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POVERTY & HEALTH: INCIDENCE, CAUSES, AND CONSEQUENCES OF MATERNAL ANAEMIA AMONG WOMEN POOR GROUPS IN INDIA - A LITERATURE SURVEY

Dr. C. Vasudevan [*1]
[*1] Assistance Professor (Economics Department), Guru Nanak College, Chennai – 600 042, India

Abstract

This Article Surveyed the Nature and Structure of Maternal Ananemia among the Poor Women Groups in India which exclaimed the Nature of Poverty and Health Hazardness are Associated deeply with in maternal Ananemia among the poor women groups. This study at large extent claimed that the structure, patterns and morphic of maternal anaemia problems among the poor women who substantially lactating nutritional deficiency in different form which causes and consequences the destitutes during their pregnancy. This study also observed various nature of incidence, causes, and consequences of maternal anaemia among the poor women in India. It also highlights the Management and Administration of Maternal Anaemia among of the poor women during pregnancy in India.

Keywords: Poverty; Causes; Anaemia.

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1. Introduction

Anaemia is a major public health problem all over the world. According to World Health Organisation (WHO) criteria, a total of 2,170 million people are anaemic in the world.[1]The most vulnerable sections of the population are pregnant, lactating and mensurating women as well as growing children.

Prevalence rates are higher in developing countries than in industrialized countries. In developing countries, prevalence rates in pregnant women are commonly in the range of 40 per cent to 60 percent, among other women between 20 per cent and 40 per cent and in school age children and adult men around 20 per cent.[2]The situation is particularly acute in parts of Asia. In Southern Asia, i.e. the area including Afghanistan, Bangladesh, India and Pakistan, which accounts for 29 per cent of the world's births, 24 million pregnant women are anaemic.[3] Several studies carried out during the last 50 years in India have shown a high prevalence of maternal anaemia here too.

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The causes and consequences of anaemia which affect the above mentioned groups are manifold. Nutritional deficiencies, such as iron, folic acid and Vitamin B12 deficiencies, are a main cause of anaemia. Apart from these deficiencies, there are other factors such as poor socio-economic conditions, poverty, illiteracy, contaminated environments and cultural beliefs. Despite the fact the effects and consequences of anaemia on these vulnerable groups were recognized several years ago, the deleterious effects of anaemia continue to be prevalent. Anaemia is one of the most common causes of high maternal mortality rates. It is directly responsible for about 20 per cent of maternal deaths and for another 20 percent of deaths it is a predisposing factor. Finally, it should be noted that maternal anaemia is also responsible for the high incidence of premature and low birth weight babies thus increasing prenatal mortality and morbidity.

Different measures and policy programmes have been followed to identify and reduce maternal anaemia. The most simple and common measure undertaken to identify anaemia is examining the deficiency of Haemoglophin (Hb). The haemoglophin level also infers the level of anaemia. Based on these measures, various policy programmes have been adopted by the government, the WHO and other public service organizations. Yet despite these efforts the anaemia rate especially in pregnant women is high in India and other parts of the world. It is therefore necessary to identify the right approach to reduce anaemia among poor pregnant women. This study attempts to carry out such a task.

The next section will explain the structural pattern of anaemia in general and maternal anaemia in particular. The section following that deals with the causes and consequences of anaemia. That is followed by a section on the treatments and programmes for maternal anaemia. Finally, studies on India are discussed followed by a summary of the report.

2. Concept of Anaemia

2.1. Definition

Anaemia is considered an outcome of deficiencies of various substances which function as carriers of oxygen from the lungs to the tissues. The term anaemia, as it is generally used in clinical medicine, refers to a "reduction below normal in the number of red corpuscles per cm, the quantity of Hb and the volume of packed red cells per 100 ml of blood".[4] If any one of these above substances on a combination of these are reduced below its normal level, the consequences will be a lack of concentration of carrying oxygen in a certain blood volume which will lead to actual anaemia. A WHO report observed that "anaemia is a disorder characterized by a blood Hb concentration lower than the defined normal level and is usually associated with a decrease in the circulating mass of red blood cells".[5] This implies that the association between Hb and red cells should be normal or in other words the population of red cells and the concentration of Hb in the blood are kept at normal level by a nice balance between the new formation and the wastage of erythrocytes. If the balance is tipped then anaemia will occur.

Anaemia has also been defined, as suggested at the outset, based on nutritional deficiencies which mainly include iron, folate and Vitamin B12 deficiencies. In other words, anaemia is a state where normal levels of Hb cannot be maintained by erythropoiesis due to deficiencies of one or more nutrients. However, these nutritional characteristics must be seen alongside other nutrients such as

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Vitamin A, C, and protein which are also important anti-anaemic factors. Based on these functional and nutritional deficiencies anaemia is classified under three different heads.

2.2. Classification and Types of Anaemia

In general, anaemia has been classified in three different ways. They are (1) Etiologic grounds, (2) Physiologic classification and (3) Morphologic classification.

On etiologic grounds, anaemia may be attributed to (a) loss of blood, (b) excessive red corpuscle destruction, (c) impaired blood production resulting from deficiency of substances essential for erythropoiesis, and (d) faulty construction of red corpuscles resulting from hereditary or congenial defects or as a consequence of some acquired infection.

The physiological classification classifies anaemia based on anaemia associated with effective erythropoiesis, impaired or insufficient erythropoiesis and ineffective erythropoiesis. Accordingly, different types of anaemia have been observed.

