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Original Article

Moderate-to-severe anaemia among children aged 6–59 months in Nepal: An analysis from Nepal Demographic and Health Survey, 2011

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ABSTRACT

Introduction: Anaemia among children is one of the major nutrition-related morbidities in developing countries. Surveillance of moderate-to-severe anaemia is recommended for the assessment of burden of anaemia in countries with high burden of anaemia. The objective of this study was to identify the factors associated with moderate-to-severe anaemia among the children aged 6–59 months in Nepal based on Nepal Demographic and Health Survey (NDHS) 2011.

Methods: This study used the dataset from the NDHS 2011. The information of last-born children whose haemoglobin was measured during the survey was used for analysis in this study. The factors associated with moderate-to-severe anaemia among children were examined using Chi-square test and logistic regression. Complex Sample Analysis was used to account for the study design and sampling.

Results: Of the 1605 last-born children aged 6–59 months, 343 (odds ratio (OR) 20.4%; 95% confidence interval (CI) 17.9–23.2%) had moderate-to-severe anaemia. Almost half (49.1%) of the children had some degree of anaemia. Mothers' education, anaemia, ethnicity and children's age were significantly associated with moderate-to-severe anaemia among children. The mothers, who had no education (OR 3.362; 95% CI 1.485–7.611), who were suffering from anaemia (OR 3.278; 95% CI 1.884–5.704) and who were from disadvantaged Dalit ethnic groups (OR 1.739; 95% CI 1.133–2.669) were more likely to have their infants with anaemia. Similarly younger infants aged 6–11 months were more likely (OR 3.477; 95% CI 2.412–5.012) to suffer from anaemia.

Conclusion: There was comparatively a high prevalence of anaemia in children aged 6–59 months. Proper treatment for mothers' anaemia with special attention on less educated and from disadvantaged ethnic groups will help reduce the anaemic status in children.

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1. Introduction

Anaemia is a decreased concentration of circulating red blood cells or haemoglobin leading to a reduced capacity for oxygen transportation. Anaemia in children increases the risk of mortality, infection, impaired cognitive disorder and impaired physical development.¹ From a life-course perspective, anaemia can start in-utero with inadequate maternal nutrition and can lead to poorer mental and physical development of a child, school absenteeism, and ultimately loss of productivity.² In the long term, anaemia can also lead to impaired reproductive performance, and provoke pregnancy complications. Anaemia is a global public health problem affecting 1.62 billion people around the world including 293 million pre-school children.³ While Africa has the highest prevalence of anaemia among pre-school children, Asia has the greatest number of school-children with reported prevalence to be 75% in India, 65% in Pakistan and 55% in Bangladesh.¹

The anaemia burden in Nepal is high, and it is of public health concern. Only 32% of the pre-school children were provided with iron rich foods. The National Nutrition Policy reported a high anaemia prevalence (78%) among preschool children, and 90% among infants aged 6–11 months.⁴ The policy sets a target of reducing anaemia to below 40% by 2017. Previous studies have suggested that a high burden of anaemia in population is an outcome of adverse geographical and social factors such as education, occupation, place of residence and wealth status.⁵ A detailed investigation of the socio-demographic factors associated with anaemia among pre-school children in Nepal has not yet been reported. Surveillance of moderate-to-severe anaemia is recommended in the countries where the burden of anaemia is high.⁵ This study, therefore, aimed at investigating the factors associated with the moderate-to-severe anaemia among the children aged 6–59 months in Nepal based on Nepal Demographic and Health Survey (NDHS) 2011.

2. Methods

NDHS 2011 is a cross-sectional two-stage survey conducted every 5 years in Nepal. This is the fourth national survey in Nepal. The NDHS covers entire country, including rural and urban samples. The comprehensive study design, sampling strategies and clusters are explained in detail in respective report.^{6,7} The NDHS included a total of 4079 last-born children within last 5 years. Of which, 1605 children of age 6–59 months had haemoglobin measured and reported during the survey, which were included in this analysis.

