Chapter 1
INTRODUCTION

"CHILDREN CAN BE ENSURED A HEALTHY START IN LIFE IF WOMEN START PREGNANCY HEALTHY AND WELL NOURISHED, AND GO THROUGH PREGNANCY AND CHILDBIRTH SAFELY."

- UNICEF, 2004

Pregnancy is the most exciting period of expectation and fulfillment in women folk. It is a period of great anabolic activities and physiological stress when the most rapid rate of growth in human development takes place in the fetus at the expenses of the mother's health (Jayshree and Kavitha, 2004). Because of nurturing a growing fetus, pregnancy is the most nutritionally demanding time of a woman's life (Foster, 2006). To support the growth of the fetus, certain physiological changes take place in the women's body. These changes along with the growth of the fetus necessitate an increase in the nutrient requirement of the woman (Kapur, 2004). Fetal development is accompanied by many physiological, biochemical and hormonal changes occurring in the maternal body which influence in the need for nutrients and the efficiency with which the body uses them. Pregnant women are a vulnerable risk group because women in developing countries like India have many pregnancies on an average, their life time risk more accurately reflects the overall burden of these women.

1.1 CURRENT STATUS OF MATERNAL AND PERINATAL HEALTH

1.1.1 Maternal Health:

1.1.1.1 Global Scenario:

Maternal mortality and morbidity are related to several factors. Among them optimum nutrition is of great importance of woman due to their special needs. Poverty, certainly also had its own affects which is more prevalent in developing countries, as the most recent UN inter-agency estimates suggest that in 2005, 536000 women died from causes related to pregnancy and child birth and 99% (533000) of these maternal deaths occur in developing countries (UNICEF,2009). It was also observed that the maternal mortality rate (MMR) in 2005 was highest in developing countries (450), in stark
contrast with developed regions (9) and countries of the commonwealth of independent states (51) (WHO, 2007). With regard to the MMR in developed countries NIPCCD, 2010 also reported it to be 4 to 20. Among the developing regions, sub Saharan Africa had the highest MMR at 900 maternal deaths per 100000 live births in 2005, followed by South Asia (490). It further reported that the adult lifetime risk of maternal death (the probability that a 15-year-old female will die eventually from a maternal cause) is highest in Africa (at 1 in 26), followed by Oceania (1 in 62) and Asia (1 in 120), while the developed regions had the smallest lifetime risk (1 in 7300) (WHO, 2007).

Improving maternal health and reducing maternal mortality have been key concerns of several international summits and conferences since the late 1980s, including the Millennium Summit which was held in New York in 2000. One of the eight Millennium Development Goals (MDGs) adopted at the Millennium Summit is improving maternal health (MDG5). With in the MDG monitoring framework, the international community committed itself to reducing the maternal mortality ratio (MMR) by three quarters between 1990 and 2015. Given that the global maternal mortality ratio stood at 430 per 100000 live births in 1990, and at 400 deaths per 100000 live births in 2005, meeting the target will require more than 70 per cent reduction between 2005 and 2015. But with the observed reduction of less than 1% of maternal mortality from 1990 to 2005, and the deadline approaching fast, the security of maternal mortality rate remain elusive despite several combative efforts.

1.1.1.2 Indian Scenario:

For a nation’s progress, it is essential that the health of its population, including the health and nutrition of women and adolescent girls i.e. the would be mothers of the new generation; are adequately cared for. Although in India, the expectation of life at birth for women has increased from 36.1 years in 1951 to 66.91 years in 2001-2006, the health and nutritional status of women and adolescent girls leaves much scope for improvement (NIPCCCD, 2010). Many international agencies like WHO, UNICEF, UNFPA and The World Bank in their efforts to investigate the maternal deaths estimated that the among 11 countries which comprised 65% of the global maternal deaths in
2005, India had the largest number of maternal deaths (117000), followed by Nigeria (59000), the Democratic Republic of the Congo (32000), Afghanistan (26000), Ethiopia (22000), Bangladesh (21000), Indonesia (19000), Pakistan (15000), Niger (14000), the United Republic of Tanzania (13000) and Angola (11000). UNICEF (2008) also reveals that the lifetime risk of maternal death was 1 in 140 in India.

