Chapter 5
DISCUSSION

5.1 The Study:

The present research work was undertaken among 292 pregnant women in the selected hospitals of Aligarh city. The aims of this research were to study the influence of nutritional status and other related maternal factors on pregnancy outcome. In this chapter, based on the above objectives, results of this study are discussed in elaborate form.

As per the results, the average gestational period at delivery was 37.01±1.33 weeks. The completion of delivery between 37 weeks to 42 weeks of gestation is known as full term. Deliveries prior to completion of 37 weeks termed as preterm and beyond completed 42 weeks of gestation is post term (Dutta, 2004).

The findings revealed that the gestational period was found within the limit of the full term but lower as compared to recent international studies such as 38.08±1.32 weeks in S. Paulo, Brazil (Ricalde et al.1998), 39.7±1.4 weeks in Eastern Guatemala (Neufeld et al. 2004), 40.0±1.2 weeks in Amsterdam (Eijsden et al. 2008), 39.4±1.9 weeks in Aberdeen, UK (Haggarty et al. 2009), 37.87±1.98 weeks in Morogoro, Tanzania (Mosha and Philemon, 2010) and some national studies like 38.5±3.03 weeks in Kolkata (Bisai et al. 2006) and 38.13±1.89 weeks in New Delhi, India (Kumar et al. 2010). Better medical facilities, good sanitary conditions, awareness regarding antenatal check-ups, low reproductive health problems, higher socioeconomic status and adequate intake of nutrients may be the causes of high gestational period in Western countries.

It was also observed that the incidence of full term deliveries was 89.4 percent (261) followed by 10.6 percent (31) of preterm deliveries. Whereas in recent national studies, the incidence of preterm deliveries were found to be 9.97 percent in Bengalee mothers of Kolkata (Bisai et al. 2006) and 23.2 percent in north Indian women of New Delhi (Kumar et al. 2010) which were lower and higher than the present findings respectively.
Various contribution factors found for lower gestational period in this study were iron intake and meal pattern during 1\textsuperscript{st} trimester, folic acid intake in 2\textsuperscript{nd} trimester, and calcium intake, fat intake, meal pattern, hemoglobin level, systolic and diastolic blood pressure during 3\textsuperscript{rd} trimester of pregnancy. Similarly, Michael (2010) reported that the poor maternal nutrition, tobacco chewing, severe anemia, pre-eclampsia, chromosomal abnormalities, multiple births, infections such as rubella, toxoplasmosis or syphilis and damaged or reduced placental tissue due to chronic renal failure, sickle cell anemia and phenylketonuria were the most risk factors for lower gestational period.

In addition to the above factors, Siega-Riz et al. (2001) in their study of frequency of eating during pregnancy and its effect on preterm delivery among lower-to-middle income group women revealed that the women who consumed food at a less optimal frequency were at a slightly higher risk for preterm delivery in general and mostly deliver after premature rupture of the membranes.

The results of the study were revealed that the average crown heel length of the newborns was 47.89±1.74 cm which was lower than the average Indian value of crown heel length as 51 cm which varies from 43.6 to 56.5 cm (Athavale, 1989). About 77.7 percent newborns had crown heel length between 45 cm-49.99 cm followed by 15.1 percent of ≥50 cm and 7.2 percent of <45 cm crown heel length. In this study, the crown heel length of newborns was comparatively lower than the international studies such as 48.78±2.08 cm in S. Paulo, Brazil (Ricalde et al. 1998), 48.4±1.9 cm in eastern Guatemala (Neufeld et al. 2004), 50.48±2.72 cm in Tehran, Iran (Shajari et al. 2006) and 48 cm in Vietnam (Vaktskjold et al. 2010). Crown heel length of western countries may be higher because of the long stature of the mothers, lower infectious diseases, favorable conditions of environment, high socioeconomic status and intake of adequate amount of balanced diet during pregnancy.

The main risk factors for the lowered crown heel length of newborns were found to be the maternal height; body mass index; weight gain during pregnancy; calorie and calcium intake; socioeconomic status; parity; number of children; hemoglobin level; protein intake during 1\textsuperscript{st} trimester; iron and fat
intake in 2\textsuperscript{nd} trimester and iron intake, meal pattern, systolic and diastolic blood pressure in 3\textsuperscript{rd} trimester. Similarly, in a longitudinal study of eastern Guatemala among rural pregnant women, Neufeld et al (2004) reported that the maternal height (a reflection of genetic potential and environmental influences, including nutrition) predict infant crown heel length at birth.