Mothers provided signed or verbal consent for their children and themselves. The NDHS 2011 was approved by Nepal Health Research Council and the ICF Macro Institutional Review Board in Calverton, Maryland, USA.⁶ Publicly available de-identified dataset was used for this study.⁸

2.1. Definition of variables

2.1.1. Outcome variable

At national level, haemoglobin concentration is the most commonly used biomarker to identify the anaemia burden.⁵

Although haemoglobin concentration only serves a good indicator for iron deficiency anaemia, in the countries such as Nepal, where the major causes of anaemia is iron deficiency, this method serves an important measure to study burden of anaemia. The NDHS 2011, similar to other DHS around the world, has used haemoglobin measurement.⁶ The NDHS 2011 used HemoCue method to measure the haemoglobin which yields result in less than minutes and is suitable for field setting.⁶ The instrument was calibrated by phlebotomist based on instruction.

Haemoglobin status was grouped into four categories: no anaemia (≥ 11.0 g/dl), mild anaemia (10.0–10.9 g/dl), moderate anaemia (7.0–9.9 g/dl) and severe anaemia (< 7.0 g/dl).⁶ Out of four categories, we created dichotomous haemoglobin status as the outcome variable: moderate-to-severe anaemia (combining the latter two sub-categories) and no-mild anaemia (combining the former two groups). In countries where the burden of anaemia is high, the use of moderate-severe anaemia has been recommended for surveillance.⁵ The obtained haemoglobin for children was adjusted for altitude at sea level.⁶

2.1.2. Independent variables

Independent variables of the study were based on the previously reported factors in the global review on anaemia.⁵ The classification and recoding of independent variables are based on the previously published NDHS 2011 based studies.^{9,10}

2.2. Statistical analysis

The prevalence of anaemia is reported as percentage with 95% confidence intervals (CI). The categorical variables associated with moderate-to-severe anaemia were first examined using Chi-square test. The significant factors ($P < 0.05$) were then further examined using logistic regression. Backward elimination procedure was used in multiple logistic regression.¹¹ A P -value < 0.05 is considered statistically significant. Complex Sample Analysis was used to account for the study design, cluster and sample weight to report a more precise estimate of point estimates, odds ratios and their confidence intervals.¹² The issue of multi-collinearity was examined by checking the correlation between the selected variables: mother's education and mother's occupation; and father's education and mother's education. The correlation coefficient showed that these variables were not highly correlated. Data analysis was conducted in Statistical Package for Social Sciences (Version 20).

While the NDHS does not provide power calculation for individual outcome variables included in the survey, we calculated power for our study using power calculator of Stata software. Assuming a rate of anaemia of 20–22.5%, alpha value 0.025, and sample 1605 (included in this analysis), our sample has 87% power to use Chi-squared test.

3. Results

3.1. Anaemia prevalence

Table 1 presents the prevalence of anaemia among 1605 last-born children aged 6–59 months. A total of 343 children (odds ratio (OR) 20.4%; 95% confidence interval (CI) 17.9–23.2%) had

Table 1 – Moderate-to-severe anaemia (%) among children aged 6–59 months by demographic and socio-economic characteristics, Nepal 2011 (n = 1605).

