REVIEW OF LITERATURE
(i) **Definition of Anaemia**

The term anaemia has been defined as 'diminution in the oxygen-carrying capacity of blood or, in other words, diminution below normal in the total circulating haemoglobin mass' (Steingold, 1966). The haemoglobin concentration is accepted as one of the indicators for the qualitative and quantitative assessment of anaemia, in general. Segruch (1979) defined anaemia as 'a condition of reduction in the concentration of haemoglobin in the peripheral blood below normal for the age and sex of the patients'.

The term 'anaemia in pregnancy' refers to all forms of anemias, that are encountered during pregnancy. The term 'anaemia of pregnancy', however, includes only those which appear for the first time during pregnancy and are directly precipitated or caused by pregnancy (Chatterjee, 1971).

(ii) **Concept of Physiological Anaemia**

In pregnancy, the disproportionate increase of plasma volume causes blood dilution and hence, inspite of a simultaneous increase in red cell mass, a fall in haemoglobin level results. This state of haemodilution is often referred as physiological anaemia (Steingold, 1966).
Various workers have expressed contradictory opinions regarding the presence of physiological anaemia. The studies conducted by Bieckmann and Sognér (1934), Berlin et al. (1953), Lund and Sisson (1953), Lawrence (1962) and Paintin (1962) supported the concept of physiological anaemia, whereas those conducted by Benstead and Theobald (1952), Davis and Jennison (1954), Fisher and Biggs (1955), Röger and Riege (1956) and Giles and Burton (1960) did not give any credence to it.

Bieckmann and Sognér (1934) were amongst the earliest workers reporting the changes in blood volume during pregnancy. They observed that the increase in red cell mass and red cell volume was comparatively less than the increase in plasma volume. Thus a fall in the haemoglobin and red cell concentration occurs, though there is no true anaemia. They further observed that at about 30th week of pregnancy, when the haemodilution was most marked, the average fall in haemoglobin concentration was 2.2 gm. per 100 ml. (15 percent). From these observations, authors conclude that presence of true anaemia can not be detected in the later stages of pregnancy until the haemoglobin concentration falls below 10 gm. percent. A considerable individual variation was observed by the authors in these volume changes during the course of pregnancy; a few women, however, did not show any significant change.
Berlin et al (1953) supported the concept of physiological anaemia on the basis of results of a therapeutic trial which revealed that iron intake throughout pregnancy had no effect on anaemia, as the prevalence of anaemia was found to be similar to that reported by Caton et al (1951) who did not give any iron to pregnant women of their study.

Lund and Sisson (1959) found that pregnant women show lower packed cell volumes and haemoglobin concentrations with higher total red cells and haemoglobin than those of non-pregnant women. The studies conducted by Lawrence (1963) and Slatin (1962) revealed that the increase in red cell volume is not dependent on iron therapy and occur even in women who are not given iron. Nevertheless, iron deficiency limits this increase and may even cause a fall. It also has a limiting effect on the plasma volume increase.

Benstead and Theobald (1952) did not agree with the concept of physiological anaemia, on the basis of their study which revealed that oral iron maintains the haemoglobin concentration in pregnancy. However, the majority of their patients were anaemic when iron therapy was commenced. Similar observations have been made by Davis and Jennison (1954).
Fisher and Biggs (1955) gave oral iron to 104 pregnant women and found that 92 of them responded while 12 did not, the criterion of response being a haemoglobin level of 12.6 gm. per 100 ml. at 38 weeks. In a similar study by Edger and Rice (1956) proportion of non-responders has been found to be 22.4 percent. They explained that patients showing no response, probably, did not take their iron or failed to absorb it. Giles and Burton (1960) found that about 8 percent of their patients showed no response to iron therapy during pregnancy.

In nutshell, above observations suggest that the iron therapy would be effective in most of the women and will maintain the haemoglobin concentration at 12.6 gm. per 100 ml. or more, or raise it to such a level if there has been significant initial anaemia. In remaining, there would be no such apparent response. In these cases, however, the response might occur but masked by greater plasma volume increase (Lawrence, 1962).


Varied criteria for diagnosis of anaemia in pregnancy have been used by different workers (Adair et al., 1936; Das Gupta, 1954; Menon, 1967; Sajwani et al., 1969). Such criteria differ between countries (Solomons et al., 1962; Paintin, 1963; Das et al., 1977 a) and also between workers within countries (Chaudhury, 1939; Good, 1967).
Adair et al (1936) recommended a haemoglobin level of 10 gm. percent as cut off point below which all the pregnant women should be considered anaemic. Solonos et al (1962) adopted haemoglobin level of 11.8 gm. percent for the purpose. Benjamin et al (1966), however, used the level of 12 gm. percent as cut off point.