The mean birth weight was found to be 2.54±0.44 kg. Low birth weight has defined as one whose birth weight is less than 2500 gm irrespective of the gestational age (WHO, 1984). Previous Indian studies from Varanasi and from Kolkata reported the mean birth weight as 2588.25±333.26 gm (Mridula et al. 2002) and 2592±371 gm (Bisai et al. 2006) respectively which were accordance with the present study. On the other hand, other Indian studies were documented high mean birth weight such as 2669 gm in Nagpur (Deshmukh et al. 1998), 2669.7±447 gm in Lucknow (Idris et al. 2000), 2864.60±487.73 gm in Pune (Kapilashrami et al. 2000), 2801.1±384.49 gm in Pune (Ghate et al. 2001), 2786.42±426.3 gm in Haryana (Rao et al. 2007), 2746±400 gm in West Bengal (Sen et al. 2009) and 2725.40±424.64 gm in New Delhi (Kumar et al. 2010).

Whereas in all the international studies, average weight of newborns was found to be higher than the 3000 gm such as 3140.29±485.24 gm in South Paulo, Brazil (Ricalde et al. 1998), 3353±456.5 gm in Portsmouth, South England (Mathews et al. 1999), 3575±448 gm (Brown et al. 2002), 3110±450 gm in eastern Guatemala (Neufeld et al. 2004), 3123.75±492.04 gm in Tehran, Iran (Shaajari et al. 2006), 3483±425 gm in Urmia, Iran (Yekta et al. 2006), 3579±497 gm in Amsterdam (Eijsden et al. 2008), 3452±560 gm in Aberdeen, UK (Haggarty et al. 2009), 3050±510 gm in Morogoro, Tanzania (Mosha and Philemon, 2010) and 3201 gm in Vietnam (Vaktskjold et al. 2010). In Western countries, high socio economic status, good medical facilities, better conditions of maternal nutrition, supplementation programmes, scheduled immunization programmes and high educational level may be the causes of the higher birth weight of newborns than India.

But exceptions always exist; as reported in daily Hindi news paper Dainik Jagran, Aligarh (24 Sept. 09), an Indonesian woman has given birth to an 8.7-
kilogramme (19.2-pound) baby boy, the heaviest newborn ever recorded in the country. The baby, who is 62 cm (24.4 inches) long, was born by caesarean section at a public hospital in North Sumatra (Annexure-8). In the above condition as an abnormally large infant size, specifically, an infant weighing 4000g to 4500g or greater is known as Macrosomia (Beckmann et al., 2010). Heredity, race, size of the parents- particularly the maternal obesity, diabetes mellitus, post maturity, multiparity, male fetus, or a previous macrosomic infant may raise the risk for the macrosomia (Dutta, 2004). This condition may dangerous for both fetus and the mother. Fetal hazards are shoulder dystocia, asphyxia, birth trauma and meconium aspiration etc. Maternal hazards include injury to the maternal soft tissues (vagina, perineum) and puerperal sepsis (Dutta, 2004).

The prevalence of low birth weight was found 40.8 percent in this study. Whereas in recent National studies, the prevalence of LBW was lower than the present study such as 32.2 percent in Lucknow (Idris et al. 2000), 31.67 percent in both rural and urban pregnant women of Varanasi district (Mridula et al. 2002), 36.6 percent in Kolkata (Bisai et al. 2006), 24.3 percent in rural pregnant women of district Ambala, Haryana (Rao et al. 2007) and 24.96 percent in New Delhi (Kumar et al. 2010) but higher than the international studies like 7.6 percent in urban area of South Paulo, Brazil (Ricalde et al. 1998), 10.9 percent in Tehran, Iran (Shajari et al. 2006), 9.6 percent in urban area of Northwest Iran (Yekta et al. 2006) and 11.6 percent in Morogoro Municipality, Tanzania (Mosha and Philemon, 2010).

