	0.405***	[0.201-0.816]	0.414***	[0.229-0.748]
RiBhoi	0.448***	[0.241-0.834]	0.538***	[0.314-0.921]
East Khasi Hills	0.219***	[0.113-0.423]	0.190***	[0.114-0.316]
Jaintia Hills	0.379***	[0.210-0.684]	0.385***	[0.220-0.675]

[#]Reference category, *p<0.01, **p<0.05 and ***p<0.001

Discussions

The present study comprehensively indicates that almost half of the children were anemic in addition to fewer cases of severe anemic, moderate anemic and mild anemic. It is also found that children aged 6-9 years were suffering more from severe anemia as compared to children aged 15-19 years. A significant correlation between anemia and age was observed. Female children aged 6-9 years were found to be suffering more from severe anemia as compared to children aged 15-19 years. The likelihood to suffering from anemia was found to be varying among the districts of the state. As prevalence of anemia is higher in India compared to the other developed countries and frequently illiteracy, poverty, and rural residence are the major factors associated with anemia.While there are different causes associated with the prevalence of anemia, the present study highlighted socioeconomic factors which are responsible for anemia among school going children. Anemia has been shown even to contribute to mortality (Scott S.P. et al. 2014).

Anemia in children may be resulted from poor bioavailability of iron, infections like intestinal parasites, malaria and tuberculosis (TB). Although anemia has a variety of causes, it is generally assumed that 50% of cases are caused by iron deficiency. The main risk factors for iron deficiency among young children in developing countries are malnutrition (low intake) and high requirement of iron during child growth (Gutema, B. et al. 2014). Children's access to education and to learning can be negatively affected by poor health and nutritional status. It is therefore of some concern that a quarter of all children eligible to be in school are malnourished and that children in developing countries frequently carry an additional burden of infectious diseases. Deficient iron status or anemia is a major cause of growth retardation (Oliveira M. et al., 2007; Saxton J. et al., 2009), impaired physical and mental development (Sharman A., 2000), and morbidity (WHO, 1994)

Conclusions

A significant correlation between anemia and age was observed. Female children aged 6-9 years were found to be suffering more from severe anemia as compared to children aged 15-19 years. Further, results indicated that the Sanitation and safe drinking water also affect the anemia prevalence. Female children from those household having safe sanitation and safe water facilities have lower prevalence of anemia as compared to their counterpart, household having unsafe sanitation and unsafe water facilities. Educational status was strongly associated with anemia, it was also observed that as educational status of male children increases the anemia decreases. In terms of prevalence of anemia at district level in the state of Meghalaya, significant variations have been noticed. The results of present analysis study highlight the need to develop pragmatic intervention programmes incorporating various strategies to improve dietary intake and bioavailability of iron; nutritional supplementation of iron and folic acid tablets and fortification of edible dietary items with iron. Nutrition and Health Education programme may be conducted in school with teachers and parents' involvement to raise awareness regarding anemia.

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Competing interests
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References

Alloway, R. Anemia Prevention and Control. What Works? USAID, World Bank, PAHO/WHO, Micronutrient Initiative.FAO, and UNICEF; 2003.

Benoist, B. D., McLean, E., Egll, I., &Cogswell, M. (2008). Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia. *Worldwide prevalence of anaemia 1993-2005: WHO global database on anaemia.*

Choudhary, A., Moses, P. D., Mony, P., & Mathai, M. (2006). Prevalence of anaemia among adolescent girls in the urban slums of Vellore, south India. *Tropical doctor*, *36*(3), 167-169.

DeMaeyer, E. M., &Adiels-Tegman, M. (1995). World Health statistics Quarterly, (38), 302-316.

Djokic, D., Drakulovic, M. B., Radojicic, Z., Radovic, L. C., Rakic, L., Kocic, S., &Davidovic, G. (2010). Risk factors associated with anemia among Serbian school-age children 7-14 years old: results of the first national health survey. *Hippokratia*, *14*(4), 252.

Galal, O. M., Neumann, C. G. &Hulett, J. (2005). International Workshop on Articulating the Impact of Nutritional Deficits on the Education for All Agenda. Food and Nutrition Bulletin (UNU), 26(2)

Gawarikar, R. S., Gawarikar, S. B., &Tripathi, B. C. (2002). Prevalence of anaemia in adolescence girls of Ujjain WesternM. P. *Ind. J. Nutr. Dietet*, *39*(11), 493-499.

Gordon, N. (2003). Iron deficiency and the intellect. Brain Dev, (25), 3–8.

Gutema, B., Adissu, W., Asress, Y., &Gedefaw, L. (2014). Anemia and associated factors among school-age children in Filtu Town, Somali region, Southeast Ethiopia. *BMC hematology*, *14*(1), 13.

Hall, A., Bobrow, E., Brooker, S., Jukes, M., Nokes, K., Lambo, J., ...&Subagio, H. (2001). Anaemia in schoolchildren in eight countries in Africa and Asia. *Public health nutrition*, *4*(3), 749-756.

International Institute for Population Sciences Mumbai. DLHS-4 Report.

Kalaivani, K. IJMR, 2009, 130, 627-633.

Muratee, S. (1990). About anaemia. *Nutrition*, *24*(3), 3-12.

Oliveira, M. A., Osório, M. M., &Raposo, M. C. (2007). Socioeconomic and dietary risk factors for anemia in children aged 6 to 59 months. *Jornal de Pediatria*, *83*(1), 39-46.

Rawat, C. M., Garg, S. K., Singh, J. V., Bhatnagar, M., & Chopra, H. (2001). Socio-demographic correlates of anaemia among adolescent girls in rural area of district Meerut (UP). *Indian Journal of Community Medicine*, *26*(4), 173-175.

Saxton, J., Carnell, S., Van Jaarsveld, C. H., & Wardle, J. (2009). Maternal education is associated with feeding style. *Journal of the American Dietetic Association*, *109*(5), 894-898.

Scott, S. P., Chen-Edinboro, L. P., Caulfield, L. E., & Murray-Kolb, L. E. (2014). The impact of anemia on child mortality: an updated review. *Nutrients*, *6*(12), 5915-5932.

Sharman, A. (2000). *Anemia testing in population-based surveys: general information and guidelines for country monitors and program managers*. ORC Macro.

WHO Report of the WHO/UNICEF/UNU Consultation on Indicators and Strategies for Iron Deficiency and AnaemiaProgrammes. Draft report, December 6–10 1993. Geneva, Switzerland: WHO, 1994.

World Health Organization. Anemia prevention and control 2014. Available from: http://www.who.int/medical_devices/initiatives/ anaemia_control/en/