Factors	Total, n (%)	No-mild anaemia (%)	Moderate to severe anaemia (%)	P ^a value
Maternal factors				
Mother's age (years)				0.014
15–19	93 (5.8)	68.5	31.5	
20–29	1034 (64.4)	79.4	20.6	
30–34	264 (16.4)	86.4	13.6	
≥35	214 (13.3)	79.6	20.4	
Mother's education				0.006
No education	705 (43.9)	77.6	22.4	
Primary	315 (19.6)	79.8	20.2	
Secondary	491 (30.6)	79.7	20.3	
Higher	94 (5.9)	93.7	6.3	
Mother's occupation				0.034
Not working	355 (22.1)	75.5	24.5	
Agriculture	1020 (63.6)	79.6	20.4	
Working (paid)	230 (14.3)	86.8	13.2	
Took iron during pregnancy				0.739
No	339 (21.1)	80.4	19.6	
Yes	1266 (78.9)	79.4	20.6	
Mother's anaemia				<0.001
No-mild anaemia	1496 (93.7)	81.1	18.9	
Moderate to severe anaemia	101 (6.3)	56.9	43.1	
Child related factors				
Sex of child				0.189
Male	847 (52.8)	81.2	18.8	
Female	758 (47.2)	77.9	22.1	
Age of child				<0.001
6–11 months	225 (14.0)	61.3	38.7	
12–23 months	427 (26.6)	69.8	30.2	
24–59 months	953 (59.4)	88.7	11.3	
Birth order				0.742
First	499 (31.1)	80.9	19.1	
Second or third	720 (44.9)	79.0	21.0	
Fourth or more	386 (24.0)	78.8	21.2	
Had diarrhoea				0.696
No	1342 (83.6)	79.8	20.2	
Yes	263 (16.4)	78.5	21.5	
Had drugs for intestinal parasite				<0.001
No	407 (25.4)	71.1	28.9	
Yes	1198 (74.6)	82.6	17.2	
Socio-economic factors				
Ethnicity				0.001
Relatively advantaged	761 (47.4)	84.6	15.4	
Relatively disadvantaged (Janjati)	561 (35.0)	76.4	23.6	
Relatively disadvantaged (Dalit)	283 (17.6)	73.9	26.1	
Wealth index				0.102
Poor	789 (49.2)	78.2	21.8	
Middle	550 (34.3)	77.3	22.7	
Rich	266 (16.6)	83.0	17.0	
Father's education				0.035
No education	287 (17.9)	79.0	21.0	
Primary	384 (23.9)	75.5	24.5	
Secondary	746 (46.5)	79.8	20.2	
Higher	188 (11.7)	88.7	11.3	
Residence				0.485
Urban	343 (21.4)	81.4	18.6	
Rural	1262 (78.6)	79.4	20.6	
Development region				0.166
Eastern	374 (23.6)	78.6	21.4	
Central	326 (20.3)	82.9	17.1	
Western	244 (15.2)	82.4	17.6	
Mid-Western	363 (22.6)	75.4	24.6	
Far-Western	293 (18.3)	73.9	26.1	

Table 1 (Continued)

Factors	Total, n (%)	No-mild anaemia (%)	Moderate to severe anaemia (%)	P ^a value
Ecological region				0.292
Mountain	306 (19.1)	76.8	23.2	
Hill	665 (41.4)	81.6	18.4	
Terai	634 (39.5)	78.3	21.7	

The bold *p*-values denote significant.

^a P value is reported from Chi-square test.

moderate-to-severe anaemia: 335 (20.0%; 95% CI 17.5–22.8%) children had moderate anaemia and 8 (0.4%; 95% CI 0.2–1.0%) had severe anaemia. Similarly, 445 children (28.7%; 95% CI 25.8–31.8%) had mild anaemia and 817 children (50.9%; 95% CI 47.0–54.8%) had no anaemia. A total of 101 (6.3%) mothers were suffering from moderate to severe anaemia.

3.2. Characteristics of study population

Table 2 presents the characteristics of 1605 children and their mother and household. The majority (64.4%) of mothers were from 20 to 29 years age group. A total of 43.9% of mothers did not have formal education with only 5.9% having higher education. The majority (63.6%) of mothers were involved in agriculture. Almost half of them (47.4%) were from advantaged ethnic groups. Only 14% of the children were in the age group 6–11 months. Oddly 16.6% were from rich families. The majority (78.6%) were from rural areas.

Table 2 – Factors associated with moderate-to-severe anaemia in children aged 6–59 months in Nepal.

Factors	Unadjusted odd ratio (95% CI)	Adjusted odd ratio (95% CI)
Mother's education	P = 0.006	P = 0.037
Higher	1.00	1.00
Secondary	3.770 (1.757–8.090)	3.291 (1.429–7.578)
Primary	3.751 (1.713–8.213)	3.215 (1.308–7.906)
No education	4.282 (2.066–8.875)	3.362 (1.485–7.611)
Mother's anaemia	P < 0.001	P < 0.001
No-mild anaemia	1.00	1.00
Moderate to severe anaemia	3.252 (2.023–5.227)	3.278 (1.884–5.704)
Age of child	P < 0.001	P < 0.001
24–59 months	1.00	1.00
12–23 months	3.392 (2.402–4.791)	3.477 (2.412–5.012)
6–11 months	4.952 (3.156–7.770)	5.461 (3.409–8.747)
Ethnicity	P = 0.001	P < 0.001
Relatively advantaged	1.00	1.00
Relatively disadvantaged (Janjati)	1.695 (1.207–2.382)	1.606 (1.106–2.331)
Relatively disadvantaged (Dalit)	1.936 (1.335–2.809)	1.739 (1.133–2.669)

The bold *p*-values denote significant.

