Original Article

Turk J Med Sci
2010; 40 (5): 783-789
© TÜBİTAK
E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-0811-44

Prevalence of anaemia in women of reproductive age in Meghalaya: a logistic regression analysis

Sanku DEY[1], Sankar GOSWAMI[2], Madhuchhanda GOSWAMI[3]

Aim: To examine the prevalence of anaemia in Meghalaya, India, by exploring the 2005-2006 National Family Health Survey (NFHS -3) data.

Materials and methods: The study population consisted of 3934 ever-married women of reproductive age (15-49 years) from the state Meghalaya, India, which were taken from the NFHS-3 survey, to explore the predictors responsible for the prevalence of anaemia by using different background characteristics such as age, place of residence, nutritional status, number of children ever born, pregnancy status, educational achievement, and economic status. As a response variable, anaemia levels were categorised as a dichotomous variable, and the predicted probabilities were worked out through a binary logistic regression model, to assess the contribution of the predictors on anaemia.

Results: A logistic regression analysis was performed for some selected predictors related to anaemia levels. All the predictors, except total children ever born, were found to be statistically significant. The mean haemoglobin concentration was evaluated as 117.43 g/L, and 49.6% of the women were found to be anaemic. Women of the age group 20-24 years, are at high risk of anaemia [P = 0.320, O.R. (95% C.I.) = 1.509 (0.671, 3.390)].

Conclusion: Pregnant, under nutritious, and poorest women are at high risk of anaemia. Urban women are also at high risk; however, higher educated women are at low risk of anaemia. The habit of cigarette smoking/pan/bidi/gutka etc. also increases the risk of anaemia.

Key words: Anaemia, logistic regression, odd ratios, Wald test statistic

Introduction

Anaemia may be defined as qualitative or quantitative deficiency of haemoglobin, a molecule found inside RBC. Since haemoglobin normally carries oxygen from the lungs to tissues, anaemia leads to the lack of oxygen in organs; and as all human cells depend on oxygen, varying degrees of anaemia can have a wide range of clinical consequences. Most of the cases of anaemia are due to an inadequate supply of nutrients like iron, folic acid, vitamin B12, proteins, amino acids, vitamins A and C, and other vitamins of the B-complex group, i.e. niacin and pantothenic acid, which are also involved in the maintenance of haemoglobin levels (1). Iron deficiency anaemia is the most common form of malnutrition in the world and is the eighth leading cause of disease in girls and women in developing countries (2). Its estimated prevalence in South-East Asia is 50% to 70% (3,4). In another study, iron deficiency and anaemia were also most prevalent among pregnant women and young children, with the highest prevalence in low-income countries (5). Iron

Received:21.11.2008 – Accepted: 06.05.2010

[1] Department of Statistics, St. Anthony's College, Shillong, Meghalaya-793001-INDIA
[2] Department of Statistics, Shillong College, Shillong, Meghalaya-793003-INDIA
[3] PBCR (I.C.M.R.), Silchar Medical College & Hospital, Silchar-788014-INDIA
Correspondence: *Sanku DEY, Department of Statistics, St. Anthony's College, Shillong, Meghalaya-793001-INDIA*
E-mail: sanku_dey2k2003@yahoo.co.in

deficiency and anaemia during pregnancy are associated with low birth weight, preterm delivery, and increased prenatal mortality (6-8). While severe anaemia is closely related to the risk of mortality, even mild anaemia carries health risks, and reduces the capacity to work (9). A mother who is iron deficient during her pregnancy has a greater risk of dying during childbirth, and of having a small baby. Iron deficiency also impairs the growth and learning ability of children, lowers resistance to infectious diseases, and reduces the physical work capacity and productivity of adults (10). The supplementation of pregnant women remains the cornerstone policy for reducing anaemia among women of reproductive age, for the reason that the demands of childbearing, high fertility rates, and breastfeeding are associated with undernutrition and maternal depletion (11-12). Little progress has been made in reducing iron deficiency anaemia among women in developing countries, in spite of the introduction of iron supplementation programmes in many of them. In Indonesia, for example, iron supplementation for pregnant women was started some 10 years ago, but the prevalence of anaemia among pregnant women remains at 63.5% (13).

