Prevalence & consequences of anaemia in pregnancy

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Prevalence of anaemia in India is among the highest in the world. Prevalence of anaemia is higher among pregnant women and preschool children. Even among higher income educated segments of population about 50 per cent of children, adolescent girls and pregnant women are anaemic. Inadequate dietary iron, folate intake due to low vegetable consumption, perhaps low B12 intake and poor bioavailability of dietary iron from the fibre, phytate rich Indian diets are the major factors responsible for high prevalence of anaemia. Increased requirement of iron during growth and pregnancy and chronic blood loss contribute to higher prevalence in specific groups. In India, anaemia is directly or indirectly responsible for 40 per cent of maternal deaths. There is 8 to 10-fold increase in MMR when the Hb falls below 5 g/dl. Early detection and effective management of anaemia in pregnancy can contribute substantially to reduction in maternal mortality. Maternal anaemia is associated with poor intrauterine growth and increased risk of preterm births and low birth weight rates. This in turn results in higher perinatal morbidity and mortality, and higher infant mortality rate. A doubling of low birth weight rate and 2 to 3 fold increase in the perinatal mortality rates is seen when the Hb is <8 g/dl. Intrauterine growth retardation and low birth weight inevitably lead to poor growth trajectory in infancy, childhood and adolescence and contribute to low adult height. Parental height and maternal weight are determinants of intrauterine growth and birth weight. Thus maternal anaemia contributes to intergenerational cycle of poor growth in the offspring. Early detection and effective management of anaemia in pregnancy can lead to substantial reduction in undernutrition in childhood, adolescence and improvement in adult height.

Key words Anaemia in pregnancy - immune depression - inter-generational impact - low birth weight - morbidity of maternal anaemia

Introduction

Anaemia is the most common nutritional deficiency disorder 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 per cent in developing countries and 65-75 per cent in India. About one third of the global population (over 2 billion) are anaemic.

Prevalence of anaemia in all the groups is higher in India as compared to other developing countries. Prevalence of anaemia in South Asian countries is among the highest in the world. WHO estimates that even among the South Asian countries, India has the highest prevalence of anaemia. What is even more important is the fact that about half of the global maternal deaths due to anaemia occur in South Asian countries; India contributes to about 80 per cent of the maternal deaths due to anaemia in South Asia. It is obvious that India’s contribution both to the prevalence of anaemia in pregnancy and maternal deaths due to anaemia is higher than warranted by the size of its population.
Table. Prevalence of anaemia and its contribution to maternal mortality

<table>
<thead>
<tr>
<th>Country</th>
<th>Prevalence of anaemia in pregnant women %</th>
<th>Maternal deaths from anaemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>74</td>
<td>2600</td>
</tr>
<tr>
<td>Bhutan</td>
<td>68</td>
<td>&lt;100</td>
</tr>
<tr>
<td>India</td>
<td>87</td>
<td>22,000</td>
</tr>
<tr>
<td>Nepal</td>
<td>63</td>
<td>760</td>
</tr>
<tr>
<td>S. Asia Region Total</td>
<td>63</td>
<td>25,560</td>
</tr>
<tr>
<td>World Total</td>
<td></td>
<td>50,000</td>
</tr>
</tbody>
</table>

Available estimates also suggest that the magnitude of reduction in the prevalence of anaemia during nineties in India is lower than that in neighbouring South East Asian countries.

Worried about the estimated high prevalence of anaemia in the country, five major surveys (National Family Health Survey (NFHS) 24 and 35, District Level Household Survey 26 (DLHS), Indian Council of Medical Research (ICMR) Micronutrient Survey7 and Micronutrient Survey conducted by National Nutrition Monitoring Bureau (NNMB)8 were undertaken to estimate prevalence of anaemia in the country. All these showed that over 70 per cent of preschool children were anaemic. NNMB, DLHS and ICMR surveys showed that over 70 per cent of pregnant women and adolescent girls in the country were anaemic (Fig. 1). Anaemia begins in childhood, worsens during adolescence in girls and gets aggravated during pregnancy. NFHS 2 and 3 reported lower prevalence of anaemia in women and pregnant women as compared to DLHS, NNMB and ICMR Micronutrient surveys. This appears to be due to the use of Haemocue method for Hb estimation. Studies in India have shown that as compared to classical cyanmethaemoglobin method, Haemocue overestimates Hb levels9-13. Data from DLHS showed that prevalence of moderate and severe anaemia was high even among educated and higher income groups6 (Fig. 2). Prevalence of anaemia is high in all the States, though there are considerable variations between States in prevalence of moderate and severe anaemia6.