Variables eliminated during backward elimination process: mother's age, mother's occupation, drugs for intestinal parasite and father's education.

3.3. Factors associated with moderate-to-severe anaemia

Table 1 presents the results of cross tabulation and their Chi-squared tests. Even though significant independent variables, as shown in Table 1 (mother's age, mother's education, mother's occupation, mother's anaemia, age of child, drugs for intestinal parasite, ethnicity and father's education), were entered into regression model, certain variables such as mother's education, mother's anaemia status, age of children and ethnicity were significantly associated with moderate-to-severe anaemia among children. With decreasing maternal education, the likelihood of anaemia among children increased (Table 2). Mothers with no education (OR 3.36; 95% CI 1.48–7.61) and mothers with primary education (OR 3.215; 95% CI 1.30–7.90) had higher likelihood of having anaemic children than their counterparts who had higher education. The mothers who were suffering from moderate-to-severe anaemia had higher likelihood of having their children anaemic (OR 3.27; 95% CI 1.88–5.70). A further exploration of scatter plot and correlation revealed a linear relationship of the mother's and children's haemoglobin level. A further important finding is that younger children were more vulnerable for anaemia than their older counterparts. It was found that children of ages 6–11 months (OR 5.46; 95% CI 3.40–8.74) and 12–23 months (OR 3.47; 95% CI 2.41–5.01) had higher odds of anaemia than their 24–59 months counterparts. The children from disadvantaged Dalit ethnic group (OR 1.739; 95% CI 1.133–2.669) and disadvantaged Janjati ethnic group (OR 1.60; 95% CI 1.10–2.33) were more likely to have anaemia than their counterparts born in advantaged ethnic groups.

4. Discussion

Results from the NDHS 2011 data showed that one in five children suffered from moderate-to-severe anaemia and one in two children had some degree of anaemia. This finding of the burden of moderate-to-severe anaemia is similar to China (25%).¹³ Childhood is the period when there is a high demand of iron for rapid growth but about half of the children are malnourished in Nepal. The higher prevalence of anaemia could lead to a higher burden of cognitive impairment, and increase susceptibility to infections.²

This study found that the younger children were vulnerable for having moderate-to-severe anaemia than their older counterparts. This finding corresponds with the finding from Timor-Leste,¹⁴ China¹³ and the Philippines¹⁵ where the younger children had lower haemoglobin concentration than their older counterparts. There could be two major reasons that can be linked with the findings: physiological mechanism and infant feeding practice. Physiologically, younger children

are in need of higher iron content. However, when children have just started weaning, the iron supplementation may be lower in their diets, as the early complementary foods are mainly soft foods such as porridge and rice. In this period the iron content from mother's milk may not be sufficient to meet the iron demand of the child. In regards to infant feeding, a former study on infant feeding practices in Nepal based on the NDHS 2011 reported that the children of younger age were less likely to meet the WHO recommended dietary requirements; overall only 26.5% of 6–23 months, and only 16.8% of 6–11 months children met the WHO recommended acceptable diet.¹⁶ Such a poor infant feeding practices could elevate the risk of not meeting iron demand of infants aged 6–11 months.

Mothers' moderate-to-severe anaemia was a significant factor associated with children's moderate-to-severe anaemia. Similar findings have been reported from Timor-Leste,¹⁴ Burma¹⁷ and China.¹³ There are three major reasons, which may explain such an association. First, mother and children usually have the same or similar food source and the same socio-economic condition.¹⁷ If the food source is not rich in bioavailable iron that will make both mother and her child vulnerable to iron deficiency anaemia. Secondly, the surrounding environment may pose the risk of parasitic infestations such as round worm and hook worm. In Nepalese society, where less than a half of the population use sanitary toilets in rural areas, so the burden of parasitic infestation would be probably high.¹⁸ This could lead to a higher rate of infestation among mother and children resulting into anaemia in both groups. Thirdly, as those mothers are already iron deficient, their breast milk may not contain enough iron to meet the physiological iron demand of children.¹³

It is not uncommon that a higher maternal educational status shall likely enhance a better maternal and child health. In our study, it was found that the children, whose mothers were uneducated, were more likely to suffer from moderate-to-severe anaemia. Similar findings were also reported from the Philippines,¹⁵ Burma¹⁷ and Timor-Leste¹⁴ showing a protective effect of maternal education against anaemia in children. Educated mothers may be able to adapt healthy lifestyles and nutritional practices for themselves and their children; they are more capable of understanding the message related to child feeding practices; also they may be more health conscious, and take adequate nutrition supplements, which could ultimately protect themselves and their children against anaemia.