Although some studies have found that anaemia is more common among adolescents, this appears to be a result of the fact that adolescents are more often primigravidae, and not from young age per se. Two studies from Malawi confirm this finding.

Several studies have also found a negative association between the socioeconomic situation (SES) and anaemia's prevalence (14-16). Women from poor households are usually found to have higher anaemia prevalence. A poor SES is known to be associated with a number of factors, such as high parity, short birth interval, poor diet both in quantity and quality, lack of health and nutrition awareness, and a high rate of infectious diseases and parasitic infestations. Since the SES is an important determinant of access to health care, poor people have often limited access to medical attention and preventive measures (17), increasing their risk of becoming anaemic.

In India, the prevalence of anaemia among all ages remains very high. The prevalence rate among rural pregnant women is 84.9%, with 9.9% having severe anaemia (18); moreover, this is supported by the Nutrition Foundation of India's study in 7 states (2002-2003) reporting 86%, with 9.3% having severe anaemia (19) posing a threat to pregnant women because anaemia reduces the efficiency of blood clotting. Many Indian women give birth at home with no supply of blood on standby, and even in hospitals, supplies of blood are unreliable. Tragically, this means that women often bleed to death after giving birth.

The determination of factors that influence the occurrence of anaemia in a population is fundamental for the implementation of control measures. In view of this, our aim is to determine the prevalence of anaemia among ever-married women of reproductive ages from the state Meghalaya, India, and to explore some factors commonly associated with anaemia. Socioeconomic differentials are also presented to understand the prevalence of anaemia.

Materials and methods

The data for the article were derived from the third Indian National Family Health Survey in 2005-2006 (NFHS-3), for the state of Meghalaya, India. A total of 3934 ever-married women of reproductive ages (15-49 years) from the state Meghalaya, India, were taken from the NFHS-3 survey to study the impact of some socioeconomic, pregnancy status, and nutritional factors on anaemia. The binomial logistic regression was used to develop a predictive model on anaemia with the help of selected predictors. SPSS was used to compute the odds ratios to assess the degree of dependence of anaemia on the taken risk factors. The Wald test-statistic was used to test the significance of the logistic regression coefficients. The reference group was taken as the first category for the age group, and last category for all other predictors.

The data on predictors were taken on age (grouped), type of place of residence, highest educational level, wealth index, pregnancy status, nutritional status, working status, occupation, total children ever born, habit of cigarette/bidi/pan/gutka etc. The response variable is designed as dichotomous anaemia level Y (0 = Non-anaemic, 1 = Anaemic). Table 1 represents an overview of the predictors used in the model.

Table 1. Description of predictors in the logistic regression model.

Predictors	Variable name and value level	Type of variable
X1	Age 5-year groups 1 = 15-19 2 = 20-24 3 = 25-29 4 = 30-34 5 = 35-39 6 = 40-44 7 = 45-49	Ordinal Categorical
X2	Place of residence 1 = Urban 2 = Rural	Categorical Nominal
X3	Highest educational level 1 = No education 2 = Primary 3 = Secondary 4 = Higher	Categorical Ordinal
X4	Wealth index 1 = Poorest 2 = Poorer 3 = Middle 4 = Richer 5 = Richest	Ordinal Categorical
X5	Pregnancy Status 1 = Yes 2 = No or unsure	Dichotomous
X6	Nutritional status 1 = Underweight 2 = Pre-obese 3 = Obese 4 = Normal	Ordinal Categorical
X7	Respondent currently working 0 = No 1 = Yes	Dichotomous
X8	Respondent's occupation 1 = Teaching/Office 2 = Sales/Services 3 = Agr-employee 4 = Manual workers 5 = Not working	Nominal Categorical
X9	Total children ever born 1 = 1 or 2 children 2 = 3 or 4 children 3 = 5 or above	Nominal Categorical
X10	Habit of Cigarette/ Bidi/Pan/Gutka etc. 1 = Yes 2 = No	Dichotomous

The logistic regresssion model is:

$$\pi = P(Y = 1 | X_1 = x_1, X_2 = x_2 \dots X_p = x_p)$$

$$= \frac{e^{z(x)}}{1 + e^{z(x)}}$$

where $z(x) = \beta_0 + \beta_1 x_1 + \dots + \beta_p x_p$ is the logit transformation of the logistic regression model. The importance of this transformation is that z(x) has many of the desirable properties of a linear regression model. The results are shown in Table 3.