Present research also reported that the maternal height, weight during 2nd and 3rd trimesters, weight gain during pregnancy, dietary intake in all trimesters, maternal age, age during marriage, socioeconomic status, gravida, parity, hemoglobin level and systolic and diastolic blood pressure in 2nd and 3rd trimesters were the most contributing factors for the weight of newborn. Similarly, in a study of maternal biosocial factors affecting low birth weight, Malik et al. (1997) also observed that a strong correlation existed between birth weight and maternal height, weight, age, antenatal check-up visits and status at pregnancy. In the same way, in a descriptive prospective study of
Tehran, Iran, Shajari et al. (2006) reported that the parity and maternal age had significant effect on birth weight.

In addition to the above factors, Nestel (2000) suggested that the Poor intrauterine growth and development as well as preterm births result in low birth weight and these babies are particularly vulnerable to under nutrition. Similarly, according to the UNICEF (2004), the causal determinants of birth weight such as maternal nutrition and general morbidity may be affected by socioeconomic conditions frequently have LBW infants. The infant’s LBW stems primarily from the mother’s poor nutrition and health over a long period of time in general and during pregnancy in particular, high prevalence of infections, or from pregnancy complications, underpinned by poverty. Physically demanding work during pregnancy also contributes to poor fetal growth.

In addition to the pregnancy outcome which are discussed above, mode of delivery was also assessed to correlate with the nutritional status of pregnant women as a pregnancy outcome in this study. In the present study, 264 (90.4%) pregnant women delivered newborns through normal delivery followed by 28 (9.6%) of caesarean deliveries. In other recent studies, the incidence of caesarean delivery was high as compared to the present research such as 25 percent in Varanasi (Mridula et al. 2002), 28.5 percent in Urmia-Iran (yekta et al. 2006) and 15.3 percent in New Delhi (Kumar, 2010) except 2.7 percent of caesarean deliveries in Morogoro Municipality, Tanzania (Mosha and Philemon, 2010).

Those pregnant women who faced the complications during delivery such as prolonged labour (3.1%), obstructed labour (1.7%), post partum haemorrhage (0.3%) and retained placenta (0.3%) were delivered newborns through caesarean section in this study. Other risk factors for caesarean deliveries may be the advanced maternal age, age at marriage, obesity, high blood pressure, short stature, lower and higher gestational weight gain than the recommended, high parity, lower interpregnancy interval, socioeconomic status, anemia and poor nutritional status of pregnant women.
In the same way, Kusiako et al (2000) revealed that the complications during labour and delivery such as prolonged or obstructed labour, abnormal fetal position and hypertensive diseases of pregnancy increased the risk of perinatal mortality fivefold and accounted for 30% of perinatal deaths. Premature labour, which occurred in 20% of pregnancies, accounted for 27% of perinatal mortality. They further recommended that the better care by qualified staff during delivery and improved care of newborns should substantially reduce the perinatal mortality.

5.2 Maternal Anthropometric Measurements:

Table IV shows the mean values with standard deviations of anthropometric characteristics of the pregnant women in different trimesters. The mean height of the respondents was 154.40±5.44cm in the study. The findings revealed that the mean values of maternal weight during 1st, 2nd and 3rd trimesters were 48.50±9.56kg, 52.378±9.63kg and 55.96±9.66kg respectively. During 1st, 2nd, and 3rd trimesters, the mean values of maternal BMI were 20.35±3.92kg/m², 21.97±3.92kg/m² and 23.48±3.94kg/m² respectively. The results reported that the pregnant women had normal range (18.50-22.99kg/m²) of BMI during 1st and 2nd trimesters and become overweight (23.00 - 24.99kg/m²) during 3rd trimester.

The mean value of total weight gain during pregnancy was 7.48±2.32 kg which was much lower than the normal range (12-13 kg in the full term pregnancy). The weight gain during pregnancy was also lower than the international studies such as 8.8±4.01 kg in S. Paulo, Brazil (Ricalde et al. 1998), 8.4±4.1 kg in Eastern Guatemala (Neufeld et al. 2004), 8.8±4.1 kg in Urmia, Iran (Yekta et al. 2006) and higher than the national study such as 6.6 kg in Lucknow, India (Saxena et al. 2007).

The attributes behind the lower gestational weight gain may be the intake of insufficient nutrients during pregnancy. Energy may possibly the chief nutritional determinant of gestational weight gain; however, the strength of the relation is confounded by a number of intervening factors (e.g., changes in basal metabolism and levels of physical activity, the composition of an
accumulated maternal and fetal tissue). In addition, deficiencies of other specific nutrients may limit or restrict gestational and fetal weight gain.

