The review of literature pertaining to this study is dealt with under the following heads:

A. Nature And Extent Of Nutritional Demands During Pregnancy

B. Existing Diets Of Expectant Mothers In India

C. Prevalence Of Nutritional Disorders Among Expectant Mothers

D. Consequences Of Maternal Malnutrition

E. Methods Of Assessing The Nutritional Status

F. Factors Affecting The Nutritional Status Of The Infants

G. Studies On Breast Milk

H. Role Of Specific Supplementation Programmes

1. Applied Nutrition Programmes

2. Prophylaxis against anemia programmes

3. Massive dose of vitamin A with iron Supplementation.

A. Nature And Extent Of Nutritional Demands During Pregnancy

Health and happiness are the outcomes of good nutrition. Good nutrition in infancy, childhood and throughout the life span is of paramount importance in fostering the physical, mental, emotional and social growth of the population (Devadas, 1970). Therefore a child who is in a state of good health will be happy, active, creative, alert and bright.
Requirements of most nutrients are known to increase during pregnancy (MIL, 1975). Manocha (1972) is of the opinion that improved nutrition of the mother during pregnancy has a profound effect on the infants birth weight, its chances of survival as well as learning abilities.

According to Gopalan and Jaya Rao (1972) pregnancy is a period of physiological stress during which, the expectant mother has to cope up with the needs of her own tissues, which enlarge to accommodate the products of conception and supply essential nutrients to the foetus. Giroud (1973) states that the embryo is a richly growing organism which required simultaneously, body building and energy producing materials. The Quantitative requirements are very small at the beginning but increase more and more until birth, and there after for nursing. Ramalingaswamy (1975) has pointed out that a biological continuity exists between the mother and foetus during pregnancy, followed by an emotional and functional continuity between her and the growing child. Leichtig et al., (1975) opine that like any other organism, the growth of the foetus depends on the provision of the nutrients from the mother and on their metabolism. The human foetus synthesizes its own carbohydrates, amino acids, and other short chain metabolites transferred from the mother to the foetus.
Thompson and Mytten (1966) point out that pregnancy involves a gain in weight of about 12.5 Kg accounted for by the foetus, placenta, liquor amni, increase in the size of uterus, mammary glands and maternal blood. They further estimate the gain to be of the order of 0.65, 4.0, 8.5 and 12.5 Kg at 10, 20, 30 and 40 weeks.

The increase in nutritional requirements is very great in pregnancy as it is essential not only for the child’s growth but also to accommodate the changes in the body composition. According to Vijayalakshmi et al., (1973) the reproductive cycle makes a huge demand on the nutrient requirement of the mother and affects her nutritional status considerably and hence of the infant should start right from the time of conception.

Srikanthia (1975) exhorts that the diet of a mother during pregnancy is one of the most important factors for a healthy baby and for her own self, for it is a period of physiological stress during which the expectant mother has to cope with both the needs of the growing foetus and those of her own tissues. To meet the increased needs the FAO/WHO expert Committee (1973) has recommended an increase of 265 K.cal/day over the 280 days of pregnancy or about 150 K.cal/day in the first trimester and 350 K.calories/day in the second and third trimesters. Gopalan and Rao (1977) recommend 300 K.calories/day in the latter half of pregnancy.
The energy needs increase specially during the last trimester. Hence Kaminetsky et al., (1973) warn that if the energy content of the diet is low, some of the valuable protein may be utilised for providing energy.

Thompson and Hytten (1966) and Gopalan and Karasinga Rao (1977) have laid down the quantity of protein required during the 10th, 20th, 30th and 40 weeks pregnancy, to be 32g, 235g, 540g and 940g respectively. King et al., (1971) observe that even an allowance of 65 g/day of protein during pregnancy is not adequate to permit maximum protein storage during the third trimester. Devadas (1972) opines that during the latter half of pregnancy the protein intake of the mother should be increased by 20 per cent over her nonpregnant requirement. Chandrasekhar (1972) estimates that on an average pregnancy needs 900–950g of proteins for the total period of pregnancy in addition to the amount normally needed by the woman before they become pregnant. Rao and Kao (1974) express that the extra protein during pregnancy is utilised for the growth of foetus and other accessory maternal tissues. As recommended by FAO/WHO expert group (1969) an allowance of 10 per cent for individual variability is allowed. This allowance comes up to 10g/day thereby making the protein allowance 65g/day for an average expectant mother with a body weight of 45kg.
The expectant mother's need for iron increases greatly during the latter part of pregnancy. In a normal pregnancy, the mother will need to absorb and utilise 700-1000mg of iron for her own and the foetal requirements (Macy, 1968). Iron balance studies carried out on expectant mothers during the three trimesters by Apte and Iyengar (1970) confirm that an intake of 40mg of dietary iron per day is necessary to meet the total iron demands during pregnancy. Physiological adaptations appear to have a role in partly meeting the increased demands as in the case of iron, where the absorption increases as pregnancy advances.

Calcium is a nutrient of great importance during pregnancy. The calcium requirement of an expectant mother is about double that of the non-expectant mother. An intake of one gram of calcium per day throughout pregnancy is sufficient, according to Damodaran (1975).

The vitamin requirements also increase during pregnancy. The thiamine, riboflavin, and niacin allowances are increased in proportion to the calorie increase. The need for vitamin D is increased during pregnancy to facilitate the utilisation of greater amounts of calcium and phosphorus. The report of BNF Bulletin (1973) and Gopalan and Narasinga Rao (1977) indicate that requirement of folic acid is increased in
pregnancy. Due to excess excretion of folic acid in urine, a daily intake of 50 mcg of free folic acid in normal adults is insufficient for expectant mothers. Supplementation studies by Iyengar (1971) indicate that the minimal requirement of folic acid to maintain serum folate levels late in pregnancy is around 300 mcg per day, while 500 mcg per day is desirable.

As against such a great demand for calorie and nutrients during pregnancy, the existing diets are inadequate in quality and quantity as can be observed from various studies, presented in the following chapter.

B. Existing Diets Of Expectant Mothers In India

There are three important population groups who suffer from the ill effects of malnutrition. These vulnerable segments are the preschool children, expectant mothers and nursing mothers. The diet of a mother during pregnancy is one of the most important factors in achieving a successful outcome in terms of a healthy baby and maintenance of her health. (Srikantia, 1975). Gopalan and Rao (1972) estimate that women of child bearing age (15–45 years) constitute 1.2 per cent of the population in India and their nutrient intake is grossly deficient when compared with the recommended allowances.
Gopalan et al., (1962) found that the diet of expectant mothers during pregnancy was no different from that during nonpregnant periods. None of the mothers surveyed believed that pregnancy called for increased demands. Infact, they felt that dietary restriction might actually be beneficial for their pregnancy. Lechtig et al., (1971) and (1975) spins that maternal morbidity during pregnancy is highly prevalent in the low socio economic groups in which endemic protein calorie malnutrition is present.

Swaminathan (1968), (1971) puts forth that the results of a large number of diet and nutrition surveys carried out during the past 30 years have shown that the diets consumed by the general population consist predominantly of cereals and contain small amounts of legumes and vegetables and negligible amounts of protective foods (milk, egg, meat and fish). Dawn (1973), found milled and parboiled rice, pulses and some vegetables as the major ingredients in the diets of 282 poor and lower middle class primigravid women aged 13 to 30 years during their last trimester of pregnancy.

Very often, diets of expectant mothers provide only 1600-1900 calories and 30-40 g of protein (Rajalakshmi, 1975). Consequently such an inadequate dietary intake and ill-spaced pregnancies, place very high burden on the mother leading to
ill-effects on her health. Surveys carried out in South India by Pasricha (1958), Gopalan (1961), Devadas (1966), Srikantia and Iyengar (1972) and Prerna (1978) reveal that the diets of poor women during pregnancy provide 1400-1500 calories and about 40g protein per day, all protein being of vegetable origin derived mostly from a single cereal. Kapur et al. (1971) studied the dietary intake of 1652 expectant mothers and found that most of them were non-vegetarian. However, in the lower socio-economic groups, this meant a frequency intake of meat about once a month only.

Sukhatama (1972) has indicated that 49 per cent of the households in Tamil Nadu and 17 per cent in Bihar do not get adequate calories. On the other hand, incidence of households with inadequate protein intake was found to be 34 per cent for Tamil Nadu and 5 per cent for Bihar.

The results of many dietary surveys carried out among women belonging to the poor income classes reveal that the diets are inadequate with respect to many nutrients even during the non-pregnant state and their diet remains essentially unaltered during pregnancy, (Rae 1975). On an average, an expectant mother in India subsists on diets which supply about 1800 calories, 45 g protein, 18-20 mg of iron and 200-300 mg of calcium per day. Vijayalakshmi et al., (1975)
conducted a three day weighing survey on 40 expectant mothers belonging to a low income group in Coimbatore and found the intake of all the expectant mothers to be lower than the allowances recommended by ICMR with respect to calorie and all the nutrients.

The ICMR (1977) reports that the diet surveys from different parts of the world and India indicate that the diets of expectant and nursing mothers belonging to poor socio-economic groups are not only deficient in quantity but also in quality.