The Morphologic classification of anaemia is considered useful as compared to the other two because the study of blood disorder naturally begins in the laboratory. Accordingly, three different types of anaemia have been identified.

Normocytic: -When in anaemic stage, the cell does not change its size or Hb content,
Macrocytic: - Majority of red corpuscles are produced larger than normal, and
Microcytic: - In such cases the majority of corpuscles are smaller than normal.

It may be noted that in all types of anaemia mentioned so far, the change in Hb and the volume of packed red cells has been proportionate. If the red corpuscles are reduced according to its size or according to the reduction of Hb level then it is called hypochromic microcytic anaemia.

The various clinical types of anaemia are differentiated according to their fundamental cause; macrocytic anaemia arises out of lack of Vitamin B12 or folic acid. The most common example is pernicious anaemia resulting from impaired absorption of Vitamin B12 because of a lack of the gastric intrinsic factor. Normocytic anaemia may result from sudden loss of blood, destruction of blood, lack of blood formation or dilution of the blood. Hyprochromic microcytic anaemia is usually a result of iron deficiency. This form of anaemia may occur for pregnant women illustrating moreover that maternal anaemia is usually classified with nutritional anaemia.

3. Anaemia in Pregnancy

Anaemia is one of the most common complications of pregnancy. It has been recognized that anaemia is a major nutritional problem during pregnancy associated with absteric outcome.[6]The nutritional problem occurs mainly due to iron, folate and Vitamin B12 deficiency. Given the large amount of iron requirement in particular during the advanced gestational period, the fact that it is not compensated by diet or any other form, leads to severe maternal anaemia. This type of anaemia has been defined by the level of Hb in the blood.

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According to the WHO (1968) reference committee on hematology, a level of Hb below 11 g% signifies a considerable prevalence of anaemia at the time of pregnancy.[7] While a majority of women go through pregnancy without any apparent problem or with mild and moderate anaemia, complications occur once the Hb levels fall below 8.5g%. At this point breathlessness and fatigue get exaggerated. When Hb levels are below 5g%, cardiac failure is common especially during the third trimester of pregnancy.[8]

Studies of Hb status during pregnancy indicate that anaemia often antedates pregnancy. There is a slow and gradual fall in Hb during pregnancy. The Hb concentration in the first trimester is significantly higher than in the second and third trimester of pregnancy. One study in Brazil shows that the prevalence of anaemia in the first trimester (3.6%) was significantly smaller than that found in the second (20.9%) and third trimester (32.1%).[9]Thosewomen who had had more than three gestations presented a higher prevalence of anaemia than those with less than three.[10]

The lowest mean Hb levels were seen between 24-32 weeks of pregnancy. In the third trimester there was a slow rise in mean Hb levels till term.[11]This may be due to the large iron requirement in the third trimester and thus more iron absorption. The other reason may be that normal hematological changes in pregnancy get stabilized in the third trimester. However, nonetheless the relationship between poor diet (with inadequate iron intake) and increased likelihood of preterm delivery persists during the third trimester[12] In general maternal blood volume increases to the extent that it is 50 percent above the non-pregnant volume. This increase in blood volume starts very early in pregnancy and reaches a peak at around 28-32 weeks and thereafter stabilizes.[13] Apart from these normal hematological changes during pregnancy, other problems also lead to pregnant women becoming anaemic, such as iron loss and the need for more iron.

3.1. Iron Loss

In general, pregnant women differ from non-pregnant women of child bearing age. This difference is reflected in the routine iron loss and extra iron requirement. For a normal woman iron loss occurs heavily during the menstruation period. The loss of iron in normal women of child bearing age is estimated to be around 1.7 - 1.8 mg/day, excluding losses through menstruation. Menstruation loss is approximately 15mg/cycle.[14]While the volume of menstrual blood is relatively constant for a given woman from month to month it greatly differs between women.

Sometime menstrual blood loss decreases by about one half through the use of oral contraceptives and approximately doubles through the use of intrauterine devises.[15]Several studies have shown that the medium blood loss during menstruation ranges between 25 and 30 ml per month. This represents an iron loss of 12.5 - 15 mg per month or 0.4 - 0.5 mg per day over 28 days. This all suggests that the iron requirement of 50% of all women is in excess of 1.25 mg per day.[16]

In the case of pregnant women, iron loss is generally considered as basal loss. Basal loss implies an iron loss in the stools and urine and through the skin. These basal losses represent approximately 14 mg per kg of body weight per day or approximately 0.9 mg of iron for an adult male and 0.8 mg for an adult female.[17] Pregnancy involves using a large amount of iron and consequently significant iron losses to the fetus and placenta. In addition to this basal loss and iron loss, 600 additional mg of iron is lost at delivery, (a total of 2.1 mg/day). The majority of the iron is expended

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in the last trimester and in delivery. Surprisingly in a fully lactating woman, only a small loss of iron, i.e. around 0.23 mg of per day occurs.[18]

Several parasites also cause blood loss and thus hookworm infection. Severe infections could cause up to 20 mg iron loss per day.[19]The intestinal parasite Trichuristrichiura also contributes to anaemia by causing intestinal blood loss. The third parasite known to cause significant iron loss is urinary schistomiasis, caused by sctrictosomahaematobium infection. Unlike hookworm, there seems to be a threshold of infection severity above which iron loss is caused. In the case of hookworm diseases, blood losses vary from 2 to 100 ml per day depending on the severity of the diseases.[20]

