

Maternal Anaemia, Pregnancy Complications and Birth Outcome: Evidences from North-East India

Mousumi Gogoi, Ranjan Kumar Prusty

Anaemia is a common disorder among women in India mostly during reproductive time period where about 55 percent women aged between 15- 49 have anaemia because of low dietary habit and other related causes. Anaemia prevalence is highest among pregnant women due to high iron demands of growth of foetus at the time of pregnancy. The paper tries to examine the causes and consequences of anaemia among pregnant women with birth outcomes and complications by using National Family Health Survey-III and multivariate and bivariate analysis were performed. Finding shows that higher risks of poor pregnancy outcome by anaemic women like premature birth, low weight at birth and termination of pregnancy. There is a U-shape relationship existing between maternal haemoglobin concentration and poor birth outcomes leading to higher risk to deliver premature birth. The study also reveals that prevalence of anaemia exists because of poor dietary habit and other lifestyle behaviour.

Keywords: Anaemia, foetus, pregnancy complications, premature birth.

Introduction

Anaemia and Iron deficiency remain epidemic levels among women and children in many nations. Anaemia is commonly known as decrease in concentration of red blood cells or haemoglobin (Hb) level in the peripheral blood. It occurs when the total volume of red blood cells is reduced below the normal values. Anaemia is mainly caused by defective red cell production, increases red cell destruction, or blood loss. At the mean time anaemia in pregnancy is defined as a haemoglobin concentration below 11 g/dl. On average, 45 percent of pregnant women and 49 percent of children under five years of age are anemic in developing regions (Mason et al, 2005). A public health problem like iron deficiency anaemia (IDA), which is complex and has a multifaceted etiology, needs to be tackled concurrently through several approaches which call for innovative thinking. As literature suggests, prevalence of anaemia in South Asian countries is the highest in the world, mirroring overall high rates of malnutrition. It is unfortunate that IDA is a major problem in most of the South Asian countries in spite of the knowledge that has

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been accumulated over the years about its etiology and prevention (Rajaratnam et.al: 1999). Iron is essential in the production of hemoglobin, which functions in the delivery of oxygen from the lungs to the body tissues. In electron transport in cells, and in the synthesis of iron enzymes that are required to use oxygen for the production of cellular energy (Bothwell et, al.. 1979; CEC. 1993).

Anaemia prevention programmes can contribute significantly to achieving many of the Millennium Development Goals (MDGs) including MDG-1 (poverty and hunger); MGD-4 (child mortality reduction); and MGD-5 (improved maternal health). World Health Organisation's (WHO) 2002 Global Burden of Disease Report identifies iron deficiency as the 12th most important risk factor for all mortality globally, and the ninth most important risk factor for the global burden of disease. Recent WHO analysis of causes of maternal death shows that haemorrhage is the major contributor to maternal deaths in developing countries (WHO: 2006). Women with Iron deficiency anaemia show an increased risk of associated complications during pregnancy, including unitary tract infections, pyelonephritis and pre-eclampsia (Kitay and Harbort, 1975). According to Godfrey et. al. (1991) increased placental weight and a high ratio of placental weight to birth weight, which are associated with an increased risk of high blood pressure in the infants later life, have been linked to maternal anaemia during pregnancy and specifically to maternal iron deficiency anaemia.

Anaemia during pregnancy also may contribute to perinatal morbidity and mortality by increasing the likelihood of intrauterine growth retardation (IUGR) and preterm delivery. The more severe the anaemia, the greater the risk that the mother will deliver a low weight baby due to IUGR. The association between birth outcomes and anaemia is strongest in early pregnancy suggesting that pre-pregnancy improvements in iron status are warranted (Gillespie: 1997; Mother Care: 1994).