Devadas (1968) has pointed out that the current dietaries of the poor segments of the population in different parts of India are highly unsatisfactory. The prevalence of frank signs and deficiency syndromes of malnutrition, particularly among the vulnerable sections of the population, infants, growing children, expectant and nursing mothers have been discussed by Banik (1973). The dietary intake during the first trimester of pregnancy among 20 non-privileged and 10 privileged primigravid, was inadequate in all the nutrients except for calcium and riboflavin. Gopalan and Rao (1972) observed that families with three or less children have a better intake of energy by 300 calories, and proteins by 10g daily than families with four or more children.
Thompson \textit{et al.}, (1974) studied the nutrient intake of expectant mothers receiving vitamin and mineral supplements and found that the youngest of the groups had the greatest need for the supplements. Baker \textit{et al.}, (1975) studied the vitamin profile of 176 mothers and showed that the higher incidence of hypovitaminosis was in those not taking vitamin supplements.

Devadas (1972) studied expectant mothers in Tamil Nadu, on food intake and food avoidance in the various physiological stages of life. Avoidances included meat, fish, eggs, butter-milk and curds, certain fruits (eg. pineapple, jack fruit, papaya), gourds, green vegetables, sweet potatoes, groundnuts and all 'cold' and 'hot' foods. All abstentions were primarily conceived in the interest of the baby to whom harmful influences may be transmitted.

Parveen and Umapathi (1976) studied the food habits of 500 expectant mothers in Mysore city belonging to different economic groups. Their study revealed that the primary foods avoided during pregnancy were papaya, egg, sesame, and jack fruit. Milk with kesar was believed to improve baby's complexion. In general, the avoidance of consumption of foods was centered around the hot or cold concept of foods. Food beliefs were influenced by family income and educational levels of the couple. Similar results were reported by
Cardenas et al. (1976) from the study of Mexican American women. Dhillon (1976) says that beliefs of the expectant mothers about hot and cold foods ends up in her eating too much or too little food, which results in an imbalanced diet.

Thiagarajan (1977) and Krishnamoorthy (1977) report that the expectant mothers surveyed in Olappalayam village said that papaya, gingerly seeds and pineapple cause bleeding and miscarriage because of their intense heat. Venkatachalam and Rebello (1971) opine that the diet of the South Indians are mainly rice, supplemented with a little pulse and vegetables. Often, a ground mixture of dry chillies and salt is kept as a stand by when vegetables and pulses are not available. Milk is used only in tea and coffee.

Eggs and fruits are used only on festive occasions. Usually two main meals are eaten and necessarily they have to be uncomfortably bulky to satisfy their needs.

Nutrition workers (Iyengar 1968; Gopalan and Vijayaraghavan 1971; Paarisha, 1973; and Report of the Region 1 workshop on planning diet for health, 1979) have emphasized the need for adequate diets for the expectant mothers, which are not different from the usual diets of the non pregnant mothers but are grossly deficient in protective foods like milk.
pulses and leafy vegetables and even staple cereals. As a result, there is a wide prevalence of malnutrition among expectant mothers, which is reviewed in the next chapter.

C. Prevalence of Nutritional Disorders Among Expectant Mothers

Sood (1966) studied the incidence of anaemia in Delhi. In institute hospital, the incidence of anaemia was 27.3 per cent. In the corporation centres it was 43 per cent. Among the 106 expectant mothers surveyed in the rural areas, 47 per cent were anaemic. Gajwani et al., (1968) indicated that in India about one third of the cases of pregnancy anaemias are dimorphic in nature that is, there is a combined deficiency of iron, folic acid and B$_{12}$.

Numerous surveys on the prevalence of anaemia in different parts of the country such as Calcutta, Hyderabad, Madras, New Delhi, Trivandrum and Vellore have shown that 30-70 per cent of women in the latter part of pregnancy have levels of haemoglobin below 10 per cent (MIN 1968; Gopalan, 1971; Yasuaka et al., 1975, and ICMR, 1975). Iron deficiency anaemia is the commonest type and its high prevalence among expectant mothers presents a serious health problem (WHO, 1963). A haemoglobin level of less than 11 g/100 ml in the second trimester and 10.5g in the third trimester is indicative of anaemia in pregnancy (WHO, 1975).
The NIN (1972) reports that the incidence of severe anaemia was significantly different between women having three pregnancies or less and those with four pregnancies or more. Thus about 8.8 per cent of all women, whose order of pregnancy was four or more had severe anaemia, with less than 9g per cent haemoglobin, while only 3 per cent of women whose order of pregnancy was three or less had severe anaemia. On an average more than 65 per cent of severe or moderate anaemia exists among these expectant mothers having higher number of pregnancies. Iron deficiency affects expectant mothers owing to the extra demands of fetal placental and decidual tissues for iron as well as for the 10-15 per cent expansion of maternal red blood cell mass accompanying pregnancy. (Callendar, 1972 and WHO, 1975). The study of Rajalakshmi (1975) shows that about 1 out of 5 of our expectant mothers suffer from severe degrees of anaemia, as judged from their blood haemoglobin levels.

Gopalan and Rao (1972) observed that in India as much as 20 per cent of all maternal deaths are reported to be directly attributable to nutritional anemias where it is an important aggravating factor in an additional 10-20 per cent. Nutritional anaemia, arising as a result of deficiency of iron, folic acid and vitamin B12 either singly or in combination, is one of the most important public health problems facing many developing countries (Swaminathan, 1968 and Kalamasz and Krishnaswamy, 1977).
Folate deficiency in pregnancy may be associated with an increased prevalence of a variety of obstetric conditions such as abruptio placenta, abortion, fetal malformation, still birth, neonatal death, low birth weight, prematurity, toxemia and post partum haemorrhage, (WHO, 1968). However, most of these relationships have not been adequately established (Rothman, 1970).

The materials essential for erythropoiesis are broadly iron and the so called anti anaemia factors folic acid and vitamin $B_{12}$, the deficiencies of which are responsible for anaemia in pregnancy. The megaloblastic anaemias produced by deficiency of vitamin $B_{12}$ and folic acid are an important group of anaemias. They are major haematological problems in South India because of the deficient diet and high incidence of mal intestinal and absorption, (Freedom From Hunger Campaign, WHO, 1963; Menon, 1967; Mathan, 1967, and ICMR, 1968).

Menon (1967), Chanarin et al., (1968) and Takeuchi et al., (1975) point out a significant fall in folate levels in pregnancy. In megaloblastic anaemia the serum folate level drops further but the drop in serum $B_{12}$ level is not statistically significant. In certain patients deficiency is increased when anaemia complicates pregnancy, which might be due to deficiency of folic acid and not of $B_{12}$. 
Mudaliar and Manon (1969) point out that in India well-to-do women, free from parasites and living on good diets, maintain their haemoglobin levels comparable to their counterparts in the West. However, a study of the so-called normal expectant mothers attending the hospital has revealed that the average haemoglobin level is about 10.5 g per cent. The serum folate levels in normal pregnancy was found to be 11.4 mg/ml and the t of anaemic expectant mothers were 6.22 mg/ml. Aykroyd (1970) pointed out that in India nutritional anaemia is a major problem among agricultural labourers, tea-garden workers and especially among expectant and nursing mothers. The condition is most severe in pregnant women and is due to iron deficiency in 85 per cent (8g/100ml).

Dietary deficiency, multiple pregnancies, hookworm and other infestations were the common causes of anaemia according to Mahta and Bethiar (1973) who found that 60 per cent of the patients suffering from these difficulties had haemoglobin levels between 6-9g/100ml.

Iron deficiency is widespread among expectant mothers throughout the world. It is widespread in India in spite of seemingly adequate intake of dietary iron. One of the important reason for this paradox may be poor absorption of dietary iron. Mean iron absorption from Indian foods were found to be 10 per cent by NIN (1975).
Bash et al., (1973) Kariyama et al., (1975) consider relatively poor iron intake, increased requirement of iron for growth and pregnancy, or pathological bleeding, to be the causes of iron deficiency.

Chanarian and Rothman (1971) conducted a study to determine whether iron deficiency in pregnancy predisposed development of folate deficiency and also the smallest iron supplement that maintained the levels in pregnancy. Three groups of women were given oral ferrous fumarate supply of 30, 60, 120 mg of iron, a fourth group was given 1 g of parenteral iron in early pregnancy followed by oral iron 60 mg, a fifth group received a placebo taken once daily. The group supplemented with oral iron 30 mg once daily, maintained haemoglobin levels throughout pregnancy. Women whose marrows lacked demonstrable iron at the 37th week, had a significantly higher incidence of megaloblastic anaemia.

Apte et al., (1971) studied the effect of antenatal iron supplementation of placental iron. The mean total iron in the placenta from women who had no iron during pregnancy, 10 placentas from women who had 60 mg iron daily and 6 placentas from women who had 200 mg iron daily during last trimester was, 33, 35 and 57 mg, respectively. It is suggested that 60 mg daily as a supplement would ensure adequate transfer of iron to the foetus.
Hore et al. (1978) and Adams et al. (1978) studied the effect of folate supplementation in pregnancy. Although there was no significant association when the prenatal nutrient intake was compared with the birth weight of infants, there was a trend to increased birth weight with additional amounts of dietary protein.