Similarly, Abrams et al. (1989) reported that the risk of spontaneous preterm birth increased 60% in women with a low rate of weight gain (less than 0.27 kg/week) compared with those with an average rate (0.27-0.52 kg/week). Women with a low rate of gain were more than twice as likely to experience a preterm delivery as those with a high gain (higher than 0.52 kg/week); the odds ratio was 2.54 and 95% confidence interval was 1.49, 4.88. This difference in weight gain appeared after 20 weeks' gestation.

Tables V-XIV represents distribution and the correlation coefficient between maternal anthropometric measurements in each trimester and pregnancy outcome (gestational period, length of newborn, birth weight and mode of delivery). There were no correlation found between anthropometric measurements and gestational period. Whereas, Elshibly and Schmalisch (2008) found that the maternal height was significantly correlated (p=0.002) with gestational age.

However, in a case-control study of Ahmedabad, Mavalankar et al. (1994) revealed that the maternal weight remained a significant risk factor for perinatal mortality, preterm birth and SGA even after adjusting for height and other important confounding factors, indicating that weight has an independent effect on perinatal outcome.

Maternal height, gestational weight gain and BMI in all trimesters were found to be positively correlated to length of newborn at the 0.01 level of significance. There is lack of available literature regarding the association between anthropometric measurements and length of newborn.

In this study, maternal height, weight gain and weight during 2nd and 3rd trimesters were found to be correlated to birth weight. Similarly, in a community based longitudinal study of Bangladesh, Nahar et al. (2007) revealed that the best predictor of birth weight as a continuous variable was maternal weight at registration, each 1 kg increase in weight at registration being associated with an increase in birth weight of about 260g. Maternal weight which was less than and equal to 43 kg in 3-5 months of pregnancy
alone gave the highest sensitivity of 80%. A combination of initial weight and height of the mother was not as a good predictor of LBW as weight alone.

Ehrenberg et al., (2003) also reported that poor weight gain during pregnancy was associated with low birth weight, prematurity and maternal delivery complications. In a population-based cohort study, Crane et al., (2009) found that the rate of adverse outcome (Caesarean section, gestational hypertension, birth weight<2500g or birth weight>or=4000g) was lower in women with recommended weight gain than in those with excess weight gain. On the contrary, Ricalde et al. (1998) reported that the gestational weight gain was not related to the birth weight and crown heel length of newborn.

There was no association found between maternal BMI in all trimesters of pregnancy and birth weight in this study.

On the contrary, Ogunyemi et al. (1998) revealed that the underweight group had the most low birth weight infants and the lowest mean birth weight. Normal BMI in pregnancy is associated with decreased perinatal complications and an optimum birth weight. Other studies also found that the maternal body mass index was significantly correlated with birth weight (Gogoi and Ahmed, 2007 and Elshibly and Schmalisch, 2008).

The findings revealed that the all maternal anthropometric measurements correlated to mode of delivery except weight gain during pregnancy at the 0.01 level of significance. Similarly, Kumar et al. (2010) found that the chances of caesarean delivery increased as the height, weight and BMI increased (p value <0.05). But in other studies, there were a negative association between maternal height and incidence of caesarean sections (Prasad and Al-Taher, 2002 and Chan and Lao, 2009).

In favour of above studies, Yekta et al. (2005) also revealed that the weight gain was not associated with caesarean rates. They further revealed that the frequency of caesarean section was significant differences among women with different level of pre-pregnancy BMI and obese women experienced the highest rate of caesarean.
Similarly, Ekblad et al. (1992) showed that the obese women and mothers with excessive weight gain during pregnancy had an increased incidence of induced labor (P ≤0.05) and tendency for emergency caesarean sections during the delivery. Obese women had more large-for-date babies than controls (P ≤0.05). Weight gain ≤5 kg during pregnancy was most common in slightly obese women and did not carry any special obstetric or neonatal risk. Underweight women had a significant risk for delivering a small-for-date baby.

The chances of caesarean delivery increased as the BMI increased (p <0.05) was found in an Indian study conducted in north Indian population (Kumar et al. 2010). Some studies also reported that the increasing BMI is associated with increased incidence of pre-eclampsia, gestational hypertension, gestational diabetes, macrosomia, induction of labor and caesarean delivery; while underweight women had better pregnancy outcomes than women with normal BMI (Bhattacharya et al. 2007 and Leung et al. 2008).