3.2. Iron Requirement

Iron requirement is generally higher for women and infants than it is for men. In women, the higher requirement is to compensate menstrual loss while for infants it is for the development of the tissues. Generally, pregnant women require more iron for the development of the fetus, placenta, and in general maintaining her own health to compensate the basal loss and loss of blood during delivery. Larger amounts of circulating blood and tissue synthesis also requires more iron for pregnant women. Compared to developed country women, third world women require more iron because depleted iron stores is more for them.[21] To meet pregnancy requirements, 4-6 mg of iron should be absorbed daily from the diet.[22] The total iron needed during pregnancy is 810 mg, of which 240 mg is required for fetus development, 400 mg for expenses of maternal red cell mass, and 170 mg for obligatory losses.[23] Some studies show that the total iron needed for the whole pregnancy period is 1,000 mg.[24]

The iron requirement varies in different trimesters of pregnancy. The requirements of the first trimester are relatively small, i.e. 0.8 mg per day. During the second and third trimester it increases to a high of 6.3 mg per day.[25]The daily requirement for iron as well as folateis six times greater for a woman in the last trimester of pregnancy than for a non-pregnant woman.[26]

Iron requirements increase in case of chronic bleeding by above mentioned parasites such as hookworm (Ancylostoma and Necator), schistosoma and possibly Trichuristrichiura. These parasites frequently cause infection in countries with hot and humid climates and poor sanitation.[27]If iron requirements are not met through dietary habits then a high prevalence of anaemia is inevitable.

Apart from the iron loss and requirement syndromes, the other important deficiencies are folate and Vitamin B12. These deficiencies are apparent in blood formation. As a result, different types of macrocytic anaemia occur at the time of pregnancy. Among these anaemia, pernicious anaemia is a crucial one. It occurs because of impaired absorption of Vitamin B12. Other diseases which also occur are sprue, idiopathic steatorrhea and certain other intestinal disorders. Thus normal hematological change and nutritional deficiency problems make expectant mothers more likely candidates for anaemia. Various other factors interwined with these above problems increase the likelihood of pregnant women being anaemic.

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4. Causes of Maternal Anaemia

Different factors are responsible for a pregnant woman becoming anaemic. These factors can be categorised under two different but interrelated functional systems. The first is related to internal physical functions of the human body such as blood formation and the substances required for such blood formation. The other functional system is related to socio-economic conditions, education, cultural beliefs and environmental conditions in general. As far as internal physiological functions are concerned, one common etiological classification of anaemia identifies three main causative groups of anaemia, i.e. nutritional deficiency, marrow diseases and hemolytic diseases.[28] Nutritional deficiency anaemia has a close association with socio-economic, education, cultural and environmental factors. Other significant causes of anaemia vary from country to country and include malaria and congenital hemolytic diseases such as sick cell anaemia and thalassemia.

4.1. Nutritional Factors

Nutritional anaemia is most prevalent in Africa. Even in industrialised countries, however, a significant number of women have insufficient iron reserves to meet the increased demand during pregnancy.[29]Anaemia even today remains the major nutritional problem associated with maternal and prenatal morbidity and mortality. In India, anaemia in pregnancy is mainly nutritional in origin. Iron deficiency is by far the most common nutritional factor. Forty to fifty per cent of cases are associated with deficiency of iron, folic acid and B12. There are other components, i.e. protein deficiency and Vitamin C and A deficiency which also contribute to a certain extent.

4.1.1. Iron Deficiency

As already mentioned, anaemia due to iron deficiency occurs for two basic reasons, i.e. basal loss and extra iron requirement for pregnant women. Because of iron deficiencies, hypochromic microcytic anaemia are present. The deficiency may be due to either excessive loss of iron from the body because of chronic hemorrhaging or to an inadequate quantity of these elements in thediet.[30] Iron provides the keystone for Hb construction; unless it is supplied inappropriate amounts the maturation of the red cell is retarded and the numbers discharged from the bone marrow into the general circulationreduced.[31] In general, body iron can be considered in terms of two main components, namely functional and storage iron. The functional components consist largely of the iron in circulating Hb and a smaller quantity in body tissues, in myoglobin and various haem and non-haem enzymes. The storageiron component has no physiological function other than to serve as a reserve from which losses from the functional compartment can be reduced. Body iron stores exist as ferritin and hemosiderin in the liver, spleen and bone marrow.

In the replete adult, male storage iron amounts approximately to one quarter of body iron. On the other hand, when the physiological demand for the iron are high, as in young children and menstruating women, iron stores are frequently lower or absent.[32]

Iron deficiency is a state of depletion in body iron stores. Anaemia resulting from iron deficiency is a haemotologic state which manifests itself in terms of (1) a severe depletion of iron stores and (2) a drop of Hb concentration. An individual can be iron deficient without being anaemic, but iron deficiency anaemia cannot occur without depletion of iron stores.[33]A decrease in storage of

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iron can be identified by a reduction in serum ferritin concentration and/or by a decrease in stainable iron in the bone marrow.

As mentioned earlier, there are a number of contributing factors to iron deficiency in women. The prime contributor, however, is dietary.