Iyengar and Apte (1970) report the results of a prophylactic trial for the prevention of pregnancy anaemia. Groups of expectant mothers between twelve and twenty-four weeks of gestation were given daily supplements of either 30 mg iron or 30 mg iron with 500 ug folic acid or 30 mg iron with 500 ug folic acid and 2 ug vitamin B₁₂. An unsupplemented group served as control. Sixty per cent of subjects in the unsupplemented group showed a progressive fall in haemoglobin levels with advancing pregnancy, whereas in the other 40 per cent the levels remained stable. In the three supplemented groups only 6, 10 and 14 per cent of the subjects showed such a fall whereas the remaining subjects showed their stable levels or an actual increase. It is suggested that daily supplements of 30 mg iron given during the last 100 days of pregnancy is adequate to maintain satisfactory hematological status during pregnancy.
Across sectional study among expectant mothers of low income groups, who had not received any antenatal care, indicated that with advancing gestation there was a progressive fall in the concentration of serum folic acid and during the last trimester, nearly 60 per cent of women had levels below 3 ng/ml. Hibbard and Hibbard (1971) reported that defective folic acid metabolism is at least a contributory factor in many cases of pregnancy anaemia, abortions, abruptio placentae and prematurity. The birth weights of infants born to mothers who had received either 200 or 300 ug of folic acid daily were higher than those born to mothers who had not received any supplements.

The NIN (1961) reports that the concentration of serum vitamin A and carotene was found to be lower in expectant mothers than the figures reported from Western countries. Gradual and significant fall of vitamin A concentration in the serum of expectant mothers, was observed with advance of pregnancy. In a sample of 1404 expectant mothers 25 per cent had oedema - 14.2 per cent slight 8.7 per cent moderate and 2.1 per cent severe. Those above 30 years exhibited more oedema than younger women. Its incidence in the first gravida and fifth or higher gravidas was similar but the third gravidas had the lowest (19.6%) oedema. Toxemia in pregnant woman,
which is characterised by high blood pressure, swelling of face and limbs and loss of protein in urine is an important cause of maternal death and can also adversely affect foetal growth and development (WHO, 1962) and (Bhaskara, 1975). A high prevalence of eclampsia is reported in mothers of low socio economic group than in the mothers of high socio economic group.

D. Consequences of Maternal Malnutrition


When both energy and proteins are in short supply it may result in a serious reduction in body protein - muscles, cells, serum, enzymes and hormones. Williams and Jelliffes (1972) observed that general malnutrition of expectant mothers especially protein shortage may be responsible for babies of lower birth weight and nutritional brain damage. Choudhury (1978) indicates that serum proteins, albumin and globulin in maternal blood are significantly diminished in toxemia of pregnancy. There is a close relationship between the plasma protein levels and degree of toxemia. A similar situation was found in babies born of toxemic mothers. The degree of prematurity had a direct relationship to the severity of toxemia of pregnancy and concurrent diminution of plasma protein levels.
As pointed out by Iyengar and Apte (1970) and Banik (1975), as much as 10 per cent of the maternal deaths are reported to be directly attributable to anemia. Anemia may also lead to prematurity and affect the nutritional status of the newborn.

Bhaskaran (1975) observed that toxemia in expectant mothers is an important cause of maternal death and can also adversely affect fetal growth and development. Villee and Furuya (1975) exhort that up to a point the placenta can supply the foetus with nutrients at the expense of the mother, but if the mother is severely malnourished, she is unable to supply her developing foetus. Severe malnutrition during pregnancy can cause irreversible changes in foetal development, changes which cannot be repaired by feeding after birth. The abnormalities in metabolism and functional disorders resulting from undernutrition during the critical period of pregnancy can persist long after an adequate supply of nutrients has become available (Reeder, 1972).

Bhargava et al., (1976) studied the causes of perinatal mortality based on 643 autopsies in 1365 perinatal deaths among 18,120 single live births for a period of two years. The results showed that antepartum haemorrhage constituted the most common cause of death. Toxemia, malnutrition, maternal diseases and infections constituted other leading causes of deaths.
Devadas (1972) observes that a deficiency of one or more of the B complex vitamins during gestation may prevent the proper use of ingested foods to supply energy, to provide body building materials and to regulate essential processes of the body. Nasey at al. (1973) studied the abnormalities of foetal growth and found that maternal under nutrition before and during pregnancy causes retardation of foetal development in both cell size and number. The effect is manifest particularly after 23 weeks of gestation. According to Roberts et al. (1974) a woman who is poorly nourished prior to pregnancy is much more subject to complications of pregnancy such as toxemia, hypertension, anaemia and premature birth.

The NIM (1968) reports that maternal anaemia affects the intrauterine growth of foetus. In one study, the average birthweight of the infants at term in normal pregnancy of a series of 1000 mothers with haemoglobin levels of not less than 10.5 g per cent was 2.9 kg whereas in mothers with haemoglobin levels less than 8.5 kg per cent, the average birthweight at term was only 2.4 kg. Since 70 per cent of deaths in the perinatal period occur in infants weighing less than 2.5 kg at birth, the role of maternal anaemia in perinatal mortality and premature birth is significant. Platt and Stewart (1971) in the review of various cases of malnutrition
including that of the small-for-date babies, concluded that energy deficiency may lead to the production of underweight infants many of whom will never reach their full physical or mental potential.

According to Venkateshalingam and Rebello (1971) poor maternal diet increases not only the risk of a series of complications during gestation but often results in a difficult and sometimes prolonged labour. Inadequate consumption of foods especially milk and leafy vegetables will lead to a death of certain valuable nutrients, constant withdrawal of these nutrients from the maternal body, to meet the demands of pregnancy, can cause anaemia and soft or bent bones in the mother.

As indicated by Rajalakshmi (1971) Habicht et al., (1973) and Higgen (1974) the low birth weight of the babies is mainly due to the poor nutrition of the mothers. The incidence of still birth is more among poor women living on low planes of nutrition and about 10 per cent of the babies born of such mothers weigh less than 2 kg as reported by Rajalakshmi and Ramakrishna (1972). According to NIN (1975), maternal malnutrition results in a good proportion of small-for-date babies.
The weight of the newborn apart from indicating an increased risk of fetal and postnatal death could be used as an index of the nutritional status of mother and of the community (Fuller, 1978).

Higgins (1976) states that nutritional intervention during pregnancy can have a significant influence on its outcome. Birth weights were significantly higher for the higher primigravid weights and for larger maternal weight gain. There was a significantly negative correlation between haemoglobin level at gestation of 36 weeks or more and birth weight.

Among the factors influencing the weight of the infant at birth are maternal age, maternal height, parity, birth interval, gestational age, obstetric history as well as diet and maternal nutritional status (Prema, 1978).

Banik (1978) showed that multiple factors like improved socio-economic status resulting in better maternal nutrition, proper maternal age and parity are responsible for beneficial effect on birth weight of the newborns and these contribute towards diminishing the incidence of low birth weight babies.

Barasavan and Behar (1978) report that there are about 22 million live born low birth weight babies per year, of whom only five per cent are born in the developed countries
and the rest around 21 million are born in developing areas. The factors attributed are gestational age, mothers size or height, age, parity, socio economic status and morbidity during pregnancy.

Ghosh et al., (1972) and Bhargava et al., (1974) studied the importance of the role of gestation age and intrauterine growth in the outcome of low birth weight babies. Antepartum haemorrhage was more common in babies of birth weight appropriate for gestation while toxaemia of pregnancy and multiple adverse factors like anaemia and chronic infection contributed significantly to severe intrauterine growth retardation.

Naseer et al., (1973) states that low birth weight babies are more frequently born to mothers with small stature and inadequate parental care. Maternal vascular diseases and toxaemia may result in low birth weight secondary to

Fetal and infant loss was high when maternal age was 17 years and below and also when the birth interval was short, according to the report of the MIN (1974).
Factors such as physical activity, prevalence of diseases and magnitude of the maternal nutritional stores before pregnancy are important along with relative contribution of calories and protein to birth weight, according to Lechtig et al., (1973).

According to Sampurnan and Ramakrishnan (1972) and Basu (1977) the weight of the infant is influenced by maternal nutrition. Serious under-nutrition during pregnancy increased the risk of intrauterine growth retardation, prematurity and abortion (Baker et al., 1975).

Philips and Johnson (1977) report that the quality of the mothers diet expressed as a nutrient adequacy ratio was positively correlated with birth weight of the infant. Birth weight was also positively related to the number of weeks of gestation and overall dietary quality. English (1977) reports that restricted weight gain is partially responsible for the low birth weights.

Miller et al., (1978) have shown that cigarette smoking, indulging in certain drugs restricting maternal weight gain in pregnancy, failing to obtain sufficient prenatal care, undertaking pregnancy too early or too late and being underweight for height at conception are identified with increased premature births or small-for-date babies.
According to Rajalakshmi et al., (1978) a positive relation exists between birth weight and maternal height and poor maternal weight gain and placental insufficiency is actually reflected in the lower birth weight and higher incidence of prematurity among the infants. The still birth rate in India is 11 per 1000 births.