In India, few workers used a very low haemoglobin level for diagnosing anaemia in pregnant women. The minimum normal value of haemoglobin reported by Das Gupta (1954) was 9.5 gm. percent. Menon (1967) used a level of 9.8 gm. percent, while Chaudhury and Manglik (1938) and Chaudhury (1939) considered a cut off point of 7.3 gm. percent.

However, most of the recent workers have considered a haemoglobin level of either 10 gm. percent (Aami et al, 1962; Shanker, 1962; Venkatachalam, 1962; Gajwani et al, 1969) or 11 gm. percent (Subramanian and Fernandes, 1970; Chopra et al, 1971; I.C.M.R., 1975; Baker, 1978) as criterion for diagnosing anaemia.

It appears, therefore, that workers using very low haemoglobin values for cut off point of anaemia have under-estimated the extent of problem in their studies. No doubt, in the absence of a universal criterion, it becomes difficult to compare the prevalence of anaemia between countries as well as in different areas of the
same country. W.H.O. (1968) recommended that in pregnant
women, anaemia should be considered at a haemoglobin level
below 11 gm. percent since 95 percent of normal individuals
will fall above this level. This should be considered
appropriate criterion for all geographical areas except as
modified by residence at higher attitude (W.H.O., 1968).

(iv) **Classification of Anaemia of Pregnancy.**

Various attempts have been made to classify
anaemia of pregnancy from time to time. Wintrobe (1934)
brought forth following categories, based on morphology of
red cells.

(a) Macrocytic normochromic anaemia,
(b) Macrocytic hypochromic anaemia,
(c) Normocytic normochromic anaemia,
(d) Normocytic hypochromic anaemia,
(e) Microcytic hypochromic anaemia.

Trowell (1942) and Roy and Kondi (1943) also
classified anaemia in similar fashion on the basis of size
and haemoglobinization of red blood cells. Trowell (1942)
evén introduced a new term 'dimorphic anaemia' for
macrocytic hypochromic anaemia. As it was found to be
caused by dual deficiency of iron and folic acid, the term
'mixed anaemia' or 'double deficiency anaemia' have also
been used at various places for describing such type of
anaemia.
Vaughan (1936) classified anaemia according to aetiological basis as

(a) Hypochromic anaemia,
(b) Haemorrhagic anaemia,
(c) Haemolytic anaemia,
(d) Miscellaneous anaemia.

Morphological classification, based on the examination of peripheral blood films, has been widely used by number of workers in field based studies (Sarna, 1976; Luvang, 1977).

(v) Complications of Anaemia in Pregnancy.

Anaemia in pregnancy is one of the major health problems in all the developing countries in view of its high magnitude and widespread ill effects on mother as well as on foetus. A number of studies have shown ill effects of anaemia (Menon, 1967; Chaudhury, 1970; Yusufji, et al., 1973; Sikdar, 1979) in one way or the other.

In Madras, it has been found to be the direct cause of 20 percent of maternal mortality and an associated factor, in another 20 percent (Menon, 1967). Khanam et al. (1979) reported that anaemia alone was responsible for 15 percent of the total maternal deaths recorded over a period of 9 years at Govt. Hospital for women, Srinagar. Sikdar (1979) found that anaemia was directly responsible of 0.9 percent of total maternal death. Sikdar and Konar
(1979) and Bhargava (1979) have also attributed a considerable proportion of maternal mortality directly to anaemia. According to the conservative estimates of a Study Group on Nutritional Anaemia (Nutritional Society of India, 1968), 85,000 pregnant women die every year from nutritional anaemia in India.

Ekblom (1972) and Marna et al (1973) observed that anaemia causes a reduction in the work capacity and even mild degree of anaemia may result in decreased performance in maximum or near maximum exercise. This may be one of the causes of early exhaustion of anaemic pregnant women during the labour pains. Joynson et al (1972) reported a positive correlation of anaemia and iron deficiency with lowering of resistance and impaired immune response. Johnson and Oso (1962) observed that iron deficiency anaemia reduces the capacity of the epithelium of the skin and mucosa to resist colonisation by organisms.

In severe cases of anaemia, circulatory alterations lead to cardiac failure which may prove fatal (McFee, 1973). Chatterjee (1971) reported that most common fatal maternal consequence of anaemia is the inability of the anaemic to withstand significant haemorrhage.