Anaemia is directly related to risk of preterm delivery, inadequate gestational weight gain, and increased perinatal mortality (Mac Gregor, 1963; Garn et. al., 1981; Murphy et. al., 1986). The more severe the anaemia the greater is the risk that the mother will deliver low birth weight baby because of poor intra uterine growth (Scholl et. al., 1992). According to Theresa and Mary (1994) high maternal hemoglobin concentrations or hematocrits appear to be related to an increased risk of preterm delivery, low birth weight, foetal growth retardation, and foetal death when present either or later pregnancy. Anaemia among pregnant mothers is associated with low birth weight and increased perinatal mortality as well as low birth weight is a major factor in subsequent infant morbidity and mortality. A decrease in the prevalence of anaemia could lead to lowering of incidence of low birth weight and thereby can reduce infant mortality (Dubey, 1994).

Anaemia is considered as a major health problem in India, especially among women and children. The high prevalence of anaemia among women in India is a burden for them, for their families, and for the economic development and productivity of the country. In a study by Loretta et. al. (1998) suggest that in India interventions that focus on reducing fertility or on iron supplementation during pregnancy will have beneficial nutritional effects but will still leave most women iron deficient. The problem of anaemia is found very high among women and children and cause increase risk of maternal and infant mortality. The high level of anaemia is imputed to nutritional deficiency and lack

of quality of care.

Need for the study

Anaemia is one of the most common nutritional disorders in the world. WHO has estimated that prevalence of anaemia in developed and developing countries in pregnant women is 14 per cent in developed and 51 percent in developing countries and 65-75 per cent in India (DeMayer and Tegman, 1998). About one third of the global population (over 2 billion) are anaemic (WHO, 2004). Many studies reveal that iron deficiency anaemia among women and mainly among pregnant women are the cause of most maternal morbidity and mortality. Anaemia has been associated with adverse reproductive health, including intrauterine growth retardation, preterm births, low birth weight, etc. According to NFHS-3 report, 56 percent of women age 15-49 are anaemic in India, which is also the highest in the world. In India Assam is the high privileged state constituting 72 percent followed by Haryana 69.7 percent and Jharkhand 68.4 percent. Considering the above statements, it is important to understand the level and vulnerability of anaemia among women during reproductive age groups. Besides, it is also important to know variations in anaemia level among women by state and subgroups of population, including the possible determinants and resultant outcomes. The present study is done to explore the factors, differentials and determinants of maternal anaemia as well as its impact on complications during pregnancy and adverse birth outcome. Therefore, the study focuses on the following objectives:

1. to see the prevalence of anaemia among women in North-East region of India, and
2. to examine the association between maternal anaemia on pregnancy complications and birth outcomes.

Conceptual Framework

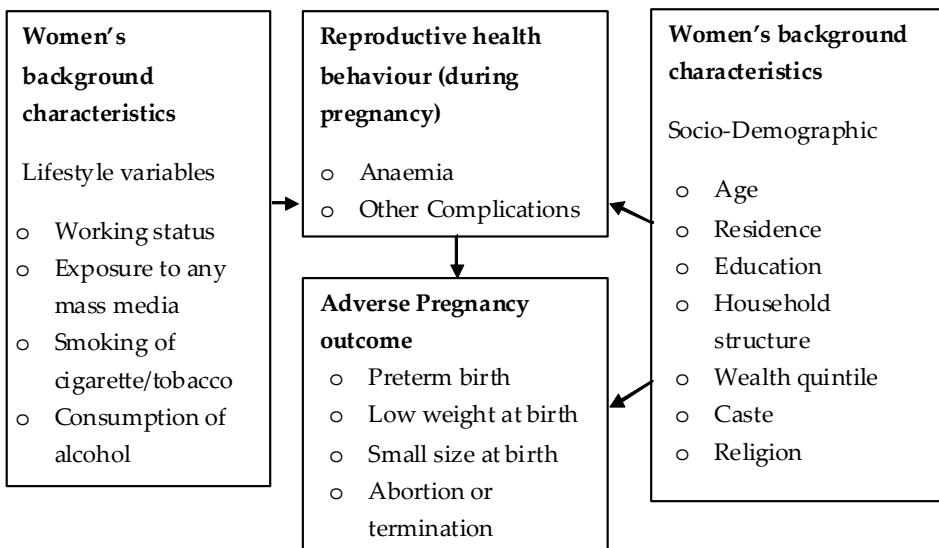


Fig. 1

Conceptual framework for the present study has been developed to show the prevalence and variation of anaemia among states, particularly for the north-eastern states where the prevalence of anaemia is higher in four states than the national average (55%). The level of anaemia varies widely within the region where Assam shows highest prevalence rate constituting around 72 percent of anaemia level among women aged 15-49.