Folate deficiency may lead to small placenta, premature labour and low birth weight infants. A study on the effect of folate supplements made no difference when given to well nourished European women. However, when given to Bantu women there was a significant increase in birth weight and virtual disappearance of premature births. It has been suggested by Chanarin and Rothman (1968) that folate deficiency leads to accidental haemorrhage and to congenital malformations. This is unproven and any role of folate would be relatively minor.

Adams et al., (1978) exhort that though 16 per cent of their study group had previously given birth to infants of low birth weight following supplementation with protein and extra calories only one per cent delivered infants of low birth weight. There is evidence that the problem of low birth weight infants from poorly nourished mothers can be corrected by protein and calorie supplements during pregnancy.
A clinical study on 238 anaemic women was done by Rosario (1971). Among the severely anaemic, 48.2 per cent showed a dimorphic picture. The prematurity rate was 37.7 per cent, 64.5 per cent babies had a low birth weight, and perinatal mortality was 242/1000. In the moderate group the prognosis was much better. The perinatal mortality was 18/1000 when haemoglobin was below 9.7 g per cent.

A study conducted in Lady Hardinge Medical College, New Delhi in 1967 shows that 88 per cent maternal deaths were due to anaemia alone. Kenon (1967) found anaemia to be responsible for 20 per cent of maternal deaths.

Winick et al., (1971) have worked on the effects of prenatal nutrition upon pregnancy. They exhort that restriction of protein content of maternal diet retards the foetal growth and vascular insufficiency of the placenta, furthermore liver is retarded in growth and depleted of glycogen and some times brain is also affected.

Lack of adequate nutrition especially protein and calories affects the lactation performance of the mother (FAO/WHO expert Committee, 1973). The average weight of infants born to women eating inadequate and nutritionally poor diets is significantly lower than the average birth
weight of babies produced, by those consuming a nourishing diet
(Venkatachalpam and Rebeilo, 1971; MIN, 1972; 1975; Srikanthia
and Iyengar 1972; Adams et al., 1978, and Sharma et al., 1978

Paige et al., (1975) report, that even short term
increase in energy and protein and other nutrients will result
in an improved gestation and a decline in low birth weight
infants.

Systematic observations on both rural and urban
women belonging to the poor socio economic groups who were
consuming diets providing less than 1500 calories and about
40 g of protein (mostly from vegetable sources) made by Parvathi
Rau (1977) showed that there was a pregnancy wastage of about
20-30 per cent. The nutritional demands of pregnancy and
lactation super imposed on women living on marginal diets
were reflected as adverse effects on their health.

Sharma et al., (1978) summarise the effects of
obstetric complications on the newborn. The neonate is adversely
affected by toxemia of pregnancy leading to a high incidence of
low birth weight and preterm by, high morbidity rates, increased
incidence of asphyxia, and prematurity leading to high prematal
loss.
Thus, maternal malnutrition results in infantile malnutrition and affects adversely the formative years of human life and impairs the physical and mental growth, as rightly pointed out by Devadas et al. (1977) and WHO (1976).

2. Methods Of Assessing The Nutritional Status

Morgan (1955) defines nutritional status as "The state of health of the individual or group as conditioned by the choice and amounts of food, and the nutrients taken". Many methods have been developed to study the nutritional status of expectant mothers and to correlate their dietary intakes with the changes occurring during pregnancy as well as the health of the mother and the newborn infant. Jelliffe (1966) and Davidson et al. (1973) suggest the following methods for assessing nutritional status. They are,

1. Diet Surveys
2. Anthropometric measurements
3. Clinical examinations

1. Dietary surveys

Jopalan (1961) and Hollingsworth (1961) point out that diet surveys directed towards the vulnerable segments of the population are an essential prerequisite to obtain baseline information for any programme designed towards the
betterment of their nutritional status. According to Swaminathan (1974) it is very important to have a detailed knowledge regarding the diets actually eaten by the community both for assessing their nutritional adequacy and for taking steps for correcting deficiencies in the diets.

Hussmann (1973) and Devadas (1975) point out the need for dietary and food consumption surveys in attempting to assess the nutritional status. Devadas et al., (1967) and Sundararaj et al., (1969) recommend the food weighing method as the best method among all the available food consumption survey methods.

A study was conducted to assess the efficiency of random one day food weighing studies as compared with that of a conventional 7 day dietary survey method by Rao (1975). Data were collected on 155 families of low socio-economic status in the industrial area of Ahmedabad. Cumulative day averages (2 day 3 day or more up to 7 day) and random day estimates agreed well with one another. Thus any single day or two or three day weighing would be as efficient a tool as a 7 day food weighing study.
2. Anthropometric Measurements

Anthropometric measurements of various physical dimensions have been used for decades in nutrition studies. According to Jelliffe (1966) it is the best index of cumulative effects of nutrition. Swaminathan (1974) opines that anthropometric measurements are useful criteria for assessing nutritional status.

The anthropometric measurements which are commonly employed in nutrition surveys are weight, height, sitting height, skinfold thickness at selected sites and calf, arm, chest and head circumference. According to Viswanathara Rao and Singh (1979), these data are useful to assess the nutritional status of the communities.

Body weight is generally accepted to be a practical parameter of nutritional status. In order to evaluate and interpret body weight changes correctly, corresponding data on heights are useful and several indices based on height and weight have been employed by workers like Billivicos (1962), Singh and Harold (1963), Jelliffe (1966), Khoala (1967), Viswanathara Rao and Singh (1970), and Ghosh (1977). Davidson et al. (1973) consider that measurements of weights of adults and of large groups of children at various ages are a valuable index of nutritional status.
Birth weight is one of the major indices indicating the maturity of newborn infants. It also reflects the health of the expectant mother, the extent of antenatal care she has received and the prevailing nutrition and socio-economic conditions of the community. According to Gupta (1971) and Doyal et al. (1972) birth weight is also an index of the nation's health. The readings at birth are most basic and essential because the child's future pattern will be dependent on those parameters. Sidhu and Anand (1972) opine, in a sample of 1,729 infants, the average birth weight of boys was 3,020g and of girls 2920g. In all the birth orders boys were heavier than girls by 3.4 per cent. The birth weight of 74 per cent of the new born were between 2000 and 3000g. The mean length of the new born was 48.75 cm. The mean head circumference was 30.24 cm.

Mukherjee and Sethna (1970) conducted an anthropometric study at the Urban Health Centre, Chatla. They found that male infants were heavier than female. The mean weight of boys was 2730g, and that of girls 2636g. They also found that with an increase in age of mothers, the mean birth weight increased up to 25-30 years after which it showed a slight fall.
An anthropometric study was conducted by NIM (1973) on 595 new borns at Niloufer hospital Hyderabad. These infants were born to mothers who had no antenatal complications, and all single births. Results indicated that there was no sex difference in birth weight and morbidity and suggested that 2250g may be considered as the criteria for birth weight for selecting new borns who require greater neonatal care.

Berger and Sesser (1971) state that low birth weight is a major factor in neonatal and infant mortality and subsequent progress is less favourable than for infants of normal birth weights.

Puri et al., (1977) showed that the anthropometric measurements of new borns remained lower in females than in males and of these only the length showed a significant difference. Sharma et al., (1979) report that all the physical measurements of infants tended to be lower than those for the western counterparts.

Srivastava et al., (1978) studied 50 small-for-date infants and 50 full-term appropriate for date (control) babies longitudinally for a period of six months, to determine physical growth and morbidity pattern. Small-for-date babies when compared with the control group remained small in all the physical
parameters of growth (weight, length, head and chest circumference) through the first six months of age. Also, the small-for-date babies had a higher frequency and duration of illness than the control group.

Anthropometry in pregnancy

Damodaran (1975) has stated that normally a woman gains about 10-12 kg of body weight during pregnancy if her diet is nutritionally adequate. Of this 3-3.5 kg are accounted for by the foetus, about 4 kg, by the fat accumulated by her and the rest by placenta, membranes and fluids incidental to pregnancy. According to Wynn and Wynn (1975) severe restriction of weight gain will increase the chance of prematurity of small-for-date babies. Thus a desirable weight gain during pregnancy will indicate the sound nutritional status of the mother.

According to Kajalakshmi (1971), (1975) the expectant mothers gain weight regularly from around the 10th week of pregnancy. The weight gain during pregnancy of the expectant mothers of developed countries and those belonging to well to do groups, in India is in the order of 12 kg. Among the women of the poorer sections in India this figure is around 6 or 7 kg.

Mallika (1974), studied maternal height and reproductive performance. The results indicated that the prematurity and perinatal mortality rates were lower in tall women in contrast to the shorter ones.
Kuntal et al. (1973) advocate weight gain and increase in fundal height as indices of foetal growth in normal and toxemic pregnancy. They conducted an anthropometric study on 115 patients attending an antenatal clinic. The results showed that the maternal weight gain is directly proportional to the birth weight of the babies. Vijayalakshmi et al. (1975) recorded the weights of expectant mothers belonging to a low income group in Coimbatore and found that the weight gain during pregnancy ranged from 5.4 to 6.5 kg.

There is a steady positive correlation between the birth weight and crown heel length of the infants and the height and weight of mother, according to Kapur et al. (1962).