Ethnicity is a unique characteristic in Nepal, which is based on caste system. The caste system of Nepal is mainly guided by the Hindu philosophy dividing entire population into more than 120 caste groups and languages. Tracing back to history, such a classification has been reported as early as around 1850s.⁹ Based on similarities among the castes, the ethnic groups are formed. The Dalit caste in Nepal is a socially and economically marginalised community. In history, even state law prohibited them from having education, entering into the temples and public places. This system has been legally abolished; however, the culturally rooted marginalisation still remains in the Nepalese society.¹⁹ The disadvantaged Janjati ethnic group is middle in the ethnic hierarchy, which, although not universal, are conservatively considered alcohol consuming groups (*Matwali*).¹⁹ They are also marginalised ethnic group in Nepal. Our current finding showed that the children who

were born to disadvantaged Dalit and Janjati mothers had higher likelihood of moderate-to-severe anaemia. This could be one of the consequences of the marginalisation of these groups in Nepal. Such ethnic differences have been also reported in other child health issues.²⁰ This finding also argues that the children from Dalit and Janjati ethnic groups need more focused nutrition intervention programmes.

A number of public health significance related aspects are discussed in this study. The younger children (6–11 months) need to be focussed for any iron supplementation or food fortification in Nepal. While the community based management of childhood illness programme has included iron-folic acid supplementation to anaemic children,^{21,22} there could be children in isolated communities who may not be in reach of public trained health workers. Therefore, feasibility of community based supplementation through outreach clinics needs to be explored. The findings that mother's anaemia was associated with child's anaemia can be useful and can be used for further improvement in the compliance with the iron-folic acid during pregnancy and postpartum period. Such a supplementation, based on the national guideline, could also be provided for the mothers who are suffering from anaemia after postpartum period.²³ This could help in increasing bioavailable iron in breast milk and contribute in reducing anaemia in younger children coming under 6–11 month infants. Nutrition promotion programme for increased intake of iron rich food in infant as well as adult diet can alleviate the anaemia deficiency, since traditional Nepali diet consists of mainly carbohydrates. While implementing such programmes, the mothers who are uneducated and who are from the disadvantaged ethnic groups need to be focussed on nutritional intervention through education and counselling.

This study has a number of strengths. We used nationally represented dataset that was based on validated questionnaire and methodology.⁶ The findings are generalisable to the whole country. Likewise, our analysis accounted for the study design and therefore, the estimation is more precise to generalise.¹² Still, we have several limitations that need to be taken care while interpreting our findings from this study. We did not have data on several medical and nutritional variables that have direct impact on anaemia including worm infestation, inadequate diet, infections or insufficient absorption of iron and there is scope of further work for more comprehensive anaemia focused study. Also, due to cross-sectional nature of our data, findings may not be sufficient to show causal inference. The NDHS 2011 did not cover the data on worm infestation, which is a major cause of iron deficiency anaemia in Nepal. Nevertheless, this study does provide some important information on factors associated with moderate-to-severe anaemia, which could be helpful for nutrition programmes in Nepal. Further intervention studies are recommended to examine the feasibility of innovative health promotion programmes focussing on increased intake of locally available iron-rich food items for mother and children.

5. Conclusions

This study found that a half of children aged 6–59 months suffered from some degree of anaemia and one in every five

were suffering from moderate-to-severe anaemia in Nepal. The children who were younger (aged 6–11 months), whose mothers had moderate-to-severe anaemia and had no education, and who were from disadvantaged ethnic groups were more likely to have moderate-to-severe anaemia. Further strengthening of community based interventions to increase iron supplementation and promotion of iron-rich infant diets are recommended, especially to the Dalit and disadvantaged Janjati caste and illiterate women.

Conflicts of interest

The authors have none to declare

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