Fig. 1 shows women's socio-demographic and lifestyle variables linked with prevalence of anaemia during pregnancy as well as other health complications during pregnancy. Among the demographic characteristics age of women has a direct impact on pregnancy complications and birth outcomes whereas other demographic variables have no direct relationship. But the lifestyle characteristics are directly linked with women's health behaviour which may causes complications including anaemia during pregnancy and its outcome like premature birth, low weight at birth, small for gestational age, abortion etc.

Data and Methods

The data for the analysis is obtained from the 2005-06 National Family Health Survey (NFHS) of India. The NFHS is a cross-sectional, multi-stage household survey and is similar to the Demographic Health Surveys in structure and format. NFHS took a direct measurement of the haemoglobin levels of all children under age five years, women aged between 15-49 and men aged between 15-54. Measurements were taken in the field using the HemoCue Hb 201+ analyser. The system uses a drop of blood from a finger prick (or heel prick in case of infants under six months old), which is drawn into a cuvette and then inserted into a portable, battery operated instrument. In less than one minute, the haemoglobin concentration is indicated on a digital read out (IIPS & Macro International, 2007). For male and female different cut-off points has been defined to identify anaemia level. In NFHS (2005-06) female cut-off point for anaemia level has set as having less than 7.0 g/dl as severely anemic, 7.0 g/dl to 9.9 g/dl as moderately anemic and 10.0 g/dl to 11.9 g/dl as mild anemic.

NFHS also provides information regarding various complications during pregnancy like difficulty with daylight vision, night blindness, convulsion (not from fever), swelling of legs, body or face, excessive fatigue and vaginal bleeding etc. Preterm delivery (before completion of 37 weeks of gestation or more than 7 months), low weight at birth baby (less than 2500 gm), experience of abortion or termination and size of the baby at birth were considered as outcome variable which were calculated by using calendar method procedure for the last one year birth (at the time of survey).

The analysis has been carried out for north-eastern region (Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Tripura, Nagaland and Sikkim) of India as the prevalence of anaemia is higher among women aged between 15-49 years. Nagaland state is not included for analysis as the data on anaemia was not collected due to refusal of giving blood sample. Therefore, the final sample available for analysis consists of 11,318 women. For state-wise analysis, state sampling weights are used to correct oversampling, while performing combined state analysis national women's weight is used (Gupta, Arnold, & Lungdim, 2009). A range of demographic, socioeconomic, behavioural and dietary covariates are examined to understand their association with maternal anaemia,

pregnancy complications and birth outcome. The variables used for analysis are age, education, caste, religion, place of residence and wealth status, smoking habit and consumption of alcohol on women's health status and its related outcomes in North-East India.

Dependent Variables

- Anaemia level among women (mild, moderate and severe anaemia)
- Pregnancy Outcomes (preterm delivery, low weight at birth, termination and size of baby at birth)

Independent Variables

a) Socio-economic characteristics

The present study utilise the data on social characteristics of women as place of residence (rural, urban), religion (Hindu, Muslim, Christian and others), caste groups (SC, ST, OBC and others), educational level of women (uneducated, primary, secondary and higher), wealth index (poor and non-poor), smoking status (smoker and non-smoker), consumption of alcohol (consume and not consume), exposure to mass media (exposed and not exposed) and household structure (nuclear and other) etc.

b) Demographic characteristics

The demographic characteristic of women includes current age of women (less than 20, 20-29, 30-39, 40 and above), body mass index (BMI) of women (Less than 18.5 kg/m², 18.5 to 24.9 kg/m² and more than 25.0 kg/m²), parity (less than 4 and above 4), Hb level (<90, 90-99, 100-109, 119-129 and more than equal to 130), age at first marriage (less than 20, 20-30 and more than 30 years), pregnancy complications (convulsions, fatigue, swelling, vaginal bleeding, night blindness and difficulty in day vision), maternal health care utilisation such as ANC visit (yes or no), taking IFA tablet (yes or no), and receive TT injection (yes or no) food supplementation to the baby (yes or no) etc.