Dietary Factors

Two diametrically opposite views are prevalent regarding nutritional needs during pregnancy. One view is that pregnant women should eat more to provide for the needs of the growing fetus. The other view is that over feeding could result in babies being too large and consequently problems in labour. In general nutrition scientists have subscribed to the former view and obstetricians to the latter view. Basic research studies on nutrition requirements during pregnancy undertaken in developed countries during the'50s and 60s' strengthened the nutrition scientist's view that pregnant women need more food.[34] These studies in general suggested that pregnant women need an extra allowance of about 300 kilo calories per day during the second and third trimester of pregnancy.[35] The basal metabolic rate might increase by10 to 15 per cent during pregnancy which also requires more nutrition intake during this period. There are also other reasons for greater nutritional intake during pregnancy. In developed countries, work activity during pregnancy is reduced and thus the required extra amount of calories will be negligible. In developing countries, however, it is different as work activities are rarely reduced during pregnancy. Thus, poor dietary intake and poor nutritional status are very common. Pregnant women require extra nutrition to maintain normal health during the gestation period.

Dietary pattern and iron absorption also effect the extent iron deficiency plays a role in determining anaemia. As far as dietary pattern is concerned, there are two distinct dietary patterns associated with content of iron, i.e. haem and non-haem iron. Haem iron is a constituent of Hb and myoglobin and therefore is present in meat, fish and poultry as well is in blood products. Haem iron accounts for a relatively small fraction of total iron intake usually less than 1-2 mg of iron per day, approximately 10-55% of the dietary iron consumed in industrialized countries. In many developing countries haem iron intake is lower or even negligible.[36]The second type of dietary iron, non-haem iron, is a more important source. It is found to varying degrees in all foods of plant origin. The poor have in general obtained non-haem iron from plants free of cost. However, scarcity conditions, especially in the summer when availability of leaf vegetables is small, is an impediment in rural areas. Moreover, cereal and pulse based diets consumed by many Indian women have low iron content. In fact, there is almost a linear correlation between calories and iron intake.[37] Rice also contributes a lower level of iron.[38]

Iron Absorption

Another important point is that iron absorption of pregnant women is very low. There is a general agreement that iron is absorbed in the ferrous form in the human body. Dietary iron absorption is influenced by various factors such as the amount of food consumed, bioavailability of dietary iron, the iron and health status of pregnant women and enhancing and inhibiting factors of iron absorption during meals.

In developing countries, the amount of food intake among poor families is very low. Diet surveys have shown that the diet of low income groups are inadequate, falling below recommended

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standards. Due to gender differentials and no improvement of food intake at the time of pregnancy, the iron absorption of poor expectant mothers is very low. To meet the requirements of pregnancy, it is felt that a minimum of 4-6 mg of iron should be absorbed during pregnancy to maintain iron balance. This is possible only if the diet has 40-60 mg of iron, something which is rarely there in a poor family diet.[39] Much dietary iron deficiency is due to poor bioavailability of iron rather than strict deficiency of dietary iron.[40] That is why it has been suggested that improving the iron bioavailability of diet has a greater potential impact than increasing the quantity of iron consumed.[41] The bioavailability of iron in diets depends first and foremost on what proportion of dietary iron is haem iron because the bioavailability of iron in the non-haem diet is very low. In other words the haem iron is absorbed by a separate and more efficient mechanism than non-haem iron. But in the developing countries most of the poor families are non-haem diet eaters.

Absorption of iron will be enhanced when ascorbic acid and protein are present in the diet and inhibited by the presence of tannin (a component in tea and coffee) and phytates, (kind of tissue). Apart from these factors, the iron and health status of the pregnant woman is a crucial factor affecting iron absorption. Dietary iron absorption is increased in the latter half of pregnancy in normal pregnant women and even more in iron deficient pregnant women.[42] Further, it has been observed that from 2 to 10 times the usual amount of radioactive iron was absorbed in the latter months of pregnancy when the iron stores are low as a result of demand from the fetus.

Iron absorption studies during pregnancy employing chemical balance and whole body counting techniques using radio-active iron indicates that iron absorption during pregnancy increases to a considerable extent (15-30%). Absorption shows a depression in the first trimester with progressive increases in the second and third trimester. This may be due to the fact that the requirement is large in the last two trimesters. However, absorption can reduce and even be nil, if the pregnant mothers are affected by serious illness and/or by parasite infections like hookworm or malaria. Infections, especially urinary and gastro-intestinal, are commonly encountered in groups of lower socio-economic status. This adds to the increased demand of iron during pregnancy thus aggravating iron deficiency.

4.1.2. Anaemia Due to Folic Acid and B12 Deficiency

Folic acid and B12 are essential for cell growth and for growing tissues in the fetus and growing children.[43]They are also very important nutrients for the production of blood cells in our body.[44] Incidence of metaplastic anaemia during pregnancy due to folic acid deficiency is between 10-20 per cent. However, despite normal Hb levels, about 60 per cent of women are folate deficient as indicated by serum folic acid levels. There is considerable evidence which suggests that a sizeable proportion of pregnant women are affected by folic acid or B12 deficiency.[45] Defective folic acid metabolism is therefore at least 'a contributory factor in many cases of pregnancy anaemia, abortion abruption placentae and prematurity.[46] In developing countries where intake of dietary folate is low and incidence of prematurity and intra uterine growth retardation high, the prophylactic supplementation with folic acid in pregnancy assumes greater importance.[47]

A study group on nutritional anaemia had recently recommended that pregnant women should receive 500 mg of folic acid and 60 mg of iron daily during the last 100 days of pregnancy to prevent anaemia.[48] However, supplements of 300-500 mg of folic acid daily are necessary to raise

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red cell folate levels in pregnant subjects.[49] Folic acid is a normal constituent of green vegetables, some fruits, liver and other meats, but is easily destroyed during cooking.