The aim of the National Health Policy (1982) was to reduce the maternal mortality rate in India from the 400 per 100000 live births to less than 200 per 100000 live births by the end of year 2000. But, WHO (2010) reported that maternal mortality rate of India stood at 230 per 100000 population in 2008. Even in 2008, the National Health Policy was far away from their target. In this context, country estimates of maternal mortality over-time are crucial to inform planning of reproductive health programs and to guide advocacy efforts and research at the national level.

1.1.2 Perinatal Health:

1.1.2.1 Global Scenario:

The perinatal period commence at 22 completed weeks of gestation and ends at the seven completed days after birth (WHO, 1992). Perinatal mortality is an important indicator of maternal care and of maternal health and nutrition. It also reflects the quality of obstetric and pediatrics care available. Although social factors exert the main influence on the outcome of a birth, as societies advance good medical care tends to play a greater role. In 2006, WHO reported more than 3.3 million stillbirths and over 3 million early neonatal deaths taking place every year. In the year 2000, over 6.3 million perinatal deaths occurred worldwide: almost all of them (98%) occurred in developing countries and 27% in the least developed countries. In 2002, United Nations Department of Economic and Social Affairs also reported that the perinatal mortality rate was five times higher in developing than developed regions: 10 deaths per 1000 total births in developed regions; 50 per 1000 in developing regions and over 60 per 1000 in least developed countries. Perinatal deaths were highest in Africa, with 62 deaths per 1000 births. The perinatal mortality rate in Asia was 50 per 1000 total births, with a peak of 65 per 1000 in South-
central Asia, the third highest rate among the sub regions, lower than only those of Middle (75 per 1000) and Western Africa (76 per 1000).

Perinatal mortality rate showed a steady decline from 1983-2000. But improvements appear to have been more noticeable in South America than in other regions of the world (WHO, 2006). Thus, improving perinatal health will require collaboration, commitment and creativity. International and national efforts are becoming increasingly cooperative in meeting the challenges of the Millennium Development Goals and other internationally agreed objectives.

1.1.2.2 Indian Scenario:

Perinatal mortality depicts the economic and health care progress of a country. It reflects the efficacy of maternity and child health (MCH) care and hence is a sensitive indicator of the MCH care. The MCI! program of India has now geared up to orient and improve the existing available facilities. During the last few decades there has been marked reduction in perinatal deaths in developing countries including India. In spite of this, in India perinatal mortality rate is much higher than that in the developed countries. Most recently, National Family Health Survey-3 (2005-06) reported perinatal mortality in India as 49 deaths per 1000 pregnancies lasting seven or more months (including live births and still births) during the period of 2001-2005. It further reveals state-level differentials in perinatal mortality of India in which Chhattisgarh has the highest level of perinatal mortality (64) and Kerala has the lowest level (11). Assam (63.3), Uttar Pradesh (59.5) and Bihar (58.7) also have high levels of perinatal mortality. In addition to Kerala, Goa (12.4) and Sikkim (16.0) have very low levels of perinatal mortality rate. The WHO (1996) established poor maternal nutritional status and maternal anemia as the main causes and correlates of perinatal mortality. Thus, the present alarming perinatal mortality can be reduced by repeated periodic analysis of its magnitude and causative factors, and by making necessary efforts to rectify them.

In addition to the maternal and perinatal mortality differences between countries, there are also large disparities with in countries between people
with high and low income and between rural and urban population. Moreover, when mothers are malnourished, ill or receive inadequate care, their newborns face a higher risk of diseases and premature death. Almost one-quarter of newborns in developing countries are born low birth weight, largely due to their mother’s poor health and nutritional status, which results in increased vulnerability to infection and a higher risk of developmental problems (Sines et al, 2006).