A close association has been observed between anaemia and toxoaemia of pregnancy. Chaudhury (1970) studied 300 consecutive women beyond the 32nd week of
pregnancy and observed that 56 percent had haemoglobin values below 10 gm. percent. Twenty five percent of these anaemic pregnant women subsequently developed toxaemia while in non-anaemic group, only 11 percent suffered from this complication. He further observed that prescribing supplementary iron and vitamins dropped the incidence of toxaemia from 14.6 percent to 4.8 percent.

Anaemia in pregnant women involves a higher risk of ill effects for foetus. Yusufji et al. (1973) observed, in a series of 1,000 pregnant cases from Southern India, a positive correlation between maternal haemoglobin level and foetal birth weight. Baker (1978) reported an increased risk of premature delivery in anaemic pregnant women. He observed that even milder degree of anaemia may be associated with premature delivery, lower birth weight and placental hypertrophy. Mac Gregor (1963) and Aattan and Beishoher (1973) demonstrated a direct relationship between birth weight and haemoglobin levels.

Infants born to anaemic mothers generally suffer a higher perinatal morbidity and mortality than those born to non-anaemic women (Llewellyn-Jones, 1965). Mac Gregor (1963) found both neonatal death rate and still birth rate elevated, each 2-3 times normal, in severely anaemic patients in Kenya.
Mittal and Ketkar (1970) reported that there was 100 percent neonatal loss in mothers with haemoglobin level below 7 gm. percent, 10 percent neonatal loss with a level between 7 - 10 gm. percent and no neonatal or perinatal loss in those with a level over 10 gm. percent.

Studies carried out at National Institute of Nutrition, Hyderabad (I.C.M.R., 1975) revealed that in infants born to anaemic mothers the iron, folic acid and vitamin B₁₂ stores were very poor and such infants had greater risk of developing anaemia during early infancy.

(vi) Methods used and Types of Studies.

Various methods - direct as well as indirect and assessment of ecological factors have been suggested for the studies on anaemia in the communities (Jelliffe, 1968). The field survey on anaemia may be undertaken by haemoglobin estimation, examination of blood film and, if practicable, haematocrit estimation.

Penon (1964, 1965, 1967), Sood et al. (1967, 1968), Upadhyaya (1971) and Yusufji et al. (1973) studied the problem of anaemia under hospital settings; they adopted various sophisticated haematological and biochemical assays like bone-marrow examination and estimations of serum levels of iron, folic acid, vitamin B₁₂ and protein. However, the applicability of these methods in the field situations seems to be impracticable.
Number of methods (Jelliffe, 1966) have been described for the estimation of haemoglobin levels viz. Talquist method, Sahli's method, Grey Hedge photometer, Spencer haemoglobinometer and Gyanmeth-haemoglobin method etc. However, in field situations, only a few of them can be adopted. Sahli's method has been found to be most suitable for field studies (Sarna, 1976; Luvang, 1977).

In recent years, problem of anaemia has been studied by carrying out micro and macro levels investigations in hospital conditions as well as in the fields (Solomons et al., 1962; Todd and Kan, 1965; Chopra et al., 1967; Sood, 1967). However, majority of them are hospital based (Solomons et al., 1962; Paintin, 1962; Benjamin et al., 1966; Chaudhury, 1979; Shanker, 1982). In fact, community based studies have been very few (Saha et al., 1973; Sarna, 1976; Luvang, 1977). Hospital based studies have their own limitations and they fail to provide real picture of problem prevailing in the general population. Field studies on anaemia are, thus, significantly important.

NATURE AND MAGNITUDE OF ANAEMIA IN PREGNANT WOMEN

(1) Prevalence of Anaemia

W.H.O. sponsored studies (W.H.O., 1968) indicated that the prevalence of anaemia in pregnant women, in different parts of the world, ranges from 21 percent to 80 percent; the highest being in India. These studies
further indicate that prevalence rate of anaemia not only
differs between countries but also between regions within
a country (W.H.O., 1968).

Solomons et al (1963) from Maimonides Hospital
of Brooklyn, United States, reported a prevalence rate of
28.7 percent in 1st and 2nd trimester which increased to
50 percent in 3rd trimester. Todd and Kan (1965) observed
that, out of 1,915 pregnant Chinese women, attending Tsan
Yuk Hospital, Hong Kong, 278 had haemoglobin levels below
10.0 gm. percent. Benjamin et al (1966) reported a
prevalence rate of 71.9 percent in 1,052 antenatal cases
attending Queen's Hospital Centre, New York. Out of this,
49.1 percent were mildly anaemic (haemoglobin level between
10 and 12 gm. percent) and 22.8 percent had moderate or
severe anaemia (haemoglobin below 10 gm. percent).