Findings

Prevalence of Anaemia among women

Anaemia is one of the major health problems among Indian women and most of the vulnerable cases were found during their reproductive age group or at the time of child bearing.

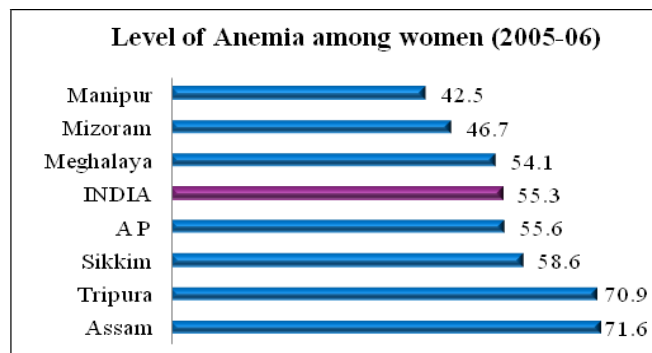


Fig. 2: Percent distribution of currently married women with anaemia level in selected states

Level of anaemia among women varies within the state and one of the probable causes of this fact is diversity in dietary habit and another may be cultural practices followed especially during pregnancy. It is also found that the level of anaemia varies with changing socio-economic characteristics like residence, living status, economic condition, etc. It is found that women living in rural areas and with low income are more vulnerable to anaemia as compared to the urban and middle or high income groups. Highest concentration of anaemia among women is found in the state of Assam which consists of about 72 percent followed by Tripura (71%).

Effect of anaemia on pregnancy outcomes

There is an adverse relationship between mother's anaemic condition and birth outcomes. Anaemia among women results in high risk of premature delivery or small for gestational age, low birth weight babies and also one of the causes of termination and abortion. The prevalence of anaemia among pregnant women varies with different demographic characteristics like body mass index of pregnant women, parity of women, age at marriage, etc. Anaemia is directly related to risk of preterm delivery, inadequate gestational weight gain and increased perinatal mortality. There is a greater risk that mother will deliver a low birth weight baby with severe anaemia because of poor intra uterine growth (Rajaratnam et. al., 1998).

Preterm Birth

Preterm birth is defined as a delivery prior to 37 completed weeks of gestation. Preterm delivery is common among anaemic women due to lack of sufficient blood in her body to supply for the development of intra-uterine growth of the foetus. Maternal iron deficiency anaemia in early pregnancy poses a greater risk of preterm delivery. Fig. 3 shows the correlation between maternal haemoglobin level and preterm delivery where it is clearly visible that increasing or decreasing level of haemoglobin has a positive impact on preterm delivery. Women having haemoglobin level less than 90 or more than 130 are more prone to have premature delivery than women with haemoglobin level 90-129g/l.

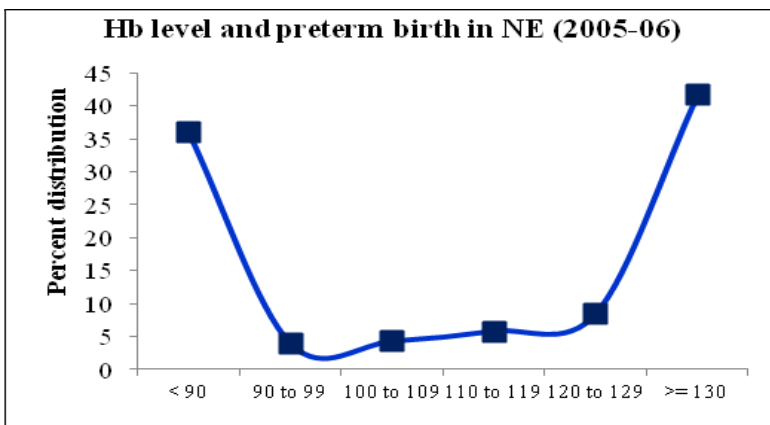


Fig. 3: Concentration of hemoglobin level and preterm delivery, North-Eastern region of India, 2005-06