1.2 REPERCUSSION OF MATERNAL STATUS DURING PREGNANCY ON THE NEWBORN

The state of maternal nutrition is one of the most important factors which might be expected to influence the course of pregnancy (Venkatachalam, 1962). As the mother has to nurture the fetus, health of the newborn depends on nutritional status of the mother during pregnancy and prior to conception. The influence of maternal nutrition prior to pregnancy on the pregnancy outcome was demonstrated during the Second World War. The babies conceived during the hunger period had higher chances of prematurity, still births, low birth weight and malformation than babies born during the hunger period (Khanna, 1997).

A well nourished mother is likely to have an uneventful pregnancy, normal labor and give birth to a healthy child. Despite all precautions; some women may experience certain complications such as anemia, pregnancy induced hypertension and eclampsia. Iron deficiency is the most commonly recognized nutritional deficiency in both the developed and the developing world. It is estimated that <50 per cent of women do not have adequate iron stores for pregnancy (Muthayya, 2009). Maternal anemia diagnosed in the first trimester of pregnancy is deleterious to the development of the fetus (Scholl and Hediger, 1994; Beard, 1994). Where as, pregnancy induced hypertension is a reflection of the outcome of maternal and neonatal complication.

As nutritional status of the mother significantly influence the outcome of pregnancy, socioeconomic status and education also plays a crucial role in determining the health status of newborn. In the developing world, where proper health systems and resources are very limited, the level of maternal education may be
of prime importance in the determination of maternal health and its outcomes. As evident from the UNICEF (2009) observations that the educated mothers are more likely to seek proper health care for themselves; according to the 2007 Millenium Development Goals report, “84 per cent of women who have completed secondary or higher education are attended by skilled personnel during child birth, more than twice the rate of mothers with no formal education”.

Like the physical problems associated with the prenatal period, the psychological problems can have persistent effects on the individual development and can influence the postnatal environment and the treatment the child receives from significant people during the early formative years.

The vulnerabilities which occur due to poor maternal status during pregnancy are discussed below:

1.2.1 Birth Weight

Traditionally, the birth weight of an infant has been accepted as an indicator of fetal well being, growth and maternal status. Low birth weight due to restricted fetal growth affects the person throughout the life and is associated with poor growth in childhood and a higher incidence of adult diseases, such as type II diabetes, hypertension and cardiovascular disease. The birth weight of infants is influenced by many factors such as maternal age, parity, height, weight, dietary intake and socio-economic status. Since mothers belonging to poor-income groups are lighter and shorter, it may be argued that the low-birth weight observed in this population is an effect of maternal size rather than her poor nutritional status (Bamji et al, 1999). Similarly, the prevalence of low birth weight babies decreased significantly with an increase in the socioeconomic status and educational level of pregnant women (Mathuravalli et al, 2001, Kapilashrami et al, 2000).

A calorie supplement is beneficial for fetal outcome in terms of birth weight and subsequent growth of the infant. Palma et al (2008) also reported that the anemia in pregnancy is a risk factor for preterm delivery and subsequently low birth weight.
Wilcox (2001) revealed that the short period of gestation (preterm birth) may also be the cause of the smaller baby and higher risk of death, morbidity and disability. He further reported that the mortality range can vary 100-fold across the spectrum of birth weight and rises continuously with decreasing weight.

1.2.2 Preterm Birth

Preterm birth is a serious health problem that may be related to poor maternal weight gain, substance abuse, placental insufficiency, gestational hypertension, or other conditions. Growing evidence also links specific environmental exposures to preterm birth (The Office of Children’s Health Protection, 2003). Undernourished or stunted pregnant women have been found to be at higher risk of delivering preterm (Siega-Riz et al, 1996) and of obstructed labor due to cephalopelvic disproportion (Harper et al, 1995). Similarly, the amount and composition of the weight gained during pregnancy are major determinants of energy and nutrient needs and the gestational weight gains which significantly influences pregnancy outcomes (Garrow et al 2000).

In addition, Singh (1998) also observed that pregnancy induced hypertension causes the baby to be low birth weight and delivered prematurely and in very severe cases to be still born. The pregnancy-related anxiety also increased a risk of preterm birth (Dole, 2003).