The results of the haemoglobin survey on 555
pregnant women of Trinidad, carried out by Chopra et al
(1967) showed that 34 percent had haemoglobin values less
than 10 gm. per 100 ml. Mean haemoglobin levels were
11.0 and 11.6 gm. percent for those having pregnancy of
under six months and over six months respectively. In
contrast, mean haemoglobin level for non-pregnant controls
was found to be 12.6 gm. per 100 ml.

A study in Warsaw, Poland, revealed that 21.8
percent of the pregnant women had haemoglobin level less
than 11 gm. percent (W.H.O., 1968). Chopra and Khanyak (1971), in their study on pregnant women of eight Latin American nations, found that 46 percent women had haemoglobin level below 11.0 gm. percent.

In India, Chaudhury and Manglik (1939) observed, in 2,400 antenatal women from Agra (U.P.), that only 5.0 percent of them were anaemic (Hb. level below 7.25 gm. percent). Chaudhury (1939) reported a prevalence rate of 8.2 percent (Hb. level below 7.25 gm. percent) in 4,070 antenatal women attending Lady Harding Medical College Hospital, New Delhi. Such low prevalence rates of anaemia, in these two studies, perhaps, could have been due to the consideration of low level of haemoglobin as criterion of anaemia. Later studies consistently revealed higher prevalence rates in different parts of the country.

Venkatachalam (1962) observed that amongst 198 women examined in the third trimester of pregnancy, 56 percent were anaemic. Shanker (1962) in a survey, conducted in 394 pregnant women from Niloufer Hospital, Hyderabad, observed an overall prevalence rate of 46 percent (Hb. level below 10 gm. percent).

A study conducted by Indian Council of Medical Research at Lucknow, revealed 28 percent of 2,500 pregnant women to be anaemic (Patwardhan, 1966). Sidhu et al (1967) reported a prevalence of 41.5 percent in 1,271 pregnant women, attending antenatal clinic at the Institute and the
Maternity and Child Health Centres in the surrounding areas of South Delhi.

Sood (1967) compared the prevalence of anaemia in three groups of pregnant women viz. (a) 504 pregnant women from the antenatal clinic of All India Institute of Medical Sciences, Delhi, (b) 497 women from Corporation Maternity and Child Welfare Centres, New Delhi Corporation, and (c) 106 pregnant women of a rural area of Delhi. It was observed that in these three groups the prevalence of anaemia varied significantly, being 27.3, 43.0 and 47.0 percent in a, b and c groups respectively.

In a hospital based study at Vellore, it was observed that 56 percent of pregnant mothers were anaemic with the criterion of the haemoglobin level less than 11 gm. percent, while only 35 percent of the non-pregnant controls were anaemic (Hb. < 12 gm. percent). The mean haemoglobin level was significantly lower among the pregnant women (10.2 gm. percent) than that of non-pregnant controls (12.3 gm. percent). In 15 percent of the pregnant women the haemoglobin levels were less than 8.0 gm. percent (W.H.O., 1969).

Gopalan and Raghavan (1969) reported a prevalence rate of 56 percent among 800 pregnant women from different parts of the country. Gajwani et al. (1969) observed that, out of 103 pregnant women in third trimester of pregnancy attending antenatal clinics of Medical College, Baroda, 83
Subramanian and Fernandes (1970), from Women Hospital, Bombay, reported that in their study of 7,420 pregnant women, 67.3 percent were anaemic (Hb. < 11 gm. percent). Mittal and Mohar (1978) from Indore, Saut and Pania (1972) from Orissa and Dutta and Dutta (1972) from Guhati have also shown a high prevalence of anaemia of pregnancy in their hospital based studies.

A study conducted in a rural community of Ludhiana revealed 30 out of 53 pregnant mothers to have a haemoglobin level less than 10 gm. percent (Uheroi et al., 1972). Gupta et al. (1973) observed, in a rural area near Kanpur, that 68.8 percent of pregnant women were anaemic. The analysis further revealed that 25 percent of pregnant women had haemoglobin level below 8 gm. percent; 20.8 percent had between 10 to 11 gm. percent whereas 6.3 percent had a level of 12 gm. percent and above. The mean haemoglobin level was 9.2 gm. percent. Suresh and Gupta (1979) in their study, in a rural area of Varanasi, found a prevalence rate of 75 percent.