Accurate assessment of gestational period is of practical importance not only for therapeutic purpose but also in research on foetal physiology. Though the foetus is viable around 26 to 36 weeks it is usually taken as a premature baby. At about 36 weeks the foetus is usually viable and may not require any special care. Prasad (1974) states a woman's nutritional status during pregnancy and the length of gestation are important in determining the extent of foetal growth. In 36 newborn babies, significant correlation was observed between maternal serum protein and cord serum protein and between the creatinine content of liquor amni and baby's birth weight.
The term 'perinatal mortality' means still birth and neonatal deaths. The WHO (1967) has defined it as a sum of late foetal deaths with gestation of 28 weeks or more, early neonatal deaths until the end of the first week of life. Gopalan (1973) pin points that the still birth rate in relatively undernourished countries is higher than in the other parts of the world. The still birth rate in India at present is 11 per 1000 live births. A major cause of still birth is prematurity. Prematurity is also the major factor underlying neonatal mortality.

3. Clinical examinations

According to Swaminathan, (1974) clinical examination is the most essential part of all nutritional surveys, since it is objective and assesses levels of health of individuals and population groups as influenced by the diet.

Nirmala et al., (1963) found that among the expectant mothers attending two hospitals in Coimbatore, 33 per cent of the subjects had anemia, 10 per cent had angular stomatitis, 2.3 per cent had bleeding gums and 5 per cent had glossitis.

Vijayalakshmi et al., (1975) conducted a clinical examination on 40 expectant mothers and found that 20 per cent of them had anemia, 40 per cent had angular stomatitis and 50 per cent had discoloration of hair.
The MIN (1961) reported that on clinical examination, nearly a third of the expectant mothers showed signs of vitamin B complex deficiency in the third trimester and six per cent exhibited conjunctival signs of vitamin A deficiency.

4. Biochemical determinations:

Arroyave (1960) has defined the biochemical methods as those which measure directly the supply of nutrients to the body and those which detect the biochemical changes indirectly reflecting metabolic alterations. Biochemical examinations of the expectant mother, can give the extent of malnutrition present. Variations in the intake of different nutrients present in the diet are reflected by changes in the concentration of the corresponding nutrients or metabolites in blood, tissue and urine. Hence biochemical estimations can reveal the sub-clinical state of deficiency due to lowered intake or absorption or impaired transport or abnormal utilisation of a nutrient. Pregnancy causes the regulatory and functional mechanisms of body to be thrown out of balance. Several biochemical changes occur in order to meet the requirement of the growing foetus. Hence estimation of biochemical metabolites may be of great use in assessing the nutritional status of expectant mothers.
Gopalan (1961), Venkatachalam (1962) and Nizams et al., (1966) state that the estimation of biochemical metabolites like retinal may be of use in assessing the nutritional status of the expectant mothers.

The concentration of haemoglobin and total serum proteins are among the commonly used biochemical determinations to assess the nutritional status in population groups. According to Bansi (1961), Jelliffe (1966) and Morse (1975) the level of haemoglobin in the blood is an useful index for assessing the nutritional status. Measurements of haemoglobin concentration can provide information on the prevalence of Anaemia (WHO, 1972).

Sankar (1962) reported that the average haemoglobin level for 394 expectant mothers whose diets were inadequate was 11.4g per cent during the third trimester. In a study with 42 subjects Venkatachalam (1962) found that the mean haemoglobin level was 11.2g per cent during the third trimester.

Hashmi et al., (1973) conducted a study in 889 women at an antenatal clinic in Karachi. The mean haemoglobin was 9.6 g/100 ml, and 64 per cent of women were anaemic with haemoglobin less than 11g/100ml. Mehta et al., (1971) observed that the most common causes of anaemia of pregnancy were
deficiency of iron in the diet, repeated pregnancies and hookworm infestations.

a. Serum protein levels of expectant mothers

Bansi, (1961) found that the changes in the proportion of albumin and globulin is a valuable indication of protein nutrition. Therefore analysis of serum protein and its fractions provides useful information on the nutritional and health status of expectant mothers.

Shankar (1962) found a progressive fall in the concentration of total proteins and albumin in the plasma as pregnancy progressed in a group of women who received an inadequate diet. The fall of the albumin exceeded that of the total proteins in the blood. Seaton (1964) confirmed that the total serum protein concentration and albumin levels and the albumin and globulin ratio fall during normal pregnancy. Menon (1967) conducted studies on protein fractions and showed that in pregnancy, there is a drop by 1 gram in the total proteins and that in anaemia there is a further drop. The plasma proteins, especially, albumins are greatly reduced in protein depletion, (Jelliffe, 1966). Therefore, poor nutrition can be assessed by the estimation of plasma proteins. A biochemical study conducted by Choudhury (1974) indicated that serum proteins, albumin and globulin in maternal blood
are significantly diminished in toxaemia of pregnancy.
There is a close relationship between the plasma protein
levels and the degree of toxaemia.

Vijayalakshmi et al., (1975) estimated the total
plasma protein on 40 expectant mothers in Coimbatore and
showed that the total plasma protein and albumin contents were
high in women receiving an adequate diet.

The impairment of vitamin A transport due to decrease
in plasma protein has been suggested by Arroyave (1964).

b. Serum iron levels of expectant mothers:

As serum iron reflects the status of iron stores,
it is possible that the maternal iron determines the iron
status of the infant (Soed, 1967).

Memon (1967) found that there is, in pregnancy, a
definite drop in the serum iron and an increase in the iron
binding capacity of the serum. Sharma et al., (1970)
measured serum iron and haemoglobin concentration in 39
expectant mothers. In 15 mothers the serum iron concen-
tration was above 50, the mean value being 74 ug/100ml.
C. Serum vitamin A levels during pregnancy

Studies conducted by Gopalan (1962), Matler and Wakefield (1971) and Gal and Christine (1974) on expectant mothers to know the serum vitamin A and carotene levels, showed a gradual fall of serum Vitamin A in pregnancy. Gal and Parkinson (1974) studied the effects of nutrition and other factors on expectant mothers serum vitamin A levels. Serum vitamin A and carotenoid concentration of 133 women were estimated during pregnancy and post partum. The physiological pattern, showed a decrease in the first trimester, followed by an increasing trend in both Vitamin A and carotenoids as pregnancy advanced. Towards the end of pregnancy, vitamin A levels again decreased but rose again after delivery almost returning to non pregnant levels by 6 weeks post partum. The season, multivitamin intake, maternal age, parity, social class, lactation and foetal sex influenced the vitamin A status.

d. Serum folate acid levels of expectant mothers:

Iyengar (1971) observed that levels of folate in plasma have been shown to progressively fall with advancing pregnancy and in subjects during the third trimester fall below 3μg/ml, which is generally accepted as the lower
limit of normal values, indicating that folic acid deficiency is frequently encountered among expectant mothers. Landon and Mytten (1973) conducted tests on 12 healthy well-nourished women in their pregnancy. Plasma folacin activity was estimated microbiologically with L. Casei. The average rise in pregnancy was similar to that of post partum.

(i) Urinary Oestrogen levels of expectant mothers:

Maternal urinary oestrogen excretion in 24 hour urine specimens has been established as a dependable method for evaluating fetal status in high risk pregnancies, (Banerjee, 1962 and Maclead et al., 1971). Iyengar (1969) has shown that there is a close correlation between weight of the infant and maternal urinary oestrogen. The results indicate that providing adequate nutrition to undernourished women during the last four to six weeks of pregnancy, brings about significant increase in urinary oestrogen excretion as well as birth weight of new borns.

Reddy and Iyengar (1972) conducted a study on expectant mothers attending antenatal clinic at Niloufer Hospital. In group I, the women were undernourished and body weights of the women were around 45 kg. The women in the II group were 55 kg. Oestrogen levels were determined and the results showed a
similar increase in both the groups up to 32 weeks, but thereafter, the levels were significantly lower in the low income group. These findings suggest that oestrogen excretion is influenced by the nutritional status of the mother.

Usha et al., (1973) conducted a study on 294 expectant mothers and found that the mean oestrogen level was 16.50mg/24 hours. Very low levels of oestriol excretions were found in patients who had still birth and in cases who went in for premature labour.

Baker et al., (1977) estimated the levels of folacin, vitamin B₆, riboflavin, nicotinic acid, pantothenic acid, thiamine, biotin, vitamin B₁₂, vitamin A and carotene, at parturition. No mother had received any supplementary vitamins. Except for vitamin A and B carotene, maternal vitamin values were lower than those of the infants. Vitamin values in blood of low birth weight infants were significantly lower in folacin, vitamin B₁₂ and pantothenic acid.

Guthrie and Guthrie (1976) showed that parameters of nutritional status routinely used in nutritional surveillance can be reduced with no reduction in diagnostic potential. Determination of the intake of two dietary components (vitamin A and iron, folate and albumin) and one urinary component provides as much information as a large protocol.
7. Factors Affecting the Nutritional Status of the Infant

According to Mukarjee and Sethna (1970) Girwad (1973) and Purohit et al. (1977) birth weight of newly born is known to be affected by multiple factors—nutrition of the mother, the quality of antenatal care and stress and strain during pregnancy. Some degree of genetic influence is also evident. Besides these, certain biological factors such as sex of infants, age, parity of the mother and the nature of delivery may also affect the birth weight and the incidence of prematurity.