Low Birth Weight (LBW)

Low birth weight is defined as a term baby born with weight less than 2500 gram or 2.5 kg. Low birth weight occurs because of poor maternal health, maternal anaemia and nutrition and poor foetal growth. Iron and protein deficiency are one of the leading causes for pregnant mothers having low birth weight babies. Low birth weight is one of the most serious challenges for mother and child health in developing countries. It has a number of public health consequences such as mental retardation, high risk of perinatal and infant mortality as well as morbidity and very high cost of special care and intensive care unit. It has been revealed that half of all perinatal deaths and one third of all infants deaths occur due to low birth weight.

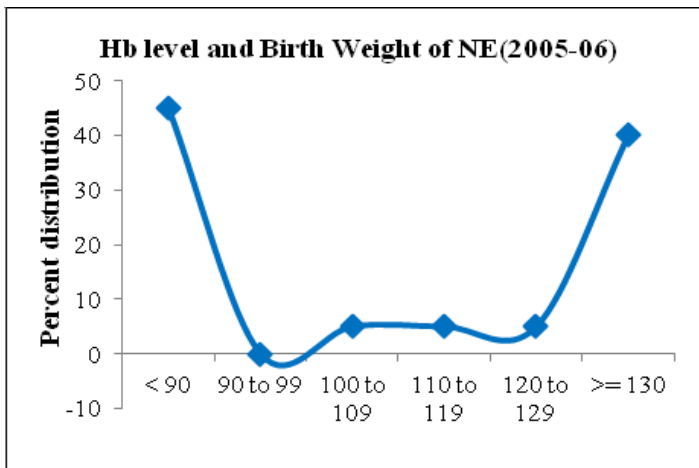


Fig 4: Concentration of hemoglobin level and low birth weight in North-Eastern region of India, 2005-06

Termination of pregnancy

Termination of pregnancy is estimated to be around one in four pregnancies. Around one in three women will have an abortion in their lifetime (RANZCOG). Abortion is the termination of a pregnancy by the removal or expulsion from the uterus of a foetus or embryo, resulting in or caused by its death. An abortion can occur spontaneously due to complications during pregnancy or can be induced as seen among humans and other species. Low self-esteem, late-gestation termination, prior psychiatric illness and conflict with religious or cultural beliefs were some important parameters found to influence negative psychological outcomes following termination (Bonevski & Adams, 2001).

From the study it is found that women having both low and high level of haemoglobin concentration in blood have a higher risk of termination or abortion in her reproductive course (Fig 5). The experience of abortion or termination is more likely among more than half of women (53 percent) with haemoglobin level less than 90 g/l. There is a higher risk of abortion among women having very low level of haemoglobin concentration in blood.

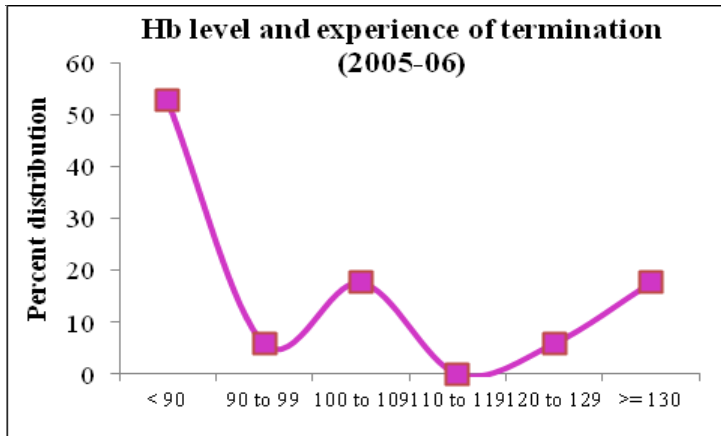


Fig. 5: Concentration of hemoglobin level and experience of termination & abortion North-Eastern region of India, 2005-06.