Factors responsible for high prevalence of anaemia

Studies carried out in India and elsewhere have shown that iron deficiency is the major cause of anaemia followed by folate deficiency. In recent years, the contribution of B12 deficiency has been highlighted14. In India, the prevalence of anaemia is high because of (i) low dietary intake, poor iron (less than 20 mg /day) and folic acid intake (less than 70 μg/day); (ii) poor bio-availability of iron (3-4% only) only in phytate and fibre-rich Indian diet; and (iii) chronic blood loss due to infection such as malaria and hookworm infestations7,8.

Data from NNMB surveys12 showed that iron and folic acid intake in the country in all the age groups was very low. There has not been any increase in iron intake over the last three decades in any group. The apparent reduction in iron intake in the NNMB surveys 2000-0115 and beyond was due to the finding that only 50 per cent of the iron in Indian diets is absorbable. Poor iron stores at birth16, low iron content of breast milk and low dietary iron intake through infancy and childhood results in high prevalence of anaemia in childhood6,17. Anaemia gets aggravated by increased requirements during adolescence and during pregnancy6. Assuming that the absorption of iron is 8 per cent in pregnant women, their average dietary intake will meet only 30-45 per cent of the requirement. Interstate differences in iron intake are of small magnitude. The low dietary...
intake of iron, folic acid and food stuffs that promote
iron absorption, coupled with poor bioavailability of
iron are the major factor responsible for very high
prevalence of anaemia in the country18,19.

Anaemia and iron deficiency in the mother are not
associated with significant degree of anaemia in
the children during neonatal period. However, iron stores
in these neonates are low, iron content in breast milk
in anaemic women is low and because of these factors
substantial proportion of infants become anaemic
by six months16. Thus maternal iron deficiency and
anaemia render the offspring vulnerable for developing
iron deficiency and anaemia right from infancy. Poor
iron content of complementary food and family food
consumed by the young child results in further increase
in prevalence of anaemia in childhood17. With the
onset of menstruation and associated blood loss, there
is a further rise in prevalence and severity of anaemia
in adolescent girls6. Early marriage and adolescent
pregnancy aggravate anaemia6 and result in poor iron
stores in the offspring. It is obvious that there is an
intergenerational self perpetuating vicious cycle of
anaemia in Indian population.

Immune status of anaemic pregnant women

In pregnancy, profound changes occur in several
laboratory parameters used for the assessment of
immune status. Studies undertaken by the National
Institute of Nutrition, Hyderabad, showed that
there was a fall in T and B cell count with fall in
haemoglobin levels below 11 g/dl. The fall in T and
B cells was statistically significant in women with
haemoglobin levels below 8 g/dl. Immunoglobin levels
showed a progressive rise with decreasing Hb levels.
There were no alterations in the phytohemagglutinin-
induced lymphocyte transformation nor was there
any difference in the in vivo tests for cell mediated
immunity20. Available data indicated that humoral
immunity as assessed by response to immunogens
including tetanus toxoid remains unimpaired. The
changes in T and B cells and immunoglobin were
reversed within 6-12 wk by parenteral iron therapy and
improvement in haemoglobin levels, indicating that
these alterations are due to anaemia per se and not due
to co-existent undernutrition18,19.

Investigations carried out in villages near Hyderabad
indicated that the prevalence of morbidity due to
infections was doubled in women with haemoglobin
levels below 8.0 g/dl18. Data from both the developed
and the developing countries have documented the
association between asymptomatic bacteriuria and
anaemia, often refractory to treatment, poor intrauterine
growth, prematurity and low birth weight. It is possible
that immunodepression in anaemic women renders
them more susceptible to infection, and increased
morbidity due to infection, might be one of the factors
responsible for the adverse effect of anaemia on the
course and outcome of pregnancy18,19.