Gajwani et al. (1969) opined that variations in the prevalence of anaemia, between countries and within different regions of the same country, are chiefly due to the differences in socio-economic status, customs, nutritional status and cultures of the people. However, in part, it may also be due to the differences in the criteria adopted for labelling anaemia.
(ii) Prevalence According to Type of Anaemia

Prevalence of various types of anaemia has shown a significant variation from one place to the other (Chaudhury, 1939; Fry, 1961; Sidhu et al., 1967; Chopra et al., 1967). However, the results on prevalence rates are not strictly comparable in view of different criteria used in the assessment of specific type of anaemia and due to the variability in the method of selection of cases as well as in diagnostic techniques adopted. The main techniques used for diagnosing the morphological type of anaemia have either been examination of peripheral blood film or bone-marrow examination or the combination of the two. Kothari and Bhende (1950) recommended that the results of only bone-marrow biopsy may be considered as suitable criteria for the diagnosis of type of anaemia. However, in field situations, it cannot be adopted and so, the examination of peripheral blood film remains the only method of choice.

Chaudhury (1939) reported that all morphological types of anaemias were equally common. Similar observations were made by Menon and Chandrashekharan (1954), Giles and Burton (1960) and Rami et al. (1962).

Fry (1961) observed in a study of 5,000 patients in London that hypochromic anaemia accounted for 92 percent of all types. Sidhu et al. (1967) reported, on the basis of
peripheral blood film examination, that 38 percent cases had hypochromia with or without microcytosis. Macrocytic changes were found in 18 percent subjects only. A study conducted by Gajwani et al. (1969) revealed that 61 out of 83 cases of anaemia of pregnancy had microcytic hypochromic blood picture. The remaining 22 patients showed the presence of megaloblasts in the bone marrow. However, out of these 22, 18 had features of an associated iron deficiency also in the form of hypochromia.

Chopra et al. (1967) reported microcytic hypochromic anaemia in 77 percent cases, 3 percent showed a picture of macrocytic anaemia, while dimorphic changes were found in 20 percent cases. Nanon (1967) reported that out of 325 cases of anaemia of pregnancy 30.5 percent showed microcytic hypochromic picture while 60 percent were of macrocytic hypochromic type. In 29 percent cases bone-marrow showed megaloblastic erythropoiesis.

Subramanian and Fernandes (1970) observed the distribution of anaemic mothers as 93.75 percent in microcytic hypochromic group, 3.12 percent in dimorphic group and 2.14 percent in megaloblastic group. Refractory anaemia was found in 0.79 percent cases. Nair et al. (1970) observed that 47.2 percent cases belonged to microcytic hypochromic type, 25.4 percent showed dimorphic picture while 7 percent had megaloblastic anaemia.
Luwang (1977) reported 60.29 percent cases of anaemia of pregnancy belonging to normocytic normochromic group, 33.08 percent were found to have only iron deficiency changes while 6.63 percent were of dimorphic type.

A wide variation has been observed by different workers in the incidence of megaloblastic anaemia of pregnancy. Todd and Kan (1965) could not encounter even a single case of megaloblastic anaemia in Chinese anaemic patients. Tasker et al. (1956) from Malaysia and Hoo (1962) from Indonesia reported the incidence of megaloblastic anaemia, among anaemic pregnant women, to be 27.7 and 37.3 percent respectively. Fullerton and Watson-Williams (1962) from Abadan, reported 28 percent of all anaemic mothers to have megaloblastic anaemia. Mackenzie and Abbot (1960), and Hilliard (1962) observed a high incidence of megaloblastic anaemia in United Kingdom.

Kothari and Shende (1952) observed that 40 out of 45 pregnant women from Bombay, were suffering from megaloblastic anaemia. Karthigaini et al. (1964) observed an incidence of 54 percent among 50 women in the third trimester of pregnancy. A study conducted by Mehrotra et al. (1965) revealed an incidence rate of 52 percent in a series of 100 cases of anaemia in pregnancy. In another study, from South India, Yusufji et al. (1973) observed an incidence rate of 60 percent amongst 1,000 women belonging
Adair et al (1936) observed that 88 percent of women had anaemia without any change in peripheral blood picture. This was explained on the basis of haemodilution which occur during pregnancy. However, Sood (1967) opined that in early iron deficiency, microcytosis and hypochromia are not pronounced and so, an apparently normal blood picture may be present in such cases.

(iii) Signs and Symptoms of Anaemia.