As far as Vitamin B12 is concerned, it is a very important nutrient element for the maturation of red blood cells. In other words, a common cause of maturation failure is a failure to absorb B12 from the gastrointestinal tract. This often occurs in pernicious anaemia in which the basic abnormality is atrophic gastric mucosa.[50] Once B12 has been absorbed from the gastrointestinal tract it is stored in large quantities in the liver and then released slowly as needed to the bone marrow and other tissues of the body. The minimum amount of B12 required each day to maintain normal maturation is 1 to 3 micrograms and the normal store in the liver and other body tissues is about 1,000 times this amount.[51]

There are different factors which lead to folic acid and Vitamin B12 deficiencies. The most common are poor dietary intake, dietary folate absorption, increased demand in pregnancy infestation, infection and anti-convulsent drugs and tropical sprue. As far as the dietary intake is concerned, the Indian diet is generally a non-haem diet which has poor content of folic acid and Vitamin B12. The general feeling is that folate absorption is impaired in pregnancy.[52]However, a recent study using tritiated folic acid in women undergoing therapeutic termination of pregnancy in the first and second trimester has indicated that there is no impairment in the absorption of folate in pregnancy. The folate status of individuals, moreover, influence the extent of the absorption.

Generally, folic acid and B12 are essential for nucleic acid synthesis. It may be expected that the increased requirement in pregnancy is due to large demand made by the growing fetus. Associated multiple pregnancy also tends to increase the requirement of folate. With regard to infestation and infection, malarial infestation in areas where malaria is endemic may play a part in the pathogenesis of metaplastic anaemia during pregnancy. Patients taking anti-convulsant drugs for treatment of epilepsy tend to become folate deficient. Folate levels and birth weight also drop. In areas where tropical sprue is endemic this condition is associated with pregnancy. These patients get steatorrhea and metaplastic anaemia. Both folate and B12 malabsorption is usually present.

4.1.3. Vitamin A Deficiency and Anaemia

Apart from iron, folic acid and Vitamin B12 deficiencies, there are other micronutrient deficiencies which also occur during infancy, childhood, pregnancy and lactation. Except for Vitamin A, all other nutrients, such as Vitamin B6, Vitamin B2, Vitamin E, copper and protein have a minor impact on anaemia. The low status of Vitamin A during pregnancy results in symptoms of night blindness. Major incidence of morbidity or mortality associated with Vitamin A deficiency have not been documented in pregnancy and lactation.[53] But one recent study in Nepal shows that low doze weekly supplementation with beto-carotene resulted in a 45 percent reduction in anaemia among the women who did not have hookworm infection.[54]

4.2. Other Factors Affecting Anaemia

Socio-Economic Factors

There is a socio-economic dimension to dietary intake, maternal nutritional status and outcome of pregnancy.[55]This socio-economic dimension is reflected in terms of traditional food habits during

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pregnancy, sex bias in the household, low caste and low income status. This socio-economic dimension is most marked in societies where the reproductive function is at a premium. The high fertility of Indian women also has a socio-cultural dimension which affects nutritional status because metabolic stresses of pregnancy and lactation may not be adequately compensated by dietary intake before, during or after these physiological processes. In a 30 years reproductive span, an Indian women spends on average 16 years in pregnancy and lactation.[56] During pregnancy women's access to food is even more restricted in the traditional Indian household through taboos and ritual observations which are widely documented.[57] Another social factor is discrimination against the women (i.e., sex bias) during food consumption. Gender is thus the most statistically significant determinant of nutritional status. Male-female differentials in nutritional status are especially great among the lower socio-economic/caste groups.[58] Studies which measure the anthropometric status of adults in different socio-economic groups in Tamil Nadu show that within the poorest groups nutritional differences are higher than for the whole population.[59] High maternal mortality and morbidity are aggravated when marriage is held at a young age and a low level of health care system is functioning particularly for mother and child.

There is a strong association among low income households between child nutrition and a mother's income whereas there is no significant association with father's income.[60] Female children are particularly dependent on their mother's wage. The gender factor is aggravated by poverty. Poverty affects women's food intake especially during the period of gestation. This results in low birth weight of new borns and high maternal morbidity and mortality.

Education

Though anaemia is an outcome of nutritional deficiency and is affected by socio-economic factors, it also has an inverse relationship with education. There are many studies which proclaim that female education has a particularly strong inverse relationship with infant mortality. In other words education is helpful to avoid diseases and in general maintain good health. One village study in West Bengal has shown that children with literate mothers have better nourishment than those with illiterate mothers.[61]Furthermore, it has been observed that increased income had a greater impact on the nutritional status of children of literate mothers than on those of illiterate mothers. One Columbia based study observed that maternal education was much more important than the presence of health institutions or high public expenditure in terms of reducing child mortality. While poverty conditions have restricted the food availability of households, good knowledge about food has led to a better intake.[62] It has also been identified that there is a statistical relationship between women's education and women's earning income on the one hand and lower fertility rate on the other.[63] Other studies show that female education is associated with impressive mortality and fertility declines.[64] Thus, while income is necessary to ensure child nutrition and health, income alone is not sufficient to guarantee child health. This underlies the fact that the need to emphasize both women's employment and education as a means to improve health and nutrition is imperative.

Cultural Factors

Cultural beliefs have a negative impact on both health care and food consumption during the time of pregnancy. Studies in different parts of the world indicate that women segregate foods and fruits into hot and cold characteristics and that they believed that hot foods will induce abortion. Vegetarian foods are assumed to be cold in character and non-vegetarian food hot which too will

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induce abortion. Further some believe that the growth of the baby (fetus) will be restricted if they consume more food because they believe that the space in the stomach is equally shared both by fetus and food. Also it is believed that by consuming nutritious food the baby will become larger in size which will induce greater labour pain to the mother. These type of beliefs, however, are not reasonable in medical terms and have a detrimental impact on both the mother and fetus's health. Habits such as picca consumption, tobacco chewing, and alcohol consumption etc. also severely affect the mother's health.