Results and discussion

Anaemia is one of the most important health problems among women from 18 to 45 years of age in the world, and especially in developing countries (15). In our study, the mean haemoglobin concentration of women of reproductive age (15-49 years) in Meghalaya, India, is found to be 117.43 g/L with standard deviation 19.13 g/L. The cumulative distribution of haemoglobin concentration is shown in the Figure. Demographic characteristics of anaemic and non-anaemic groups are presented in Table 2.

The results of our study show that all the predictors, associated with the prevalence of anaemia, are statistically significant except the predictor 'children ever born' (Table 3). In this study, we found that women of the age group 20-24 were at high risk of anaemia with an odds ratio of 1.509. The associated risks for pregnant and under-nutritious women increase by 1.843 times, and is increased 1.739 times with reference to non-pregnant and normal nutritious women, respectively. The prevalence of anaemia among women is higher in urban areas. Data also show that uneducated, primary educated, and secondary educated women are at greater risk of anaemia as compared to higher educated women with odds ratios at 1.133, 2.329 and 1.788, respectively. The wealth index indicates that as the women become richer, the risk of anaemia decreases. Working women are more prone to be anaemic, and out of these, manual workers are at the highest risk with odds ratio 2.098, followed by the women employed in teaching or office jobs with odds ratio of 1.675. The predictor 'total children ever born' has not been found to be significant. However, the odds reveal that women having more children are less prone to be anaemic. The habit of consuming pan/bidi/cigarette/gutka etc. increases the risk of anaemia.

Conclusion

This paper reviews the present situation of the prevalence of anaemia in women of reproductive ages in Meghalaya, and thus summarises the information available to provide the magnitude of anaemia among women of a reproductive age (15-49 years) from Meghalaya, India. The prevalence rate of anaemia among women in the age group 15-49 is 49.6%. The highest rate of prevalence of anaemia was found in the age group 20 -24. Low income has been found to be significantly associated with the increased prevalence rate of anaemia among the women studied. The logistic regression suggests that all the predictors, associated with the prevalence of anaemia, are statistically significant, except the predictor 'children ever born', which clearly demonstrated that the magnitude of the problem is considerable. Therefore, the gravity of the problem makes it clear that there is a need for well-planned, large-scale studies using standardised methodologies to estimate the prevalence of anaemia and other micronutrient deficiencies among women of a reproductive age. While planning these studies, it is necessary to ensure that importance is given to the accurate evaluation of

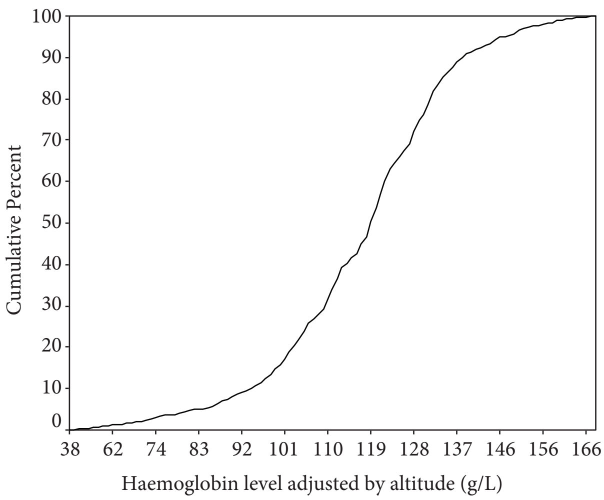

Figure. Haemoglobih level adjusted by altitude (g/L).

Table 2. Demographic characteristics of the 2 groups (n = 3934).