Maternal consequences of anaemia

Mild anaemia

Women with mild anaemia in pregnancy have
decreased work capacity. They may be unable to
earn their livelihood if the work involves manual
labour. Women with chronic mild anaemia may go
through pregnancy and labour without any adverse
consequences, because they are well compensated.

Moderate anaemia

Women with moderate anaemia have substantial
reduction in work capacity and may find it difficult to
cope with household chores and child care. Available
data from India and elsewhere indicate that maternal
morbidity rates are higher in women with Hb below
8gm/dl21. They are more susceptible to infections and
recovery from infections may be prolonged. Premature
births are more common in women with moderate
anaemia. They deliver infants with lower birth weight
and perinatal mortality is higher in these babies21. They
may not be able to bear blood loss prior to or during
labour and may succumb to infections more readily.
Substantial proportion of maternal deaths due to ante-
partum and post-partum haemorrhage, pregnancy
induced hypertension and sepsis occur in women with
moderate anaemia.

Severe anaemia

Three distinct stages of severe anaemia have
been recognized - compensated, decompensated,
and that associated with circulatory failure. Cardiac
decompensation usually occurs when Hb falls below
5.0 g/dl. The cardiac output is raised even at rest, the
stroke volume is larger and the heart rate is increased.
Palpitation and breathlessness even at rest are symptoms
of these changes. These compensatory mechanisms
are inadequate to deal with the decrease in Hb levels.
Oxygen lack results in anaerobic metabolism and lactic
acid accumulation occurs. Eventually circulatory failure
occurs further restricting work output. Untreated, it
leads to pulmonary oedema and death. When Hb
is <5 g/dl and packed cell volume (PCV) below 14,
cardiac failure is seen in a third of cases\textsuperscript{23}. A blood loss of even 200 ml in the third stage produces shock and death in these women. Even today women in the remote rural areas in India reach to the hospital only at this late decompensated stage. Available data from India indicate that maternal morbidity rates are higher in women with Hb below 8.0 g/dl. Maternal mortality rates show a steep increase when maternal Hb levels fall below 5.0 g/dl. Anaemia directly causes 20 per cent of maternal deaths in India and indirectly accounts for another 20 per cent of maternal deaths\textsuperscript{24}.

### Foetal consequences of anaemia

Studies to define the effect of maternal anaemia on the foetus indicate that different types of decompensation occur with varying degrees of anaemia. Most of the studies suggest that a fall in maternal haemoglobin below 11.0 g/dl is associated with a significant rise in perinatal mortality rate\textsuperscript{18,19,25}. There is usually a 2 to 3-fold increase in perinatal mortality rate when maternal haemoglobin levels fall below 8.0 g/dl and 8-10 fold increase when maternal haemoglobin levels fall below 5.0 g/dl\textsuperscript{21,26}. A significant fall in birth weight due to increase in prematurity rate and intrauterine growth retardation has been reported when maternal haemoglobin levels were below 8.0 g/dl (Fig. 3)\textsuperscript{21,26}.

### Factors responsible for the adverse obstetric outcome

Investigations undertaken to determine the factors responsible for the adverse maternal and perinatal outcome seen in association with anaemia indicated that anaemia per se might be responsible for some of the observed adverse effects\textsuperscript{18,19,21-24,26}. However, prevalence of several maternal risk factors which are associated with low birth weight, increased perinatal, maternal morbidity and mortality, such as twins, PIH and APH are higher among anaemic women\textsuperscript{19}. It is, therefore, possible that coexisting obstetric problems contribute, at least in part, to the adverse obstetric outcome reported among anaemic women. Anaemic women should, therefore, be treated as a high risk obstetric group.