1.2.3 Infant Mortality

Perinatal and infant mortality rates reflect the health of a society and its health-care services. Over the decades, there has been significant decrease in the infant mortality rate in most developing countries including India. The major components of infant mortality i.e. perinatal (22 weeks of gestation to 7 days postnatal) and early neonatal (7 days - 1 month after birth) mortality rate are directly related to the health and nutritional status of the mother during pregnancy. Due to the high incidence of low birth weight and prematurity in poor as well as in middle and high communities, perinatal and neonatal death rates are also higher and contribute to almost 60% of infant deaths. The incidence of prematurity, low birth weight, perinatal mortality and severity of anemia in the mother are closely related with each other. Besides anemia,
other conditions such as pregnancy hypertension, placenta praevia and other complications when associated with poor nutritional status result in much higher perinatal deaths (Bamji et al. 1999). United Nations Children's Fund and World Health Organization (2004) also stated that the low birth weight is closely associated with fetal and neonatal mortality and morbidity, inhibited growth and cognitive development, and chronic diseases later in life.

1.2.4 Nutrient Stores in Fetal Liver

Many of the nutrients are adequately stored in intrauterine life to meet the immediate postnatal needs of the infant. It was believed that fetus being a parasite; it derives and stores the nutrients at the expense of maternal reserves even in severe maternal malnutrition. However, body composition studies of the fetuses born to poor-income-group mothers in India showed substantially lower values for several nutrients. Stores of iron, folic acid, vitamin B12 and vitamin A were 50-60% of the reported values for western or developed country’s women. Due to insufficient intake of nutrient during pregnancy or due to low socioeconomic status, breast milk of the mothers become deficient in most of these nutrients (Bamji et al, 1999). Moreover, some evidence exists that severe maternal iron deficiency causes reduced iron storage in the fetus and newborn infant, predisposing them to iron deficiency anemia (Scholl and Hediger, 1994).

1.2.5 Development of Brain and Mental Function

The peak period of human brain growth is in the last few weeks of intrauterine and first six months of extra-uterine life. After this the brain growth slows down. Insults during these phases can be expected to affect brain development and lead to poor mental function. Severe global reduction in nutrition during pregnancy has identifying extended result in fetal growth restriction and to cause permanent brain dysfunction, especially cognitive and behavior deficit (Morley and Lucas, 1997; Olness, 2003; Grantham-McGregor and Baker-Henningham, 2005; Walker et al, 2007; Benton, 2008). Older women also tend to have smaller babies and to have more complications at birth than younger women (Meredith, 1975; Selvin and Garfinkel, 1976). The reason is that as women approach the menopause, they frequently have
endocrine disorders which slow down the development of the embryo and fetus, causing such developmental irregularities as cretinism, Down's syndrome, heart malformations and hydrocephalus, all of which involve physical and mental defects.

1.2.6 Congenital Malformations in the Fetus

Dietary deficiencies of protein, B-complex vitamin and vitamin A are contributed to higher incidence of congenital malformation. Fetal wastage or miscarriage is high in those pregnant women who belong to low-income group in comparison to middle and high income group because their food is deficient in many nutrients. Shah and Sachdev (2001) in a study of effect of gestational zinc deficiency on pregnancy outcomes concluded that improving maternal zinc status through prenatal supplementation might improve fetal neurobehavioral development. However, the incidences of congenital malformation in the fetus are much higher if mothers have suffered from viral infections such as rubella, influenza etc during first trimester of pregnancy.

As pregnancy imposes a great strain, it is essential that mother leads healthy life throughout child bearing stage. One of the major factors that promotes the health and well being of the mother is nursing diet (Mohapatra et al, 1995). In 1989, World Health Organization signified that women's normal nutritional requirement increase during pregnancy to meet the needs of the growing fetus and of the maternal tissues associated with pregnancy.