Variable	Anaemia (n = 1951) 49.6%	Non-Anaemia (n = 1983) 50.4%	Total (n = 3934)
Age (5-year groups)			
15-19	15 (53.6%)	13	28
20-24	185 (65.8%)	96	281
25-29	293 (47.2%)	328	621
30-34	247 (42.1%)	340	587
35-39	474 (46.8%)	538	1012
40-44	359 (49%)	373	732
45-49	378 (56.2%)	295	673
Type of place of residence			
Urban	599 (48.6%)	633	1232
Rural	1352 (50%)	1350	2702
Highest educational level			
No education	788 (47.9%)	858	1646
Primary	513 (58.5%)	364	877
Secondary	583 (48.8%)	612	1195
Higher	67 (31%)	149	216
Wealth Index			
Poorest	330 (65.6%)	173	503
Poorer	463 (54.5%)	387	850
Middle	501 (46.3%)	581	1082
Richer	434 (46.2%)	506	940
Richest	223 (39.9%)	336	559
Pregnancy status			
Currently pregnant	135 (63.7%)	77	212
Not Pregnant	1816 (48.8%)		1906
3722			
Nutritional status			
Underweight	329 (62.7%)	196	525
Pre-Obese	126 (46.5%)	145	271
Obese	35 (43.8%)	45	80
Normal	1461 (47.8%)	1597	3058
Working status			
Currently working	804 (47.6%)	885	1689
Not working	1147 (51.1%)	1098	2245
Respondent's occupation			
Teaching/ Office	113 (42.8%)	151	264
Sales/ Services	180 (42.5%)	244	424
Agri-Employee	465 (50.5%)	456	921
Manual workers	262 (61.1%)	167	429
Not working	931 (49.1%)	965	1896
Cigerette/bidi/pan/gutka etc			
Yes	877 (50.1%)	872	1749
No	1074 (49.2%)	1111	2185
Children ever born			
Up to 2	315 (47.2%)	352	667
3-4	572 (48%)	619	1191
5 or above	1064 (51.3%)	1012	2076

Table 3. Logistic regression model parameters.

Predictors	$\hat{\beta}$	S.E.($\hat{\beta}$)	Wald test	d.f.	P-value	Odds Ratio	95% C.I. for O.R.	
							Lower	Upper
Age group(X1)			56.844	6	<0.001			
X1 (2)	0,411	0,413	0,990	1	0,320	1,509	0,671	3,390
X1 (3)	-0,392	0,407	0,930	1	0,335	0,676	0,305	1,499
X1 (4)	-0,578	0,411	1,976	1	0,160	0,561	0,251	1,256
X1 (5)	0,354	0,410	0,747	1	0,388	0,702	0,314	1,567
X1 (6)	0,268	0,413	0,423	1	0,515	0,765	0,341	1,717
X1 (7)	0,059	0,415	0,020	1	0,888	1,060	0,470	2,390
Place of residence(X2)								
X2 (1)	0.198	0.089	4.938	1	0.026	1.219	1.024	1.451
Educational level(X3)			72,712	3	<0,001			
X3 (1)	0,125	0,200	0,392	1	0,531	1,131	0,766	1,677
X3 (2)	0,845	0,201	17,696	1	<0,001	2,329	1,571	3,454
X3 (3)	0,581	0,179	10,495	1	0,001	1,788	1,258	2,541
Wealth Index(X4)			70,5554	4	<0,001			
X4 (1)	1,203	0,176	6,766	1	<0,001	3,331	2,359	4,703
X4 (2)	0,572	0,157	13,296	1	<0,001	1,771	1,303	2,409
X4 (3)	0,275	0,143	3,714	1	0,045	1,316	0,995	1,740
X4 (4)	0,134	0,126	1,140	1	0,286	1,144	0,894	1,464
Pregnancy status(X5)								
X5 (1)	0.611	0.157	15.254	1	<0.001	1.843	1.356	2.504
Nutritional status(X6)			32,029	3	<0,001			
X6 (1)	0,553	0,102	29,166	1	<0,001	1,739	1,422	2,125
X6 (2)	0,092	0,136	0,459	1	0,498	1,096	0,840	1,430
X6 (3)	-0,339	0,243	1,942	1	0,163	0,712	0,442	1,148
Currently working(X7)								
X7 (1)	0.480	0.124	15.027	1	<0.001	1.616	1.268	2.059
Occupation(X8)			31,370	4	<0,001			
X8 (1)	0,516	0,188	7,504	1	0,006	1,675	1,158	2,424
X8 (2)	0,270	0,157	2,936	1	0,087	1,310	0,962	1,783
X8 (3)	0,137	0,132	1,080	1	0,299	1,146	0,886	1,484
X8 (4)	0,741	0,155	22,838	1	<0,001	2,098	1,548	2842
Children ever born(X9)			4,848	2	0,089			
X9(1)	-0,255	0,116	4,849	1	0,028	0,775	0,618	0,972
X9(2)	-0,077	0,084	0,852	1	0,356	0,925	0,785	1,091
Cigarette/bidi/pan/gutka etc.(X10)								
X10 (1)	0,164	0,070	5,515	1	0,019	1,178	1,027	1,350
Constant	-1.128	0.246	21.061	1	<0.001	0.324		

different background characteristics, such as age, place of residence, nutritional status, number of children ever born, pregnancy status, educational level, and economic status. A comprehensive study including anthropometric data, biochemical data, clinical signs, and dietary intake data among the same group of women will give a better insight into the situation.