5.3 Maternal Dietary Pattern:

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.

Table XV shows the average daily intake of different nutrients by pregnant women during all trimesters in comparison with RDA. It is evident from the analysis that the average consumption of different nutrients of pregnant women was very low as compared to RDA except fat intake during 3rd trimester of pregnancy.

This indicates that the diet of pregnant women was not adequate to meet the requirement of nutrients during the course of pregnancy. This might have been due to the poor knowledge on nutrition, low socio economic status and ignorance about health by these women. Therefore, apart from supplementary nutrition to pregnant women of poor socioeconomic status, emphasis should be given towards nutrition and health education adopting multi-media approach. The agriculture extension home science extension officials should
encourage the women to cultivate low cost nutritious fruits and vegetables and popularize the same for consumption in their families. For supplementary nutrition, iron and folic acid tablets should be supplied to the pregnant women.

In the present study, Tables XVI-XXXVI depicted the distribution and correlation between maternal dietary intake during each trimester of pregnancy and pregnancy outcome (gestational period, length of newborn, birth weight and mode of delivery). Meal pattern and iron intake during 1st trimester; folic acid during 2nd trimester; and meal pattern, calcium and fat intake during 3rd trimester were found to be significantly associated with gestational period at 0.05 significant level.

Similarly, Siega-Riz et al (2001) found that the women who consumed only three meals without snacks or one meal with or without snacks per day had the highest rate of preterm birth.

Scholl and Johnson (2000) revealed that during pregnancy, low concentrations of dietary and circulating folate are associated with increased risks of preterm delivery, infant low birth weight and fetal growth retardation. Belizan et al. (1991) and Repke and Villar (1991) suggested that calcium supplementation may reduce the incidence of gestational hypertension, preterm delivery and, possibly, pre-eclampsia. Amount of calcium in a full grown fetus is 25 to 30g and most of this is deposited in the third trimester. This corresponds to an additional daily calcium need of 250 to 300mg during the last 100 days of pregnancy.

The results reported that the significant correlation found between calorie, protein, calcium intake during 1st trimester; calorie, calcium, iron, fat intake during 2nd trimester and meal pattern, calorie, calcium and iron intake during 3rd trimester and length of newborn at level of 0.05 level of significance.

Similarly, in a recent cross sectional study, Borazjani et al (2011) showed that the protein intake had the highest significant positive contribution towards birth length and weight. Each 1 gm increase of protein in maternal
consumption was associated with a 31.47 gm increase in birth weight (95% CI, 5.36-57.59 gm) and 0.158 cm rise in birth length (95% CI, 0.046-0.27 cm).

The findings reported that an increasing trend found in the weight of newborn with increasing intake of nutrients. Therefore, meal pattern, calorie, protein, calcium, iron, fat and folic acid intake during all trimesters were found to be significantly associated with birth weight at 0.01 significant level. Similarly, in a community-based study of Haryana, Rao et al. (2007) reported that the higher prevalence of LBW babies observed in pregnant women with mean calorie intake of less than 1500 kcal. Mridula et al. (2002) also found that the mean birth weight of newborns was found to be increase with proportionate increase in the consumption of calories by the mothers during the last trimester (p<0.05).

Khoushaabi and Saraswathi (2010) also showed that the high intake of calcium and iron significantly influenced the birth weight of babies. They further revealed that the pregnant women with higher intake of minerals gave birth to neonates with normal weight, while pregnant women with lower intake gave birth to neonates low birth weight.

In relation of fat intake and birth weight, Muthayya et al. (2009) found that the increases of between 100 and 200g in birth weight between the lowest and highest fish/ DHA intake groups. Women who did not eat fish during the 3rd trimester had a significantly higher risk of LBW (OR: 2.49, p=0.019). Similarly, low EPA intake during the 3rd trimester had an association with a higher risk of LBW (OR: 2.75, p=0.011). Olsen et al. (1992) also showed that the fish oil consumption increases birth weight.