Harrison and Obesiako (1973) show that there is an association between maternal anemia and birth weight. To prove that maternal anemia is associated with fetal growth retardation, it is essential to eliminate the influence of other factors like folate deficiency and malaria which cause hemolysis, while coexisting with anemia they are also known to reduce birth weight. (Fleming et al., 1969).

Teverud et al. (1966) Masese et al. (1973) Villena and Furuya (1975) and Lechtig et al. (1976) warn that malnourished mothers produce children with irreversible changes resulting in a child with fewer cells, less DNA, stunted growth and may have impaired mental functions. Only moderately malnourished foetuses can survive to birth as stunted, retarded individuals. Malnourished foetuses are subsequently less able than normally nourished foetuses to respond to stress and infection.
The influence of low standard of nutrition on the growth and development of the live born foetus was studied by Ghosh (1974), on a group of expectant Bengali women of low and middle socio economic levels. The effect of an improved nutritional standard was perceptible only in the primigravida from the middle income groups. In the multigravida increased growth potential outweighed the nutritional disadvantage of the low income group.

Welshman (1972) points out that malnutrition is the greatest single contributor to infant and the child mortality in most of the developing countries. In such parts of the world, he estimates that 25-30 per cent of the children do not live beyond their 6th birthday and most of those who do survive have had a rough time getting there. When mothers are undernourished foetal growth tends to slow down in later pregnancy and this in turn leads to a rise in small-for-date or premature babies. Such babies not only show higher prenatal morbidity and mortality rates, but are more prone to have long lasting sub-lethal effects. Correcting maternal under-nutrition by means of a good liberal diet prevents this sluggishness in foetal growth, later complications and enhances production of breast milk.
Gopalan (1973) opines that infestation of various nutritional deficiencies singly or in combination have been shown to produce congenital malformation, increased foetal wastage and reabsorption and growth retardation of surviving off-spring.

Krishnaswachari and Iyangar (1973) postulates that the bone density of the off-spring is also affected by maternal malnutrition Bhatnagar and Ramash (1978) opine that prematurity is the leading factor associated with neonatal mortality and morbidity. To avoid this, diet and health of the mother should be good through out pregnancy.

One of the tragic consequences of severe malnutrition early in infancy is that the child may grow up to be permanently retarded, not only physically but sometimes intellectually as well. The central nervous system seems particularly vulnerable to nutritional insults during periods of rapid cellular proliferations as occurs during the first few neonatal months. When the reproductive history began with one or more spontaneous abortions, birth weights in subsequent pregnancies tended to be considerably reduced and ended in still births (Wolman, 1972) and Srivastava et al., 1978).
Colman (1975), Leichtig et al. (1976), WHO (1978), and Fedrick and Adelstein (1978) assert that the high prevalence of low birth weight babies is a major problem in many poor communities.

Mukerjee and Sethna (1970) and Bhaskaram (1975) reported that the birth weight increased with an increase in the maternal weight. It is well known that the average weight of newborn infants in India is considerably lower than that in the advanced countries. Various workers attribute different reasons for this (Chandra, 1971). Gopalan and Vijayaraghavan (1971) have indicated that the mean birth weight of Indian infants is 2.8 kg.

Nayya (1973) opines that low birth weight babies are more frequently born to mothers with small stature and inadequate parental care. Maternal vascular diseases and anemia may result in low birth weight secondary to anemia. The prematurity rate was higher (9.6 per cent) in the lightest 25 per cent primigravida compared to that (4.10 per cent) in the heaviest 25 per cent. It was concluded that the possibility of producing a small body at full term delivery is greater for shorter than for a taller woman. But among women of any given height, those low in the social scale have a greater risk of having a low birth weight baby than those of higher social status.
WHO (1965), Sahgal and Sinha (1969) have shown that birth weights of babies were directly related to maternal nutrition and socio-economic status of the family. Kapur et al. (1971) reveal that among the 1,652 women they studied this from different socio-economic groups, the birth weight and length of mature babies correlated with weights and heights of their mothers. The socio-economic status of the mother influenced the birth weight of the babies.

Pachauri and Marwah (1970) point out the mean birth weight, length and head circumference of the newborn as 2,493.6 g., 48.75 cm and 33.65 cm. respectively. These measurements did not vary significantly among different socio-economic groups at birth and during infancy. Low birth weights were observed among 2.7 per cent and congenital malformation in less than two per cent babies.

Aiyar (1972) opines that incidence of "Small-for-date" babies is greater in developing countries like India. The incidence is 23.39 per cent compared to United States 10.6 per cent and Canada's 6.7 per cent. Most of these data were gathered from general hospitals, that is, low socio-economic group (24.3 per cent). Better economic class indicated the incidence to be lower (13.3 per cent).
very high perinatal death rate (20.61%) was found in babies delivered to mothers having irregular antenatal care according to Banik and Saha (1975). Similar observations were reported by other workers Kerman et al., (1972) Misra et al., (1973) and Kasturjal and Jammial (1974).

Chandra (1971) reports that incidence of low birth weight among infants of different economic groups in Hyderabad is six times higher than that reported from U.S.A. and U.K. He further reports that maternal age and parity and economic conditions of the family affect birth weight. Banik et al., (1972) Lechtig et al., (1975) and (1976) and Ghosh (1977) state that birth weights of infants belonging to the poor socio economic group are generally lower than those of infants born to well nourished mothers, also a greater proportion are small-for-date. In a study the relationship between maternal diet and birth weight of the babies produced was examined. The average birth weight was 2.99 kg. Nine mothers with highest energy intake between 2,200 and 3,100 cal/day had babies with a mean weight of 3150g and with the lowest intake between 700 and 1300 cal/day the mean birth weight was about 2850g and only 38 percent exceeded 3 kg. (Nutrition reviews, 1973). Barajani et al., (1975) studied the fetal growth in relation
to maternal socio-economic conditions. It was found that the average birth weight, head and chest circumference were lower in the newborns of the low socio-economic group when compared with the high socio-economic group.

Studies carried out by Vijayalakshmi et al., (1975), and (1976) on expectant mothers in the lower socio-economic status showed that the nutritional status of the expectant mothers had a direct role in the outcome of pregnancy.

Rajalakshmi et al., (1978) showed that maternal weights had little variation with parity and gains of less than 3.5 kg. in the last trimester of pregnancy were associated with a mean birth weight of 2.3 kg as against 2.8 kg for those with gains greater than this.

Jesudasan and Ambika devi (1973) show that lower the economic status the higher the nutritional deficiency. Social class as reflected in father's occupation affected birth weight only to the extent that infants of professional fathers were heaviest and those of the unemployed were lightest (Cagini et al., 1978).
Bharyava et al., (1971) and Puri et al., (1977) explain, at all ages, the low birth weight babies exhibit smaller length and head circumference compared to normal babies. In the second year of life however, babies with birth weights of 1500 g or less showed an accelerated growth, almost on par with babies of birth weights between 1500g and 2000g. According to Bahl et al., (1971), the mean birth weight increased with advancing maternal age till 34 years.

Srivastava et al., (1972) observed that mothers between 25 and 29 years delivered 46.6 per cent babies with birth weights over 3000g. Only 4.5 per cent babies born to these mothers were below 2000g. Fetal and infant loss was high when maternal age was 17 years and below and also when the birth interval was short, according to Mukarjee, and Sethna (1970) and NIN (1974). Cagini et al., (1978) have shown that the age of the mother influenced the course of pregnancy, the incidence of complications rising after 30 years of age and the incidence of malformation rising in the age group of 35 to 39 years. Mean birth weight was less if the mothers were under 20 or over 40 years old.
Of 1051 mothers studied by Garcia et al.. (1978) 42 per cent were 18 to 23 years old. For 49 per cent their infants were the first child and for 30 per cent their second. More than 40 per cent of the infants weighed between 3000 and 3500g at birth. Banik (1978) reports that the incidence of low birth weight babies is 13.91 per cent among the mothers up to 20 years and suddenly drops to 3.6 per cent in the age group of 21-25 years and thereafter increases again.

Kapur et al.. (1971) Puri et al.. (1977) and Banik (1977) showed that maternal factors like period of gestation, maternal age up to 35 years and parity up to third rank augmented the growth of the foetus and thus influenced the measurements of the born significantly, while toxaemia, maternal age beyond 35 years and parity beyond third rank were found to retard the growth of foetus.

Choudary et al.. (1978) showed that birth weight and gestational age were the most significant factors for determining the survival. Perinatal mortality was also
correlated to parity, maternal age, type of birth and mode of delivery. Shalla et al., (1974) studied the relation of birth spacing with birth weight, morbidity and mortality of the newborn and indicate that birth spacing has a definite influence on determining the weight of the newborn and reduces the morbidity.