1.3 DETERMINANTS OF NUTRITIONAL STATUS OF PREGNANT WOMEN

Women are generally vulnerable to under nutrition especially during pregnancy and lactation, the periods which demand more nutrient requirement. The demographic consequences of the lower status in women has expressed in various forms such as female infanticide, higher death rate for women compared to men, lower sex ratio, lower literacy rate in female, lower level of employment of women in the non-agricultural sector as compared to men etc. (Srinivasan and Tara, 1989). Generally, at household level, cultural norms and practices and socio-economic factors determines the extent of nutritional status of pregnant women. The high fertility rate of Indian women is one of the most detrimental socio-cultural influence on nutritional status
because the metabolic stresses of pregnancy may not be adequately compensated by
dietary intake before, during or even after this physiological process. During
pregnancy, women who are already under nourished due to lack of availability of rich
nutrients food, their access to available food is also restricted in the traditional Indian
households through taboos and ritual observances, which are widely documented in
both rural and tribal population (Chatterjee, 1989). Due to the restrictions on foods,
malnutrition is a serious health concerns that Indian pregnant women face (Chatterjee,
1990). It threatens their survival as well as their growing fetus. The negative effects of
malnutrition and absence of due care among women are compounded by heavy work
demands, by poverty, by child bearing and rearing and by special nutritional needs of
women, resulting in increased susceptibility to illness and consequently higher
morbidity. In addition to the malnutrition, eating disorders like anorexia nervosa and
bulimia nervosa is most common cause of the poor nutritional status among pregnant
women in the United States. Women with bulimia nervosa exhibit poorly controlled
eating patterns marked by recurrent episodes of binge eating, whereas, women with
anorexia nervosa fully dedicated to achieving extreme thinness. In both of the
conditions, pregnancy is suspected with poor nutritional status of the mothers and
their outcome. In a recent study, Dharmalingam et al (2009) indicated that the impact
of nutritional status of mother is more pervasive than the impact of other factors on
birth weight.

One of the most dramatic aspects of the global nutrition situation is the extent of
famine, hunger, starvation and food crisis. During food crisis such as sharp increases
in global prices on basic food stuffs as vegetables, oils, grains, dairy products and rice
and other commodities, pregnant women are most at risk of under nutrition owing to
their higher nutritional requirements. Poverty, ignorance and disease, coupled with
inadequate food supplies, unhealthy environments, social stress and discrimination,
still persist unchanged as a web of interacting factors which combine to create
conditions in which poor nutritional status of pregnant women flourishes. Pregnant
women’s poor social position which is often related to the economic value placed on
familial roles helps perpetuate poor health, inadequate diet, early and frequent
pregnancy and a continued cycle of poverty (Tinker et al, 2000).

Because of the wide variation in culture, religion and levels of development among
different Indian states, it is not surprising that women’s health also varies greatly from
State to State. There is need for necessary steps for more community participation in various developmental programmes for removal of poverty and improve literacy rate among all women. Health and nutrition education has to be strengthened through department of health and ICDS, to bring awareness and behavioral change for better health and nutrition practices to improve the nutritional status of mother and child.

Thus, if a woman becomes malnourished during pregnancy, it can cause significant health problem in both mother and the fetus. This condition increases the risk of poor growth of the fetus, complications during pregnancy, abortions and even increases the maternal mortality rate. So, a successful pregnancy can result in a good pregnancy outcome.