Anaemia and other Pregnancy related Complications among women in North East India

For the most recent birth in the five years preceding the survey, the mothers were asked whether at any time during her pregnancy had any experience of pregnancy related complication like difficulty in vision during daylight, night blindness, convulsion (not from fever), swelling of the legs, body or face, excessive fatigue, or vaginal bleeding. Night blindness or difficulty in seeing at dusk is the result of chronic vitamin A deficiency and is often seen in pregnant women in areas where vitamin A deficiency is endemic. Pregnancy complication is also an important factor related with anaemia among women. The study shows that complications like night blindness, swelling of legs, face and body, excessive fatigue are more common among severely anaemic women. Supplementation with iron is generally recommended during pregnancy to meet the iron needs of both mother and foetus. Routine use of iron supplementation by pregnant women can reduce the problem of anaemia or maternal anaemia. Results also show that mothers' nutritional status is the most important determinant of the weight of newborn children. Result shows that pregnancy complication like difficulty in vision during daylight and night blindness have been reported more by women with any type of anaemia than non-anemic women in all the studied states. Complication like swelling of face, hands and feet and excessive fatigue during pregnancy are also common among women those reported of any anaemia almost in all the states as compared to non-anemic women (table 4).

Discussion

The study tries to demonstrate a relationship between maternal anaemia and adverse birth outcomes and related pregnancy complications. Anaemia is considered as one of the major public health problems where women and young children are the most vulnerable of it and women having anaemia during pregnancy is found to affect the growth and development of child. In India the prevalence of anaemia among women is quite high

(55.3 percent) which may be due to poor diet and malnutrition. Anaemia during pregnancy is very much common among Indian women, which is enhanced further by restrictions in food intake that deprives women of rich iron and proteins due to cultural taboos and beliefs.

Women are more vulnerable to anaemia, particularly during their reproductive age time. In India women are suffering from anaemia, which may be imputed to poor diet and cultural beliefs followed by women at the time of pregnancy. The anaemia prevalence is found high among women in Assam and Tripura (more than national average of 55%), whereas the prevalence is low in the state of Manipur and Mizoram, which is less than the national average. So, there is a differential in the prevalence of anaemia within the region as well as within the states.

The analysis shows a U-shape relationship between maternal haemoglobin concentration and preterm delivery. Because of low concentration of haemoglobin in blood there is higher risk of premature birth, as well as high haemoglobin concentration in blood means the increase of poor plasma volume (yellow blood cell) which increases delivery of premature birth. The other pregnancy outcomes like low weight at birth, small size of baby and abortion, there is also a U-shape relationship among birth outcomes and maternal haemoglobin concentration. From this study we can say that the rates of preterm delivery, LWB (low weight at birth), size of the baby at birth and termination or abortion experience, are related with women's enrolment haemoglobin level in a U-shape fashion. The lowest risk is found for women in the 90-120 g/l haemoglobin group.

Conclusion

It is a known fact that one of the objectives of public health is to reach and target the population at risk in providing better health care so as to achieve the goal of health for all. Anaemia should be considered not only as alarming for both the mother and foetus during pregnancy but also after the detachment. It is important to note that anaemia has multiple causes and influenced by biological variables as well, which can be addressed during antenatal and prenatal care in general and iron and folic acid consumption and dietary intake in particular. The government's anaemia prevention and control programme should focus more on pregnant women. The three ANC visits recommended by the government must have a strong anaemic or nutritional component. Iron supplementation programmes need to be expanded to include nutrition education programmes and be effectively implemented. ICDS centres can also be expanded to cover far-flung areas.

Table 1: Prevalence of anaemia in currently women age 15-49, North- eastern states of India, 2005-06.

State	Anaemia status by haemoglobin level				N
	Severe (<7 g/dl)	Moderate (7-9.9 g/dl)	Mild (10-11.9 g/dl)	Any Anaemia (> 12. g/dl)	
Assam	4.3	24.0	43.9	72.1	864
Arunachal Pradesh	2.8	14.9	37.8	55.6	577
Manipur	0.7	6.6	35.3	42.5	1382
Meghalaya	2.6	15.8	35.6	54.1	688
Mizoram	0.5	10.7	35.4	46.7	526
Tripura	1.7	17.6	51.6	70.9	500
Sikkim	2.2	16.7	39.7	58.6	525

Table 2: Percentage of currently married women age 15-49 with any anaemia by background characteristics, North-Eastern states of India, 2005-06.