Sebastian (1977) shows that if the interval between two children is short the child suffers from varying degrees of malnutrition. The incidence of toxemia and other complications of pregnancy like difficult labour, rupture of uterus, high blood pressure, and kidney diseases are higher for women who have given birth to five or more children. The severity of these complications increases at higher ages with inadequate prenatal and delivery care and with poor nutrition. Increases in birth weight up to fourth and fifth parities have been reported by Rajalakshmi et al., (1978). This impression was confirmed by longitudinal studies on ten women through 2 successive parities. The mean birth weights were 2.0 and 3.0 kg and practically no change was found in maternal weight.
6. Studies on Breast milk:

Breast feeding has been the sheet anchor of infant nutrition in India. (Belavady and Gopalan, 1959). Under the existing conditions of poor hygiene, widespread infection, use of over diluted foods given in unclean bottles and interfering taboos and superstitions, breast feeding is still the best and the only insurance for the survival of young children, (Sedrun and Dumuso, 1971). Functional and practical understanding of infant feeding can best be achieved by appreciating the dynamic nature that is as a nutritional, psychological and biological interaction between the mother and the off-spring with each affecting the other. (Jelliffe 1976).

The information available from the studies on breast milk are dealt with under the following headings in this 

1. Techniques for measuring milk yield
2. Volume of breast milk
3. Length of breast feeding
and 4. Composition of breast milk.
1. **Techniques for measuring the milk yield**

Two techniques exist for measuring the milk yield by the mother: (a) weighing the child before and after each feed known as test feeding technique (b) emptying the breast by hand or breast pump (WHO, 1965) and weighing the milk output.

Both techniques have their drawbacks. In the first method, the quantity measured represents the quantity taken by the child and not that secreted, which may be larger. This technique does not allow the taking of samples for determinations. In the second method it is difficult to ensure that the breast is completely empty and the process may be painful.

2. **Volume of breast milk**

Rickard (1975) found that, women with very inadequate diets or frank malnutrition have a reduced milk volume and the energy content of the milk may be lowered by a decline in the lipid constituents.

Someswara Rao et al., (1959) estimated the yield to be 530 - 730 ml/day. Gopalan (1973) observes that milk output during the first few weeks after delivery will be high and there after about 450-650 ml of milk is secreted daily.
Jelliffe (1976) estimated the amount of daily milk secretion of 12 Swedish women, at the sixth month of nursing to be 756 ± 140 ml.

Gupta (1974) suggests that milk production is affected by oral contraceptives and prolactin reflex. When supplementation is done during lactation the peak milk production was about 730 ml/day according to charves et al., (1975).

3. Length of breast feeding

Saxena and Gary (1968) put forth that about 20 per cent of upper class mothers in an sample of 691, never breast fed their babies. The usual duration of breast feeding was six months to one year. The number of breast feeding depended mainly on the baby's demand.

Bansal et al., (1973) point out that out of 600 infants 66 per cent were breast fed up to 18 months. Madhavi (1972) explains that breast feeding is continued as long as possible (even up to four years) in poor income families. Only ill-health or next pregnancy stops breast feeding.

Mehta (1972) puts forth that in a group of 400 infants, 91 per cent of mothers gave the neonates a prolactal feed, and continued breast feeding for long periods. Prolonged breast feeding, poor knowledge of infants diets and delayed weaning were the major causes of nutritional disorders of children. Only mothers in the low income group who,
nutritionally speaking, can ill afford the added stress of lactation, breast feed their young for prolonged periods of time (Hosita, et al 1973).

John and Devarajan (1973) estimate that out of 150 mothers 21.4 per cent breast fed for 3 months and 9.7 per cent for 6 months. Ghosh et al., (1976) opine that breast feeding in the Delhi mothers is being curtailed rather early. Literate or older mothers tend to breast feed their infants for a shorter time compared to illiterate and young mothers, who tend to continue breast feeding for unduly prolonged periods.

Selavady (1960) and Gopalan (1973) explain that the duration of breast feeding was related to the sex of the infant, age of the mother and social class. According to these authors, males were breast fed for longer periods than females. All mothers in malnourished communities breast feed their children for prolonged periods even upto two years. This practice is attributable not only to cultural but also to economic factors. Surveys conducted by Margaret and Hofvander (1975) show that only 28 per cent of babies were breast fed even soon after birth and in most cases this was not continued beyond the first month.
Gopalan et al. (1971) carried out a survey on the breast feeding practices in higher socio-economic groups. It was found that only 22 per cent of the mothers investigated had been able to feed their infants for at least six months. This breast feeding differs with different sects, educational level of the mothers and their responsibilities outside their home.

4. Composition of breast milk

Milk is not constant in composition from one human or animal to another, at all periods of lactation. The composition of milk is related not only to the amount secreted and the stage of lactation, but also the time of its withdrawal and to the individual variations among nursing mothers such as age, parity, health and social class (Patwardhan, 1969; Kyoden et al., 1975; and Srikantia, 1975). Studies on the chemical composition of milk show that as far as proximate principles are concerned the milk from the poorly nourished mother is nearly as satisfactory as those from well fed mothers, (Belavedy and Gopalan, 1961; WHO, 1962; and Jelliffe, 1968). The lactose is remarkably unchanged and the pattern of fatty acids varies considerably with the mother's past and present diet. (Edsion et al., 1976, and Crawford et al., 1976).
Venkatachalam and Balvady (1962) observe that protein supplementation to nursing mothers decreased the concentration of vitamin A in serum without influencing the concentration of vitamin A in milk. Gopalan (1963) points out that the protein supplementation to a group of 15 mothers immediately after the birth of the child did not show any difference in the yield of milk between the supplemented and unsupplemented groups. Dietary intake, socio-economic status and maternal parity did not alter the breast milk iron and protein composition according to Rao and Gopalan (1962).

Thiamine, riboflavin and ascorbic acid supplementation increases the breast milk levels, which does not occur rapidly with vitamin A according to Deodhar et al (1964). Beaton and Moheyry (1964) observed no increase on supplementation in the vitamin A content of milk of women who had already been taking a diet with good amounts of vitamin A. On the other hand Kon and Mawson (1973) studied the effects of supplementation to the mother in different stages of lactation on the concentration of vitamin A, state that mothers supplemented with vitamin A in the form of cod-liver oil or vitamin capsules had higher concentration of vitamin A in their milk as compared to the unsupplemented mothers.
Venkatachalam (1975) suggests that the fat content of the breast milk might be related to the fat intake of the mother.

Milk samples in different stages of lactation were analysed by Peter (1975) for all the proximate principles, vitamins and minerals. Thiamine was higher in the first month after delivery than in the later stages of lactation. There was no correlation between the iron content of milk and the haemoglobin levels of mothers.

Deb (1976) pointed out that calcium levels ranged in most of the cases from 20 to 27 mg/100 ml, phosphorus levels varied from 15 to 20 mg/100 ml and there was not a great difference between the socio economic groups and time of lactation. Thus it seems that content of fat and the water soluble vitamins may be affected by the type of nutrition the mother receives.

H. **Role Of Specific Supplementation Programmes**

The supplementation programmes reviewed are:

1. **Applied Nutrition Programme**
2. **Prophylaxis against anaemia**
3. **Massive dose of vitamin A with iron supplementation**
1. **Applied Nutrition Programme**

The Applied Nutrition Programme (ANP) was launched in Tamil Nadu in the year 1962-63. The definition of ANP as endorsed by the joint WHO/UNICEF and FAO/UNICEF policy committee (1963) is, "Coordinated educational activities between agriculture, health and educational authorities and other interested agencies with the aim of raising the levels of nutrition of local populations particularly, mothers and children in the rural areas". In order to realise this general objective, the ANP has following specific objectives.

a. Encourage the local production of protective foods, namely pulses, dark green leafy vegetables, other vegetables and fruits.

b. Encourage local consumption of the produced foods of animal origin at family, school and community levels, and

c. Educate mothers, school children and others in the village community about the types and quantities of foods that should be consumed for health and well being (Nutrition Education).

The programme is a joint effort of UNICEF, Government of India and the State Governments. When the ANP is introduced in a block, all the concerned personnel and the community particularly, the vulnerable sections who constitute the beneficiaries, are informed about the objectives and scope of
the programme. The selection of the villages is done by the officials hailing from various departments, and at various levels, from the state to the village. The beneficiaries are divided into the following three groups:

a. Children who attend the Kushanthaigal Kappagam (Preschools)

b. Children who do not attend Kushanthaigal Kappagam but are given food

and  c. Expectant and nursing mothers

All the beneficiaries receive food, Bulgar wheat 80g and salad oil 7g/day/beneficiary for 300 days. These foods are the gifts arranged with the assistance of CARE. Originally skim milk was distributed along with eggs and vegetables grown in the community garden. The CARE officer at the district level, helps in the distribution of CARE foods to the blocks. Under the supervision of the Commissioner of the block and Mukhyasevikas and gramasevikas, the balasevika collects the needed amount of CARE food during the first of every month.

Apart from the CARE gift foods, three eggs are supplied/beneficiary/week.
Immediately after the ANP is introduced in a block, assistance is available for five or six years from UNICEF and the central and state governments. The ANP is basically an educational programme. Hence training is organised at three levels, State, Training Centre and Block levels down to the women's clubs.

**Evaluation of ANP:**

The effects of the supplementary foods made available from ANP in the community development block at Bhavanisagar, Coimbatore district, on the growth and nutritional status of preschool children, expectant and nursing mothers in rural areas were studied by Devadas and Thomas (1965), Devadas and Vijayalakshmi (1966), Devadas and Pruma (1966) and Devadas et al., (1970), 1971). These studies indicated the following findings:

1. The ANP supplements contributed considerably to the intake of energy, protein, calcium and vitamin A of the beneficiaries, namely children, expectant and nursing mothers.