Immune depression due to anaemia and consequent increased morbidity due to infection, especially urinary tract infection, might be one of the factors responsible for low birth weight babies in anaemic women. Screening for, and effectively treating infections in anaemic women might therefore result in improved foetal and maternal prognosis\textsuperscript{19}.

In the habitual cereal and pulse based diets consumed by Indian women, there is an almost linear correlation between calorie and iron intake\textsuperscript{18}. Women with haemoglobin levels below 8.0 g/dl weigh less than their non-anaemic counterparts from similar income groups\textsuperscript{19,21}. These data suggest that anaemia might be one manifestation of overall maternal dietary inadequacy and consequent undernutrition\textsuperscript{19}. It is possible that supplementary feeding programmes aimed at improvement of maternal dietary intake might result in some improvement in maternal haemoglobin status.

Poverty, ignorance, non availability and/or failure to utilize available medical facilities have been shown to be associated with maternal anaemia on the one hand and maternal and perinatal morbidity and mortality on the other, though the association is not causal. Health education to improve the utilization of available facilities and improvement in the health care delivery system to cater to the needy, right at their doorsteps might thus go a long way in reducing adverse obstetric outcome associated with maternal anaemia.

### Prevention and management of anaemia in pregnancy

In view of the high prevalence of anaemia in pregnancy and serious adverse consequences in both mother and baby, management of anaemia in pregnancy was accorded a very high priority both in obstetric and public health practice. Mandatory monthly screening for anaemia became the ‘routine’ in all antenatal clinics. Skilled management of severe grades of anaemia detected late in pregnancy, through blood transfusion and parenteral iron therapy became the hallmark of good obstetric practice and resulted in maternal and perinatal salvage rates in hospitals\textsuperscript{23}. However, it became obvious that unless effective steps were taken to reduce the prevalence of anaemia, further reduction in morbidity and mortality rates could not be achieved.
Programmes for prevention and management of anaemia

India was the first developing country to take up a National Programme to prevent anaemia among pregnant women and children. The National Anaemia Prophylaxis Programme of iron and folic acid distribution to all pregnant women in India through the primary health care system was evolved and implemented from 1972, so that the vast majority of pregnant women who never seek health care, could benefit from this outreach programme. It was hoped that this programme will bring about a reduction both in the prevalence and severity of anaemia in pregnancy. There were two major components of the anaemia prophylaxis programme – pre-school children were to receive 20 mg elemental iron and 100 μg folic acid and pregnant women to receive 60 mg elemental iron and 500 μg of folic acid. Of the two components, the coverage under the component for children had always been very poor.

Comparatively the component for pregnant women has fared better. At that time antenatal care coverage under rural primary health services was very low and there was no provision for screening pregnant women for anaemia. Therefore an attempt was made to identify all pregnant women and give them 100 tablets containing 60 mg of iron and 500 μg of folic acid. However all the national surveys indicated that coverage under all these programmes was very low and there has not been any change either in the prevalence of anaemia or the adverse consequences associated with anaemia.

Two decades after the initiation the National Anaemia Prophylaxis Programme, an ICMR study confirmed that most women received 90 tablets without Hb screening. Many did not take tablets regularly. Even among small number of women who took over 90 tablets, rise in Hb was low and mean Hb levels were no more than 9.1 g/dl (Fig. 4). The study conducted in 1989 by ICMR indicated that coverage under the National Anaemia Pregnancy Programme was low and that 60 mg of ferrous sulphate was perhaps inadequate to treat anaemia. The Programme was revised and renamed as National Anaemia Control Programme (NACP). The Programme envisaged that all pregnant women will be screened for anaemia. Non anaemic women would get iron (100 mg) and folate (500 μg) and those with anaemia should get two tablets daily.