Clinical examination is one of the simple and efficient method for assessing the nutritional status of a community (Jelliffe, 1966). Chopra et al (1967) found 36.1 percent subjects to have symptoms and signs of anaemia. Easy fatiguability, weakness and dizziness were reported by 50 percent of the examined ladies. Breathlessness was complained by 21.5 percent while fourteen patients were found to have no complaint at all. Around 36.5 percent had pallor of the skin and mucous membrane. Slight papillary hypertrophy of the tongue, bleeding gums, and enlarged thyroid was observed in 22.2, 17.2 and 10.7 percent of cases respectively.

Yusufji (1973) observed, in his study, that majority of pregnant women were normal on physical examination. Among those who had signs of anaemia, glossitis was found in 10 percent and stomatitis in seven percent cases. Koilonychia was found in 8 percent of cases. Pitting oedema on ankle was present in 11 percent of the subjects. The 3 percent had general anasarca. Eight
percent of the cases were considered to be suffering from toxaemia of pregnancy. Vijayalakshmi et al (1975) reported that 4 out of 40 expectant mothers had glossitis while 3 showed angular stomatitis as well.

Shanker (1962) observed that 200 out of 395 pregnant women complained of long standing general weakness, fatiguability and vague bodyaches at the time of examination. The nutritional significance of these findings could not be assessed. Nearly one third of these women showed frank clinical signs of Vit. B complex deficiency affecting orolinguial mucous membrane. Dutta and Sarkar (1970) observed that in a gradual onset of anaemia, some of the patients get so well adjusted to lower haemoglobin that they may not have any complaint inspite of a very low haemoglobin level. Mehta (1976) was of the opinion that symptoms like easy fatiguability, tiredness, weakness, headache, bodyache, inability to concentrate and giddiness etc. were non-specific and had no relation to haemoglobin level.

FACTORS INFLUENCING ANAEMIA IN PREGNANCY

(1) Age of the Mother.

A number of attempts have been made, from time to time, to see the association of age of the mother with the prevalence of anaemia of pregnancy (Ganguli, 1954; Leon and Blazer, 1965; Mehta et al, 1971; and Raut and
Panda, 1972). Most of these studies indicate that the prevalence of anaemia increase with the advancement of age (Nitra, 1937; Chaudhury and Manglik, 1938; Chaudhury, 1939; Miller, 1959).

Ganguli (1954) reported an increase in the prevalence rate of anaemia with the advancement of age. The mean haemoglobin level was also low in higher age group, being 69.8 percent in above 20 years and 72.2 percent in below 20 years age group. Miller et al (1959) also observed that the age and haemoglobin levels were related to a definite tendency towards anaemia in the older age group.

Nitra (1937), Chaudhury and Manglik (1938) and Chaudhury (1939) observed that anaemia was less common in younger age group. Leen and Blazer (1965) reported a higher percentage of anaemia in women upto 34 years of age in comparison to those above 34. Giles and Burton (1960), Das et al (1967 b) and Asut and Panda (1972) noted highest incidence of anaemia in the age-group of 20-29 years whereas Mehta et al (1971) reported that anaemia was more common in the age group 25-30 years.

On the other hand, Das Gupta and Chatterjee (1953), Shanker (1962), Medalia (1965), Chopra et al (1967) and Chatterjee (1967) could not find any significant relationship between age and anaemia in pregnancy.
(11) Period of Gestation.

A number of observations have been made on the relationship of anaemia of pregnancy with the period of gestation. Most of the observers are in general agreement (Shanker, 1962; Solomon, 1962; Mehrotra, 1965; Chopra et al., 1967) that the prevalence of anaemia increases and the mean haemoglobin level decreases with the advancement of pregnancy.

Shanker (1962) observed a gradual fall of mean haemoglobin level, with the advancement of pregnancy, being 11.4 gm. percent in first trimester, 10.3 gm. percent in the second trimester and 9.9 gm. percent in the third trimester. Paintin (1962) reported the mean haemoglobin levels to be 12.6 gm. percent in 11.9 weeks, 11.7 gm. percent in 20.5 weeks, 11.0 gm. percent in 28.9 weeks and 10.9 gm. percent in 36.8 weeks of pregnancy. Solomon et al. (1962) also reported a fall in haemoglobin levels in the last trimester of pregnancy.