Environment

Poor environmental conditions can result in many diseases to human beings. This therefore, is also one of the factors leading to maternal anaemia. Hookworm and malaria are associated with a contaminated environment especially in urban slum areas. Hookworm larva are prominent in defection grounds and fields fertilized with human feces.[65] Torrential rains may result in a large number of hookworm larva being flushed from latrines or other faecally contaminated areas into ponds, pools or larger bodies of water. Heavy infection probably occurs in secondary contaminated areas. Iron deficiency anaemia is the most important outcome of chronic blood loss due to hookworm infection.[66]It is a contributor to anaemia because hookworm causes direct intestinal blood loss. The blood loss is proportional to the intensity of the infection. Moderate hookworm infections in women have been estimated to cause intestinal iron loss of about 3.4 mg per day. Severe anaemia has been strongly associated with hookworm infection. Hookworm infection apparently affects 65% of women and was most common in the most anaemic women.[67]

The transmission of hookworm infection depends upon three factors: the extent of faecal pollution of the soil, the suitability of environmental conditions for *egg* hatching and larvae development, and the extent of contact that humans have with contaminated soils. Hookworm infection is mostly commonly associated with faecal contamination of soil.

The other disease which may cause profound anaemia through hamoglogis is malaria. Malaria is associated with a contaminated environment coupled with bad drinking water. Susceptibility to malaria is increased during pregnancy particularly during primi gravid and prophylaxis investigation. Treatment is an important part of care of all pregnant women in endemic and epidemic areas.[68] Malaria causes severe complications during pregnancy. Studies in Sub-Saharan Africa report that the malaria parasite is 30-40 percent higher in primi gravid than in non-pregnant women. Persistent infection consequently increases the level of anaemia. A recent study in Tanzania estimated that malaria was responsible for about 60% of the cases of severe anaemia.[69]

5. Consequences of Maternal Anaemia

Iron is important to carry oxygen and essential for foetal growth, brain functioning, muscle activity and protection from infection etc. Folic acid and B12 are essential for cell growth and for rapidly growing tissues in the fetus and in growing children. If there are iron deficiencies, enough oxygen is not carried by the blood to vital tissues like the brain, muscle etc. Some of the manifestations of anaemia are dullness, lack of concentration, reduced activity and fatigue, all of which lead to poor performance in the work place. The consequences of anaemia can be discussed with regard to two things, namely the effect on mother and effect on fetus.

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5.1. Effects on Mothers

Anaemia can affect psychological and physical behaviour. Even in very mild forms, it influences the sense of well-being, results in lower resistance to fatigue, aggravates other disorders and affects work capacity. For pregnant women anaemia can result in severe morbidity. It also reduces resistance to blood loss and thus can result in death when blood is lost during normal delivery.[70]In mild and moderate forms of anaemia, no obvious effect may be seen on the health of the mother except for a progressive deterioration of the hematological status occurring with successive pregnancies. Severe forms of anaemia in the third trimester of pregnancy is invariably associated with cardiac failure.

Twenty to forty per cent of deaths are directly and indirectly the result of severe anaemia.[71] Severe anaemia (Hb<7g/dl) during pregnancy results in decompensation of the heat due to dual stress of anoxia as well as cardiac output. Thus the increased needs of subjects are not met. This is especially true in the third trimester when blood volume increases enormously. The extra stress of an increased volume of blood combined with anoxia results in cardiac failure. Most of the deaths due to anaemia are encountered either during the early part of the third trimester or during labour and the immediate postpartum period when uterus contraction and retraction increases the load on the heart.[72]

Studies to define the fictional decompensation due to anaemia in pregnancy indicate different types of decompensation occurring with varying degrees of anaemia. It has been observed that conditions such as abortions, premature births, past-partum haemorohages, and low birth weights are especially associated with Hb level in pregnancy. Most of the studies indicate that a fall in maternal Hb below 11 g/dl is associated with a significant rise in the perinatal mortality rate. There is usually a two to three-fold increase in the perinatal mortality rate when maternal Hb levels fall below 8g/dl and an eight to ten fold increase when maternal Hb levels fall below 5g/dl.[73] It is reported that anaemia directly results in 10-15 per cent of maternal deaths and in another 5-30 per cent of cases indirectly contributes to mortality and morbidity.[74]

Contradictory reports have appeared regarding the role of folic acid deficiency in increasing absteric complications. Some studies illustrate that metaplastic anaemia in pregnancy is associated with a high incidence of toxemia, prematurity, still births and neonatal deaths.[75] Other studies suggest that there is no association between metaplastic anaemia and the above factors.[76] Occurrence of urinary tract infection, it is generally agreed, is much more frequent in anaemic pregnant women than women with normal Hb values. The incidence furthermore is much higher in metaplastic anaemia cases.[77] Malaria and hookworm infection also aggravate anaemia and women experience breathlessness and increased output at rest. At this stage added stress from labour, spontaneous abortion or other major complications all may result in maternal deaths.[78] Thus maternal anaemia has severe consequences on the mother's side. The mother's health will also affect the fetus and even new born babies.