1.4 SCOPE OF THE STUDY

The importance of the study could be established from the very fact that children born healthy are an asset not only for the family but also to the society and the nation as a whole. The health of the newborn “the future generation”, without any doubt depends on the maternal status “a very important and critical period in a woman’s life”. Worthington and Williams (1993) also emphasized that the maternal status is an important determinant in the course and outcome of the pregnancy and 75% of the fetal growth is related to maternal nutritional status. Barker (1998) further goes to the extent that the maternal nutritional status not only determines the states of the offspring at birth, but also the future course of its development and health throughout their life. Although a vast improvement has been achieved with regard to female life expectancy, infant and child mortality in the last 50 years in India, but still a high proportion of offspring with low birth weight persist at large (Gopalan, 1999). Many studies revealed that the normal healthy infant is the expectation of the every parent when pregnancy is considered. However, there is a threat to the fulfillment of the prospective parent’s dreams, due to the many unwarranted complications during pregnancy that contribute to unhealthy and low birth weight babies. Even if these children survive, they may develop nutritional diseases like diarrhoea, anemia, vitamin A deficiency, and rickets and may suffer from infectious diseases due to lack of resistance. Such infants find it difficult to keep pace with the other normal children hindering the development of the nations.
Keeping in mind, the adverse consequences (which cannot be altered once established) of negligence in the care of pregnant women throughout their gestational period, the present study, particularly aims to study the status of pregnant women throughout their gestational period and its effect on the newborns. A special emphasis on the examinations of nutritional status of pregnant women and its outcome has been made in the present study because good nutritional status of pregnant women contributes significantly to attainment in a healthy newborn. Improvement in nutrition and health status during pregnancy is of great importance as it is inextricably linked with the quality of life of next generation and will go a long way in improving national health.

Studies of this kind ultimately lead to remedial interventions. They help to evolve short term and long term policies. They facilitate pragmatic priority planning both at national and local level. The few prospective cohort studies done in India on pregnant women covered only second and third or third trimester and have focused mostly on weight of newborn. The effect of maternal factors on her gestational period, mode of delivery and crown heel length of newborn that indicates a broader definition of the outcome of pregnancy is needed than birth weight alone. Despite many health policies and programmes focused on the health of expectant mothers and their newborn, mortality and morbidity rates are still high and the goals set by the world health agencies are still at bay. Thus there is room for much more to be done to ameliorate the plight of women particularly during their pregnancy at the grass root level.

Therefore, investigations on status of pregnant women and their outcome among communities are important. In view of the above discussion, present study was undertaken in Aligarh city because no such study has been done so far in this region.

**OBJECTIVES:**

The specific objectives of the proposed investigation are:

1. To evaluate the association of maternal height, weight and body mass index during each trimester and weight gain during pregnancy with pregnancy outcome.

2. To establish the correlation between maternal dietary intake during each trimester of pregnancy and pregnancy outcome.
(3) To assess the influence of maternal factors in terms of age, age at marriage, socioeconomic status, education, gravida, parity, number of children and birth interval on pregnancy outcome.

(4) To find out the relationship between maternal hemoglobin status during each trimester of pregnancy and pregnancy outcome.

(5) To observe the relativity of maternal blood pressure status during each trimester of pregnancy with pregnancy outcome.

**HYPOTHESIS:**

Based on the above objectives the following hypothesis will be formulated in relation to the pregnant women and their outcome.

(1) The risk of low birth weight infants and the related neonatal mortality may be increased when mothers are short statured and gain low weight during pregnancy. So, the anthropometric measurements like maternal height, weight and body mass index during each trimester and weight gain during pregnancy will be significantly related to pregnancy outcome.

(2) The mother’s diet during pregnancy has a direct influence on fetal growth and hence, the size and health of the newborn. So, the maternal dietary intake during each trimester of pregnancy will be correlated with the pregnancy outcome.

(3) The pregnancy outcome will be significantly influenced by the maternal age, age at marriage, socio-economic status, education, gravida, parity, number of children and birth interval.

(4) During the antenatal period, the requirement for iron increases several folds due to the demands of the growing fetus as well as expanding maternal red cell mass and these often outstrip the available supply of iron from the diet and iron stores. Anemia during pregnancy is correlated with poor birth outcomes and is an important risk factor contributing to the high incidence of low birth weight. So, there will be significant relationship between the maternal hemoglobin status during each trimester and pregnancy outcome.
During pregnancy, despite all precaution, some women may experience certain complications like hypertension. The path of physiological changes during pregnancy with hypertension leads to serious complication pregnancy induced hypertension causes the baby to be smaller than normal (LBW- Low Birth weight), delivered prematurely and in very severe cases to be still born (death). So, the maternal blood pressure status during each trimester of pregnancy will be associated with pregnancy outcome.