Todd and Kan (1965) observed the highest proportion of anaemia between 28th and 36th weeks of gestation. Mehrotra (1965) in 100 normal pregnant cases found a distinct fall of haemoglobin values with the advancement of pregnancy, the mean values being 12.1 gm. percent in the 1st, 11.98 gm. percent in 2nd and 11.76 gm. percent in the 3rd trimester. Perhaps, increased nutritional requirement of foetus and rapid storage of
iron in foetal liver, in the later part of pregnancy were responsible for the fall.

Chopra et al. (1967) observed a progressive fall in mean haemoglobin values with the advancement of pregnancy. Women with under 6 month of gestation had a mean haemoglobin level of 11 gm. per 100 ml. whereas in those having a pregnancy of over 6 months it was 10.6 gm. percent. Chatterjee (1967) observed maximum incidence of anaemia during 3rd trimester of pregnancy. Iyengar and Apte (1970) reported that out of 89 subjects, who were non-anaemic during their first trimester of pregnancy, 60 percent showed fall in haemoglobin after 12 to 16 weeks.

Surveys carried out in different parts of India (I.C.N.R., 1975) indicated that while only 15-20 percent of women were anaemic at the onset of pregnancy, the incidence of anaemia increased to 60-70 percent in the last trimester. Jolliffe (1978) also reported that majority of women maintained their haemoglobin, within non-anaemic range, up to second trimester but in third trimester a rapid fall occurred.

Medalie (1965), however, reported that there was no significant difference between the distribution of haemoglobin levels in different trimesters. Sarna (1976) also reported no significant difference in the mean haemoglobin levels between 2nd and 3rd trimesters.
She explained that it was probably due to the extensive antenatal care which the mothers received during the 3rd trimester.

(iii) Parity.

A close association has been observed by a number of workers between the parity and the haemoglobin levels (Todd and Kan, 1965; Mehrotra et al., 1965; Yusufji et al., 1973; I.C.M.A., 1974). Most of them suggest that due to depletion of haemopoietic substances in each pregnancy, the prevalence of anaemia is higher in multigravidae.

Todd and Kan (1965) observed that anaemia was more common among multigravidae than in primigravidae. Ganguli (1954) reported that the average haemoglobin level was 71.5 percent in primigravidae as against 69.1 percent in multigravidae. Leon and Blaser (1965) also reported that the prevalence of anaemia increased with the increase in parity being 16.7 percent in lesser parity (upto 6) and 29.7 percent in grand multipara (7 and above). Mehrotra et al. (1965) found that incidence of macrocytic anaemia was significantly related with the parity.

Yusufji et al. (1973) observed that the mean haemoglobin concentration was significantly lower in women who had had 3 or more pregnancies in comparison to those who had less than it. A study conducted by I.C.M.A. (1974) revealed
that prevalence of anaemia was significantly lower in
women with less than 4 parity than those with parity 4
and above, for the similar age of gestation.

Prevalence of anaemia amongst primigravidae
has been reported by Nitre (1937), Chaudhury (1939) and
Giles and Shuttleworth (1958). However, these studies
were hospital based and the higher incidence was probably
due to greater incidence of confinement of primigravidae
in the hospitals.

(iv) Lactation.

Very few workers have studied the effect of
prolonged lactation as a causative factor in anaemia
during pregnancy. Todd and Kan (1965) reported that
prolonged and repeated lactation was one of the important
factors playing a role in the causation of anaemia. They
observed that out of 270 anaemic pregnant patients, 94 were
found to have a history of breast feeding of one or more
infants for prolonged periods (in excess of one year).

I.C.M.R. (1975) also reported that besides the
increased demands during pregnancy, demands during
lactation contribute to reduce iron stores and worsen the
deficiency state. Since many women have repeated, closely
spaced pregnancies with prolonged periods of lactation,
there is progressive depletion of iron stores with
increasing number of pregnancies.
(v) **Socio-economic factors.**

Steingold (1966) was of the opinion that poverty is the most important social factor in the causation of anaemia. Kothari and Shende (1949) observed that in lower socio-economic group, prevalence of anaemia was higher. Das Gupta and Chatterjee (1953) as well as Raut and Panda (1972) were also of the same opinion. Datt (1973) observed a higher family income in non-anaemic group in comparison to anaemic group. Vijjalakshmi et al (1975) observed in a study in Coimbatore that 75 percent of anaemic pregnant females belonged to the lower socio-economic group. The study revealed that the mean haemoglobin level was also low (9.2 gm. percent) in lower socio-economic group in comparison to that in higher socio-economic group (10.2 gm. percent). Sarna (1976) also observed a positive correlation between monthly per capita income and haemoglobin levels. Chaudhury (1939) reported that majority of anaemic pregnant women in his series, were from lower middle class.