5.2. Effects on Fetus

Adverse pregnancy outcomes such as intra-uterine growth retardation (IUGR), prematurity etc., are some of the foetal consequences of anoxia due to severe anaemia during pregnancy. These are

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related to iron deficiency along with deficiency of folate and B12.[79] A significant fall in birth weight due to an increased prematurity rate and IUGR has been reported to occur when maternal Hb is below 8g/dl.[80] Severe maternal anaemia is correlated to the birth weight of new borns.[81] Several studies have also found that maternal anaemia is associated with perinatal or neonatal mortality and low iron status of the new born.

The foetus is often born with poor stores of iron and folate and suffers from anaemia from early infancy due to poor availability of these two nutrients from breast milk.[82]It has been observed that folate deficiency even at levels of 300 mg is a major factor in causing low birth weight of children. The low status of iron stores of neo-natal will reflect in growth retardation of infants and children. In the course of development also, children experience sub-optimal behavioral development which manifests itself in poor learning capacities. In order to tackle these problems, there are different types of treatment followed to reduce maternal anaemia.

6. Management and Administration of Maternal Anaemia

Various investigations on maternal anaemia have highlighted different techniques and programmes to reduce anaemia. Different methods are adopted for different levels of anaemia. These methods are generally iron therapy, blood transfusion, food fortification and dietary modification - all aimed principally at reducing nutritional anaemia. Oral iron therapy is supposed to be the best method in improving Hb concentration and reducing anaemia in pregnant women.

6.1. Oral Iron Therapy

Oral iron therapy is a method for prophylaxis and treatment of iron deficiencies. It is the easiest and cheapest method and a means to supplement dietary provision of iron for pregnant women. Iron supplementation is considered a part of a strategy to maintain Hb levels at normal levels and to prevent anaemia. Iron supplementation is most effective in high risk groups such as pregnant women, infants and pre-school children.[83]There are arguments nonetheless about whether all pregnant women should receive iron supplementation or only anaemic pregnant women. While some have argued that all pregnant women should be given iron supplementation,[84] a case is also made for only giving patients with depleted iron stores iron therapy. There is therefore no general consensus about who should receive iron supplements and about the amount of iron supplementation to be given. One study suggested that one tablet of 65 mg of iron per day could be given to non-anaemic women to prevent a decrease in Hb levels whereas in the case of anaemic pregnant women three tablets of 65 mg of iron could be given to help increase Hb levels.[85] It has been found that daily iron supplementation of either 180 mg or 60 mg for a period of 1.5 to 3 months could significantly increase Hb levels.[86] Moreover, supplementation of 120 mg of iron given daily during the second half of pregnancy is considered as an effective means for prevention of iron deficiency anaemia.[87]

During pregnancy, for anaemic women, as illustrated earlier, not only is iron deficient but also folate. It is therefore desirable to combine haematinius in one tablet.[88] For a pregnant woman the daily administration of folate (500 mg) with iron (120 mg) is beneficial since anaemia during pregnancy is usually caused by deficiency of both nutrients. A suitable combination tablet to be taken twice a day would contain 250 mg of folate and 60 mg of iron.[89]

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Iron tablet supplementation, however, also creates certain side effects for the expectant mothers. The most frequently reported side effects are abdominal discomfort, nausea, vomiting, diarrhea and constipation.[90]That is why most women are not prepared to take iron supplementation. Despite all the side effects, there is general agreement that iron supplementation helps reduce anaemia. In India, however, the iron supplementation programme is not very successful due to lack of awareness and realization of the consequences of anaemia, poor distributional arrangements and irregular intake by the beneficiary.[91]

6.2. Other Methods of Anaemia Management

Other methods of anaemia management exist such as parental iron therapy, blood transfusion and food fortification. Parental iron therapy is used when severe iron deficient anaemia is detected in the last trimester of pregnancy and in patients who for one reason or another do not take oral iron proportion. The advantages of parental iron therapy are (a) minimization of hospital stay (b) amount of iron needed for pregnancy can be administrated in a short time period and (c) no problem of gastrointestinal intolerance. However, serious side effects like (a) immediate anaphylactic reactions and (b) delayed and prolonged systemic reactions such as fever, myologic joint pains and lymphadenopathy has been noted in a few cases.[92]

Blood transfusion is the treatment of choice in severe anaemia especially in conditions where there are serious time limitations. Also, it is common during the third trimester of pregnancy to prevent severe anoxia and cardiac failure.

Food fortification with iron acts as a long-term measure to improve the iron balance. Salt is said to be the most suitable vehicle for improving iron balance. The other vehicle of iron fortification is sugar. The WHO suggested that a food fortification programme may be an effective means of controlling anaemia where the prevalence and severity of anaemia is lower over a longer period of time.[93]

7. Studies of Maternal Anaemia in India

In India anaemia is a major public health problem. Prevalence rates are high and persistent in character throughout the country. Irrespective of age and sex, anaemia due to nutritional inadequacy affects all people. The overall prevalence in different age groups of women indicates that anaemia is widely prevalent not only during pregnancy but right from early infancy till the conception period.[94]In 1968, anaemic women constituted 62.3% of the female population (< 11 g/dl). Moderate and severe anaemia was present in 17.0% of women (Hb< 9g/dl). Differences existed between rural and urban areas. While in rural areas 70% had moderate or severe anaemia in urban areas the percentage was only 26%.[95]In 1985-86, a national study of nearly 4,000 pregnant women in India, found that the mean Hb level was 90 g/L with 88%. of pregnant women having Hb levels below the norms of HO g/L.[96] Eighty-eight percent of all pregnant women who were anaemic fell in the age group of 15-49 years.[97] While 15 to 20% of pregnant women had anaemia from the onset of pregnancy, the incidence increased to 60 to 70% in the last trimester of pregnancy.[98] Prevalence of anaemia was highest amongst low income groups, i.e. 40 to 50% in urban areas and 50 to 70% in rural areas.[99]