Acknowledgement

The comments of the referee are appreciated.

References

1. Lee G R, Herbert V. Nutritional factors in the production and function of erythrocytes. In: Lukens J, Paraskevas P, Greer JP, Rodgers GM, editors. *Wintrobe's clinical hematology*. Baltimore, Maryland USA: William & Wilkins 1998; 228-66.
2. World Bank. World development report investing in health. New York: Oxford University Press, 1993.
3. Garcia M, Mason J. Second report of the world nutrition situation. Geneva: United Nations Administrative Committee on Co-ordination/Sub-Committee on Nutrition, 1992.
4. Mother Care. Prevalence of maternal anaemia in developing countries. Working Paper No. 7. Arlington, Va, USA: John Snow 1992.
5. DeMaeyer EM. Preventing and Controlling Iron Deficiency Anaemia through Primary Health Care. A Guide for Health Administrators and Programme Planners. Geneva: World Health Organization, 1989.
6. Scholl T, Hediger M, Fischer R, Shearer J. Anaemia vs. iron deficiency: increased risk of preterm delivery in a prospective study. Am J Clin Nutr 1992; 55: 985-8.
7. Lieberman E, Ryan K, Monson R, Schoenbaum S. Association of maternal hematocrit with premature labor. Am. J. Obstet. Gynecol 1988; 159: 107-14
8. Murphy J, O'Riordan J, Newcombe R, Coles E, Pearson J. Relation of haemoglobin levels in first and second trimesters to outcome of pregnancy. Lancet 1986; 992-4.
9. Cohen BJB, Gibor Y. Anaemia and menstrual blood loss. Obstet Gynecol Surv. 1980; 35:597-618.
10. ACC/SCN Fourth Report on the World Nutrition Situation. Geneva, 2000
11. Winikoff B. The maternal depletion syndrome: clinical diagnosis or eco-demographic condition? Biol Soc 1988; 5: 163-70.
12. Winkvist A, Rasmussen KM, Habicht J. A new definition of maternal depletion syndrome. Am J Public Health 1992; 82: 691-4.
13. Muhilal, Sumarno I, Komari. Review of surveys and supplementation studies of anaemia in Indonesia. Food Nutr Bull 1996; 17: 3-6.
14. Carlo EB, Sosa EM. Iron status in non-pregnant women of child bearing age living in greater Buenos Aires. Eur. J Clin Nutr 1991; 45: 215-20.
15. Isah HS, Fleming AF, Ujah IAO, Ekwempu C.C. Anaemia and iron status of pregnant and non-pregnant women in the Guinea savanna of Nigeria. Ann Trop Med Parasitol 1985; 79: 485-93.
16. Johnson A, Latham MC, Roe DA. The prevalence and etiology of the nutritional anaemias in Guyana. Am J Clin Nutr 1982; 35: 309-18.
17. Lovell C, Abed FH. Scaling up in health: two decades of learning in Bangladesh. In: Rohde J, Chatterjee M, Morley D, eds. Reaching Health for All. Bombay: Oxford University Press, 1988; 212-32.
18. Teoteja G, Singh P. Micronutrient deficiency disorders in 16 districts of India. Report of an ICMR Task Force Study – District Nutrition Project. Part 1, 2001
19. Agarwal KN Agarwal DK Sharma A Sharma K Prasad K Kalita MC Khetarpaul N Kapoor AC Vijayalekshmi Govilla Ak Panda SM Kumari P. Anaemia in rural in rural pregnant and lactating Indian women. Indian J Med Res (In Press).
20. National Family Health Survey (NFHS 3). India, International Institute of Population Sciences, Mumbai, 2005-06.