Background Characteristics	Level of any anaemia among currently married women						
	Assam	Arunachal Pradesh	Manipur	Meghalaya	Mizoram	Tripura	Sikkim
Age							
Less than 20	69.7	58.3	41.7	53.8	43.8	76.3	73.7
20-29	70.5	56.3	44.4	56.9	45.3	69.5	61.8
30-39	75.7	52.3	41.6	48.9	46.5	70.2	45.7
More than 40	75.0	64.0	34.2	56.6	62.5	90.0	66.7
Education							
Uneducated	79.8	58.0	40.5	53.3	70.8	77.3	57.0
Primary	68.5	57.5	41.6	61.6	53.5	69.9	60.8
Secondary	67.2	49.7	43.9	49.5	42.4	70.1	60.1
Higher	76.3	61.1	42.1	50.0	31.4	52.2	44.0
Residence							
Urban	64.4	53.9	43.4	52.3	35.7	59.7	53.5
Rural	73.5	56.2	42.2	54.3	56.5	73.0	59.6
Household Structure							
Nuclear	74.4	58.5	41.8	55.5	50.0	71.7	55.5
Others	69.3	51.4	43.5	51.3	41.7	72.3	59.9
Religion							
Hindu	73.2	67.4	44.2	54.9	20.0	72.1	61.8
Muslim	67.3	66.7	50.0	60.0	-	63.8	64.3
Christian	87.5	52.0	35.2	58.0	46.1	66.7	57.4
Others	20.0	46.7	46.3	33.0	70.0	75.0	52.0
Caste							
Schedule Tribe	77.1	46.8	35.6	54.1	47.5	79.2	54.7
Schedule Caste	73.8	62.5	44.3	45.5	-	72.9	65.5
OBC	74.3	69.2	47.6	45.5	50.0	68.1	59.3
Others	66.7	73.3	43.6	61.5	-	67.2	61.8
Wealth Index							
Poor	75.4	57.1	40.8	63.2	73.5	77.2	60.0
Non poor	68.1	54.2	43.0	46.9	42.7	67.0	58.4
Exposure to Mass Media							
Yes	71.0	54.8	41.7	54.7	50.7	76.1	58.9
No	73.9	57.2	50.0	59.4	68.6	78.5	68.0
Smoking Status							
Smoking	77.4	62.9	41.8	52.7	48.1	71.5	55.9
Not smoking	70.6	52.4	43.1	54.8	44.1	70.4	59.3
Alcohol consumption							
Consume Alcohol	81.0	54.2	21.4	63.0	50.0	79.1	50.0
Not Consuming	71.4	56.4	42.9	53.7	46.7	69.5	60.4
Total	72.1	55.6	42.5	54.1	46.7	70.9	58.6
N	864	577	1382	688	526	500	525

Note: '-' No of cases are less than 25

Table 3: Percentage of currently married women age 15-49 with any anaemia and adverse pregnancy outcome by haemoglobin level, North-Eastern states of India, 2005-06.

Haemoglobin level (g/l)	Level of haemoglobin and adverse birth outcome								
	Exp of Preterm delivery		Size at Birth			Termination Exp		Weight at Birth	
	No	Yes	>Average	Average	<Average	No	Yes	< 2500gm	≥ 2500gm
<90	17.4	36.0	15.5	24.6	27.5	18.1	52.9	45.0	24.1
90 to 99	1.4	3.8	1.5	2.3	3.5	1.6	5.9	0.0	3.7
100 to 109	2.8	4.2	2.9	3.3	4.1	2.8	17.6	5.0	5.6
110 to 119	4.9	5.7	6.8	5.4	6.0	4.9	0.0	5.0	6.5
120 to 129	6.5	8.4	8.1	7.5	6.3	6.6	5.9	5.0	7.4
≥130	66.9	41.8	65.2	57.0	52.6	66.0	17.6	40.0	52.8

Table 4: Percentage of currently married women age 15-49 with any anaemia and other pregnancy complications, North-Eastern states of India, 2005-06.