Tenth Plan strategy for combating anaemia in pregnant women

The Tenth Five Year Plan suggested multi-pronged strategies for the control of anaemia in pregnancy. These include: (i) fortification of common food items like salt with iron to increase the dietary intake of iron and improve the haemoglobin status of the entire population, including girls and women prior to pregnancy; nutrition education for dietary diversification to improve the iron and folate intake; (ii) screening of all pregnant women for anaemia using a reliable method of haemoglobin estimation; (iii) oral iron folate prophylactic therapy for all non-anaemic pregnant women (with haemoglobin more than 11 g/dl); (iv) iron folate oral medication at the maximum tolerable dose throughout pregnancy for women with haemoglobin level between 8 and 11 g/dl; (v) parenteral iron therapy for women with haemoglobin level between 5 and 8 g/dl if they do not have any obstetric or systemic complication; (vi) hospital admission and intensive personalised care for women with haemoglobin less than 5 g/dl; (vii) screening and effective management of obstetric and systemic problems in all anaemic pregnant women; and (viii) improvement in health care delivery systems and health education to the community to promote utilization of available care.

Problems in implementation of anaemia prevention and control programmes

The DLHS (1998-99) showed that pregnant women were not being screened for anaemia and given appropriate therapy. Most women in poorly performing States did not come for antenatal check up. Many of those who came for antenatal check up (ANC) did not get IFA throughout pregnancy nor did they get 100 tablets (Fig. 5). Majority of those who got the tablets did not consume all the tablets. NNMB surveys showed

![Fig. 4. IFA supplementation in pregnancy](image-url)
that the proportion of pregnant women who receive IFA tablets is not high even among well-performing States like Tamil Nadu, Kerala and Maharashtra.

DLHS 2 (2006) showed that there was some improvement in the coverage and content of antenatal care. About 40 per cent women had blood examination done which included Hb estimation. DLHS 2 also showed that there has been some improvement in % of pregnant women receiving IFA tablets. There has been a significant reduction in the percentage of women who received but did not consume the tablets. These data suggest that if all pregnant women are screened for anaemia and provided appropriate therapy it might be possible to achieve substantial reduction in prevalence of anaemia in pregnancy.

Parenteral therapy for moderate anaemia in pregnancy

Ample data exist in India to show that supervised oral administration of up to 240 mg iron has not been able to raise the Hb levels above 11 g/dl in pregnant women if their initial Hb levels was between 5.0 and 7.9 g/dl. Therefore, obstetricians have used intramuscular (IM) iron therapy for correction of anaemia. Unless this practice is taken up in all the primary care institutions, majority of women with moderate anaemia will not be able to access IM therapy. NIHFW and NFI undertook operational research studies and demonstrated that in urban primary health care institutions it is possible to screen all pregnant women attending the antenatal OPD for anaemia using cyanmethaemoglobin method. Women in second trimester of pregnancy who did not have any systemic and obstetric problems with Hb levels between 5.0 and 7.9 g/dl and willing to come to receive IM therapy as outpatients [six injection each containing iron sorbitol citric acid complex containing 150 mg of elemental iron, (NIHFW) and each containing iron sorbitol citric acid complex containing 150 mg of elemental iron, folic acid 1500 µg and vitamin B12 150 µg (NFI)]. Both these studies demonstrated the feasibility of IM iron sorbitol therapy to pregnant women in primary care institutions. Both the studies showed that mean Hb rose and there was significant improvement in birth weight. Metallic taste on the tongue, nausea, vomiting and pain at the injection site were the side effects reported with IM therapy. These were treated symptomatically. The subjects were followed up through pregnancy and till delivery. The mean Hb level, even 9 wk after completion of IM therapy was only 9.6 g/dl. But majority of women who received 900 mg of iron sorbitol had Hb levels around 10 g/dl and birth weight was lower than the birth weight in non anaemic women. It would appear that 1500 mg of iron sorbitol citric acid complex would be required for optimal results.

Summary and conclusions

Anaemia in pregnancy is associated with adverse consequences both for the mother and the foetus. Studies have shown that the adverse consequences of maternal anaemia may affect not only the neonate and infant but also increase the risk of non communicable diseases when the child grows into an adult and the risk of low birth weight in the next generation. Technology for detection of anaemia and its effective treatment are available and affordable and it is possible to effectively implement these even in primary health care settings and these are very cost effective interventions.

Effective implementation of the Tenth Plan strategies for combating anaemia can go a long way in reducing the short- and long- term adverse consequences of anaemia.

References