The relationship of anaemia of pregnancy with other socio-economic factors like educational status of pregnant women and their husbands, caste, occupation etc. have been studied by very few workers and literature on it is very meagre. Chopra et al (1967) observed in Trinidad, that the race of the pregnant lady had little or no influence on the incidence of anaemia. Medalie (1965) also could not demonstrate any significant relationship between haemoglobin values and education.
(vi) **Dietary Factors.**

(a) **Dietary Habits** - Upadhyaya (1944) observed that there was no case of anaemia in the non-vegetarian group, which used meat, fish or eggs in addition to vegetable diet. Das et al. (1967 b) reported that in a series of 181 anaemic pregnant women, 83 percent were found to be pure vegetarian. Dawn (1973) observed a significant association between prenatal dietary habits and various grades of anaemia. However, Todd and Kan (1965) could not find any significant difference between diets of anaemic and non-anaemic pregnant ladies in Hong Kong. Gopalan et al. (1969) also reported that diet of pregnant women was not much different from the usual diet of the non-pregnant women.

Vijayalakshmi et al. (1975) observed that none of the 40 expectant mothers included any special foods in their diets during pregnancy. On the other hand, 25 percent were particular to avoid certain foods like pumpkin ashgourd, jackfruit etc. due to various erroneous believes.

A study of dietary intake in Gauri village of Lucknow (Singh et al. 1971) revealed that the majority of the population was vegetarian and even those who were non-vegetarian, consumed hardly any flesh food.

(b) **Calorie Intake** - Parvatha (1958) observed that, in Coonoor, mean intake of calories by the pregnant women was approximately 1,900 calories. However, there were only
3 percent women belonging to 1st trimester when the food consumption is said to be low. Bagchi and Bose (1962) reported a positive correlation between socio-economic status and calorie intake, in pregnant women of Calcutta.

Shanker (1962) observed, in his study of low income women of Hyderabad, the average calorie consumption as 1,390, 1,520 and 1,650 per day during 1st, 2nd and 3rd trimester respectively. Chopra et al. (1967) found the daily mean calorie intake for pregnant and non-pregnant women to be 1,698 and 1,713 respectively. The study conducted by Vijayalakshmi et al. (1975) revealed mean calorie intake of 1,716 per day in higher socio-economic group as compared to 1,503 only in lower socio-economic group.

(c) **Protein Intake** - Protein intake, as reported by different workers, varies a lot depending upon the regional variation, population characteristics, socio-economic status and religion.

Shanker (1962) observed a mean daily intake of 40 gms of protein in pregnant women. Chopra et al. (1967) reported a mean intake of 59.1 and 56.1 gm. in non-pregnant and pregnant women respectively. Gopalan (1969) found a mean intake of only 37 gm protein in pregnant women of Hyderabad. Singh et al. (1971) in their study in a rural population of Lucknow, observed a mean daily intake of
71.8 gm. protein. Vijayalakshmi et al. (1975) reported a mean intake of 36 gm. in lower socio-economic group while in higher socio-economic group it was 47 gm.

(d) Iron Intake - The average daily intake of elemental iron per person had been estimated to vary from 12 to 40 mg. in India (Foy and Kondi, 1957). Shanker (1962) observed that the dietary iron intake in pregnant women was satisfactory. Gopalan (1967) also reported that the average Indian diet seemingly contains adequate amount of iron. Singh et al. (1971) found an average intake of 22.3 mg. of iron in rural population of Lucknow. Sood (1967) reported that the estimated dietary iron ranged from 30-50 mg. per day. Banerjee et al. (1968) and I.C.R.I.R. (1975) have accepted a relatively higher iron content in average Indian diet. However, the high phytate and low calcium and ascorbic acid content in Indian diet have been shown to restrict the availability of iron and also inhibit its absorption (Apte and Venkatachalam, 1962, 1964 and 1965).

Few workers, however, have reported a lesser intake of dietary iron. Shanker (1962) observed a mean daily dietary intake of 16.8 mg. iron in pregnant women. et al. Menon (1964) reported a still lower intake (9 mg.) in his series of cases.
(e) Dietary intake of folic acid and Vit. B₁₂ - Very scanty literature is available on the dietary intake of folic acid and vitamin B₁₂; the reports correlating the intake of these nutrients and anaemia are also not available. Mehta (1971) reported that out of 143 anaemic cases, 67 percent had inadequate folate in their diet. Kuria (1976) observed that the mean daily folic acid intake of pregnant women was only 54.1 mg. per day.