Complications	Anaemia with other pregnancy related complications							
	Assam	A P	Manipur	Mizoram	Meghalaya	Tripura	Sikkim	India
Difficulty in daylight vision								
Not Anemic	6.6	15.1	5.5	12.1	7.9	7.5	14.3	5.2
Any Anaemia	8.8	18.2	8.0	15.8	8.1	10.2	14.7	6.1
Night Blindness								
Not Anemic	4.2	10.8	4.8	6.0	7.9	9.0	11.1	6.9
Any Anaemia	8.1	13.7	6.5	11.6	7.6	11.9	7.5	8.6
Convulsions								
Not anemic	20.2	25.1	12.2	20.2	20.0	14.3	39.3	17.5
Any Anaemia	18.8	18.4	13.5	13.9	12.9	10.7	37.4	16.3
Swelling of legs, body or face								
Not Anemic	22.8	26.2	25.6	38.8	34.5	41.1	32.4	25.8
Any Anaemia	28.0	28.8	23.8	44.7	39.4	47.2	36.2	26.2
Excessive fatigue								
Not Anemic	49.0	50.7	22.6	55.4	47.2	79.5	56.7	45.6
Any Anaemia	55.1	60.8	24.5	56.6	55.8	79.7	52.8	49.8
Vaginal bleeding								
Not Anemic	8.8	4.1	5.9	3.2	0.9	5.5	6.0	4.9
Any Anaemia	7.7	7.4	4.6	6.1	2.2	5.4	4.9	4.3

Note: 'Any anaemia' includes having any one form of anaemia such as, severe, moderate and mild anaemia

References

- Agarwal, T, GK Kochar, S Goel (2008): "Impact of Iron Supplementation on Anaemia during Pregnancy", *Ethno-Medicine* 2(2): 149-150.
- Bonevski, B, J Adams (2001): "The Psychological Effects of Termination of Pregnancy: a Summary of the Literature", Newcastle, Australia: Newcastle Institute of Public Health; *Nursing Times* 105(1): 26-29.
- DeMayer EM, A Tegman (1998): "Prevalence of anaemia in the World", *World Health Organization Qlty* 38:302-16.
- Gran, S M, S A Ridella, A S Petzold, F Falkner (1981): "Maternal haematologic levels and pregnancy outcomes", *Seminers in Perinatology* 5:155-162.

- Gupta, K, F Arnold, H Lhungdim (2009): "Health and living conditions in eight Indian cities, National Family Health Survey (NFHS-3), India, 2005-06". Mumbai: International Institute for Population Sciences.
- Loretta, B, N Sarala, G Alka, G Sharad, K Alka (1998): "High prevalence of anaemia among women in Mumbai, India", *Food and Nutrition Bulletin* 19(3): 205-209.
- MacGregor, M W (1963): "Maternal anaemia is a factor in prematurity and perinatal mortality", *Scottish Medical Journal* 8:134.
- Mason, R Helwig (2005): "Recent trends in malnutrition in developing regions: Vitamin A deficiencies, anaemia, iodine deficiency, and child underweight", *Food and Nutrition Bulletin* 26: 57-162.
- Murphy, J F, J O'Riordan, R G Newcombe, E C Coles, J F Pearson (1986): "Relation of haemoglobin Levels in first and second trimesters to outcome of pregnancy", *Lancet* 1:992-995.
- Rajaratnam, A, R X Jolly, V Sampathkumar (1999): "Anaemia in Pregnancy: impact of iron deworming and IEC" RUHSA Department Mother Care Project.
- RANZCOG, Nov (2005): "Termination of pregnancy: A resource for health professionals", Royal Australian and New Zealand College of Obstetricians and Gynaecologists.
- Scholl, T O, M L Hedigr, R L Fischer, J W Schaerer (1992): "Anaemia versus iron deficiency; increased risk of preterm delivery in a perspective study", *American Journal of Clinical Nutrition* 55:958-992.
- WHO (2004): *Micronutrient deficiency: Battling iron deficiency anaemia: the challenge*. Available from: <http://www.who.int/nut/ida.htm>, accessed on April 24, 2008.