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As for region-wise comparisons, in southern India 60% to 80% of pregnant women were anaemic whereas in the north it was marginally higher. The prevalence of metaplastic changes in bone marrow was extremely high in thesouth.[100]

Analysis of data on anthropometric indices of nutritional status indicate that women with Hb levels less than 8g/dl were more undernourished. In other words anaemia was part of overall undernourishment.[101]This is confirmed by the fact that there is an inverse relationship between daily dietary intakes of iron, folic acid and protein and prevalence of anaemia.[102] Apart from iron deficiency, a sizeable proportion of pregnant women are affected by folic acid and/or Vitamin B12 deficiency. A study conducted in a village in Varanasi, U.P illustrated that mean daily dietary intake of iron, folic acid and protein of anaemic women was significantly lower than those of non-anaemic women.[103]

In India many issues hinder attempts to improve dietary patterns. Dietary iron intake is inadequate because total food intake is inadequate. Sufficient iron intake would entail higher costs and changes in customary dietary habits. Several known maternal risk factors associated with low birth weight and increased perinatal mortality such as maternal height below 140 cm, maternal weight below 40 kg., antenatal complications such as toxemia, twins and anti-proton haemorrhage were also more common in the groups of women with Hb levels below 8/dl. All these factors are known to be associated with anaemia on the one hand and low birth weight and increased perinatal mortality on the other.[104]

Apart from these factors, there are other factors which affect women's health status such as the overall status of women early marriage and cultural beliefs. An Indian woman undergoes six to seven pregnancies on average, resulting in five or six births of whom four to five will survive. She thus spends the greater part of her reproductive years in pregnancy and lactation. Maternal depletion is seldom compensated by adequate nutrition. Early marriage is also a crucial factor. Approximately 8% of annual births in India are to mothers who are below 19 years of age. Teen-age marriages in rural and urban areas are common. The mean age of marriage varies between 13-15 years in rural areas and 14-18 years in urban areas.[105]Early marriage thus is a contributory factor to maternal mortality.

In India the habit of picca is common. Eating of mud and clay, ash, lime, raw rice and charcoal is not uncommon at the time of pregnancy. This occurrence is seen to be a perversion of appetite and an irresistible desire for eating unusual, often indigestible substances which of course have no nutritional value. One study indicates that 51% of low income mothers have this habit. The incidence of picca is observed to decrease considerably with the increase in income and educational level of both husband and wife.[106]

In India, most poor pregnant women, due to economic constraints, continue to actively participate in the labour force even during gestation period. A WHO study illustrates that 81.3 percent of women in India have heavy workloads outside the home.[107] Occupation stress is not duly compensated with enough nutritional food intake and consequently affects both the mother's and child's health severely. The dual stress, i.e. work in and outside of the home, have adverse effects on maternal health and nutritional status. It has been observed that prevalence of anaemia, low

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levels of nutritional status, frequency of illness, and other health hazards were higher in working women that in non-working women.[108]

The main consequence of maternal anaemia in India is maternal mortality. Data confirms that maternal anaemia is associated with low birth weight, increase in premature deliveries, intra-uterine growth retardation and higher perinatal mortality rates. In Nagpur, between 1955 and 1964 nearly 20 to 40% of maternal deaths were due to anaemia. Studies conducted in different part of India indicate that maternal anaemia is associated with increased maternal morbidity and mortality. Other consequences are foetal wastage resulting in abortion, intra-uterine growth and still births. Almost 20% of births among poor communities are still births. Children in poor communities also tend to have low birth weights and a perinatal mortality rate ranging from 50 to 70 per 1000 live births.[109]

With regard to the management of maternal anaemia, there are different types of programmes being implemented. It has been suggested for women in India especially that in order to reduce maternal anaemia 120 mg of oral elemental iron is needed daily. A study group of the Nutrition Society of India has recommended the use of 60 mg of iron daily for the prophylaxis of anaemia in pregnancy. This figure was determined after taking into consideration the poor iron stores of the mother, the variability of iron absorption, and possible irregularities in supply and intake of iron tablets.[110] However, to maintain a satisfactory hematological status during pregnancy it has been suggested thatdaily supplements of 30 mg of iron given during the last 100 days is adequate.[111] In an evaluation study of NNAPP in India ICMR found that there are no side effects from iron, folate and B12 supplementation tablets. Only 4% reported gastro-intestinal upset/constipation, nausea, vomiting and/or a combination of more than one. Anoxia was reported by only 3 beneficiaries.[112] The evaluation study, however, also observed that the NNAPP programme did not have an effect on pregnant women in terms of reducing anaemia.

8. Summary and Conclusion

Maternal anaemia is a serious problem amongst pregnant women, especially in low income groups. The nature and magnitude of the problem differs according to the type of deficiency and the consequence of these deficiencies in terms of blood formation. Although there are different factors which make pregnant women anaemic, iron deficiency is considered to be the major cause. To prevent maternal anaemia iron supplementation along with folic acid and B12 supplementation are suggested. However, there should be a multi-pronged strategy to reduce maternal anaemia.

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*Corresponding author.
E-mail address: cvdev2017@ gmail.com