2. The nutritional status of the children who participated in the ANP in terms of heights and weights and haemoglobin levels was significantly higher than that of the corresponding groups of children not participating in ANP.

3. The mean body weights of mothers increased to a significant extent as a result of consuming the supplementary foods.
4. The bio-chemical profile with respect to selected nutrients were better for the mothers participating in ANP than those who were not participating.

and 5. The mean increases in weight, height and head-chest measurements of infants of mothers receiving the supplementary foods were also greater than those of infants whose mothers did not receive any supplement.

and 6. The ANP had brought about a profound change in the attitudes of mothers. Because of the beneficial effects of protective foods on their health, they showed a keen interest in raising poultry units and kitchen gardens.

2. Prophylaxis against anaemia programme:

The State Family Welfare Bureau is carrying out this programme since 1970. The main objective of the programme is to prevent anaemia due to iron deficiency in mothers and children.

Iron tablets in the form of ferrous sulphate are supplied by the Director of Medical Services on the basis of the population of the district to the concerned district Family Welfare Officer, who in turn supplies them to the Auxiliary nurse midwives (ARN) and health workers. These ARN's and health workers take the responsibility of distributing the iron tablets to the beneficiaries through the Municipal maternity centres. One hundred iron tablets are distributed in three instalments (30, 30, 40) to the mothers
in the third trimester of pregnancy and are advised to
each day. Each tablet contains 200 mg of dried ferrous
sulphate (equivalent to 60 mg of elemental iron) and 500 mg
of folic acid. Follow up work is done by the same health
workers through home visits to ensure regular consumption
of the tablets. Selection of the beneficiaries is made by
the ANM, health workers and medical officers, on the basis of
clinical symptoms. So far no study has been carried out to
assess the impact of these supplements on expectant mothers
or children—given through this programme. Through many
studies have been carried out on iron and folic acid
supplementation which are presented below.

Seed (1967) Aykroyd (1970) opine that increased
demands of pregnancy results in a fall in haemoglobin levels,
depletion of iron from marrow, fall in serum iron and
expansion of iron binding capacity. Hence administration
of prophylactic iron during pregnancy is advised. The WHO
scientific group on nutritional anaemia (WHO 1975) recommended
a dose of a ferrous salt containing at least 200 mg of
elemental iron given during the II and III trimesters of
pregnancy.
In Glasgow, the iron stores of healthy women and normal expectant mothers receiving prophylactic iron supplementation was assessed by measurement of plasma ferritin by Kelly (1977) and he found that the ferritin concentration fell progressively to a low level in late pregnancy, suggesting that the average iron store was inadequate to feed the demands of pregnancy and that dietary iron supplements were therefore required. There was no evidence that iron supplementation led to excessive iron stores.

Mehta et al., (1973) and Saxena et al., (1973) opine that the total dose of iron deficiency anaemia with iron dextran complex is a well established technique for managing both obstetric and gynaecological problems.

The studies conducted by Chamarin et al., (1960) Merchant et al., (1970) and Gopalan and Vijayaraghavan (1971) brought out an emphasis that iron is the most important single element required during pregnancy and supplying this by a parenteral route will quickly bring about a significant improvement in haemoglobin level and other parameters of blood.

Penton et al., (1977) measured serum ferritin during the course of pregnancy in 154 women. There was a rapid decrease in iron stores during early pregnancy, irrespective
of treatment with iron, but iron by mouth did prevent the store reaching deficient levels during the second half of pregnancy. These results suggest that the maternal erythroid activity starts early in pregnancy and may exhaust the store before fetal demands for iron can be met. The findings are that pregnant anaemic patients who have an Fe/TIBC under 30 per cent respond to iron therapy. Fe/TIBC for assessing iron status is important because it usually reflects depressed levels early in the course of iron deficiency at a time when familiar peripheral criteria are not reliable. In this early stage the anaemia that occurs is normocytic and normochromic. The more familiar hallmark of iron deficiency is microcytic hypochromic anaemia, which manifest only at a more advanced stage of iron deficiency.

Apte and Iyengar (1972), Gopalan (1973) and Mynn and Wynn (1975) exhort that dietary supplementation to the mother during the last trimester of pregnancy can bring about significant impact on the condition of the off spring. The birth weight of infants born to mothers who receive dietary supplements were significantly higher than those of the unsupplemented mothers. Colman et al., (1975) espine that haematological and folate nutritional status of expectant mothers given 300 mg to 500 mg of folic acid showed an
increase in red cell folate level and the rate of synthesis. Increased dose of folic acid for the prophylaxis of anaemia during pregnancy has shown that supplementation of 60 mg of elemental iron/day during the last 100 days of pregnancy can prevent haemoglobin from falling below 10.5 g in almost all expectant mothers. They also showed that simultaneous administration of 500 ug of folic acid/day during the last 100 days of pregnancy resulted in the birth weights of infants being 200-300g more than control groups.

The WHO (1968) reports that in pregnancy and in hyper metabolic states, requirements of iron increase. The amount of folic acid required for prophylaxis in pregnancy is approximately 200 ug/day. Hesainki and Merchant Scarfield (1970) and Namasrathy et al. (1971) state that routine administration of iron and vitamins during pregnancy has beneficial effects on birth weight, length of gestation, infant morbidity and mortality.

Fletcher et al. (1971) quote that in a double blind trial of folic acid supplementation (50mg/day) during pregnancy, no effects were seen in the incidence of anaemia or complications of pregnancy, although the serum folate levels were less abnormal in the treated groups.
Nor was evidence found that anaemia or serum folate levels determined the incidence of complications and the outcome of pregnancy. Routine early prophylaxis with combined iron and folate supplements have shown clearly the improvement in haemoglobin levels in women as pointed out by Scott et al. (1974).

Iyengar and Rajalakshmi (1974) carried out a trial on matched controls with iron and folic acid and iron during the last 12-16 weeks of pregnancy. Incidence of small-for-date was half in the iron and folate supplemented group, as compared with the iron supplemented group. The heights of mothers did not make any difference on the effect of folate supplement. Improvement in the birth weights seem to have been brought about by increase in placental size and cell number.

Osife (1970) Izak (1973) Wureshi et al. (1974) and NIN (1974) have reported that expectant mothers who had received 300-500 ug of folic acid in addition to elemental iron during the latter half of pregnancy delivered babies who were heavier than those born to mothers who had received only elemental iron. It was suggested that the administration of folic acid may have contributed to the increase in birth weight.
3. **Massive dose of vitamin A with iron supplementation**

A massive vitamin A supplementation with proper medical coverage is essential to overcome vitamin A malnutrition and the resulting blindness among children. Department of public Health and preventive medicine which has undertaken the programme called, "Prevention and control of blindness among children" from 1977. The main objective of the programme is to control and prevent blindness among children below five years of age. Areas where the prevalence of vitamin A deficiency is highest and where immediate action must be taken have been selected to implement the programme. Mahalir Manrams (women's clubs) have been organised in each village and the women are educated to have liberal intake of inexpensive green leafy and other vegetables which are rich sources of vitamin. A massive single dose of 2,000,000 I.U. of vitamin A is administered twice a year to pre-school children.

The MIN (1977) reports that vitamin A may play an important role in haemopoiesis. Vitamin A deficiency induced in human volunteers has been shown to result in anaemia and hypoferrremia (Hodges *et al.*, 1975). Hypovitaminosis A and anaemia coexist in many poor rural communities, particularly among children.
Van Veen (1974) reviews some present day aspects of vitamin A problems in developing countries. Neither physical activity nor climate appear to influence human requirement for vitamin A. On the other hand, a number of communicable diseases commonly found among children and adults in developing countries are known to play an important role in precipitating vitamin A deficiency or in aggravating an existing one.

Vitamin A supplementation to the mother during pregnancy caused a rise in serum vitamin A content of neonates according to Gopalan (1962). Reddy (1978) reports that dietary intake of vitamin A is low among expectant mothers of poor communities. Serum vitamin A levels in pregnant women of low income group have been found to be low especially during the third trimester. Supplementation of vitamin A to the mother during the last trimester of pregnancy resulted in a significant increase in the vitamin A level of the cord blood. Poor nutritional status of the mother during pregnancy leads to low liver stores of vitamin A in infants and at birth (Srikantia, 1976).
Despite a daily intake of 18-19 mg of iron in the diet of middle aged men fed vitamin A deficient diets, the men gradually began to manifest a mild degree of anemia. When medicinal iron was given orally to these men the response was only poor and transient with regard to hemoglobin levels. It was only after vitamin A was also given that a full haematologic recovery was obtained. Positive correlation was obtained between serum vitamin A and serum iron when iron intake was adequate, (Heja et al., 1977; and Moharram et al., 1977).

In the study of Gal (1974) the effects of improved vitamin A intake during pregnancy were assessed and factors evaluated which might affect the maternal circulating vitamin A. The physiological pattern showed a decrease in the first trimester followed by an increasing trend in vitamin A levels. Recommendation for supplementing vitamin A in pregnancy should be based on up to date nutritional surveys for each country in conjunction with the assessment of maternal vitamin A status.