In addition to the positive co-relation of all nutrients with birth weight, folic acid intake in all trimesters was also found to be positively co-related with birth weight. In the same way, in a follow-up study, Bang and Lee (2009) revealed that the folic acid intake was 236.9±96.7 μgDFE, 289.2±108.4 μgDFE and 307.5±139.5 μgDFE in the low, normal and high birth weight groups, respectively. The folic acid intake of the high birth
In the present research, the correlation was also found between meal pattern during 1st and 3rd trimesters, fat intake during 2nd trimester and mode of delivery. But, other remaining nutrients were not correlated with mode of delivery.

There is lack of available literature regarding the association between dietary intake during pregnancy and mode of delivery.

5.4 Other Maternal Attributes:

On the basis of analysis, it was observe that 45.9 percent pregnant women belonged to 20-24 years age group, followed by 25-29 years of age (39.4%). 53.1 percent respondents got married between 20-25 years of age, 41.8 percent respondents got married above 25 years of age. The mean age and age at marriage of the respondents was 24.58±3.75 years and 20.41±3.22 years respectively in this study.

According to per capita income 45.9 percent pregnant women belonged to poor group, followed by 31.5% in Below Poverty Line with only 6.5% respondents in high-upper high group. The findings revealed that the mean value of per capita income was 1337.70±1887.17 rupees. That is, most of the pregnant women belonged to poor socioeconomic status in the present study. A family’s socio economic status is based on family income, parental education level, parental occupation and social status in the community. Educational level may be the strongest and most consistent socioeconomic status predictor of health. A low educational level limits access to jobs and other social resources, especially in industrialized countries, and thus increases the risk of poverty.

In this study, the educational level revealed that 32.9% of pregnant women were illiterate, where as the remaining 67.1% had educational level from primary to post graduation.

The mean value of gravida was 2.22±1.27 that is most of the respondents were pregnant for the second time. The mean value of parity was
found to be 0.92±1.05 which revealed that most of the respondents were primipara i.e. women who delivered one viable child. The result also shows that the birth interval from last birth was below 2 years (22.38±26.13 months).

In Tables XXXVIII-LV, the distribution and co-relation between maternal age, age at marriage, socio-economic status, education, gravida, parity, number of children and birth interval with pregnancy outcome has been given. In this study, only maternal education was found to be positively correlated to gestational period at the significant level of 0.01.

In favor of this study, other studies reported that the educational level was associated with small-for-gestational age (Millar and Chen, 1998 and Raum et al. 2001) and preterm birth (Savitz et al. 2004).

In this study, no correlation was found between age and gestational period. On the contrary, other studies reported that the advanced maternal age (40 years or older) compared with younger age, was associated with significantly higher rates of preterm delivery, cesarean delivery, still births (Seoud et al. 2002, Chibber, 2004, Delbaere et al. 2007, Huang et al. 2008, Jahromi et al. 2008 and Muganyizi et al. 2008).

In a study of effect of the interpregnancy interval on perinatal outcomes in Latin America, Conde-Agudelo et al. (2005) have compared with infants with interpregnancy intervals of 18-23 months, those born to women with intervals shorter than 6 months had an increased risk of early neonatal death (adjusted odd ratio OR 1.49, 95% confidence interval CI 1.06-1.96), fetal death (adjusted OR 1.54, 95% CI 1.28-1.83), low birth weight (adjusted OR 1.88, 95% CI 1.78-1.90), very low birth weight (adjusted OR 2.01, 95% CI 1.73-2.31), preterm birth (adjusted OR 1.80, 95% CI 1.71-1.89), very preterm birth (adjusted OR 1.95, 95% CI 1.67-2.26), and small for gestational age (adjusted OR 1.30, 95% CI 1.25-1.36). Intervals of 6-11 months and 60 months and longer were also associated with a significantly greater risk for the adverse perinatal outcomes.

The findings revealed that a progressive increase found in crown heel length of newborn with increase in the maternal socioeconomic status, parity
and number of children. Therefore, maternal educational level, socioeconomic status, parity and number of children of pregnant women were significantly associated with length of newborn at 0.05 significant level in this study. There is lack of available literature regarding the correlation of maternal education, socioeconomic status, parity and number of children with length of newborn.

Present research revealed that the progressive increase found in weight of newborn with increase in the maternal age, age at marriage, socioeconomic status and education. Therefore, maternal age, age at the time of marriage, socioeconomic status and education were positively correlated to birth weight at 0.05 level of significance.

A decreasing trend was found in weight of newborn with increasing gravida, parity and number of children. Therefore, gravida, parity and number of children were found to be negatively correlated to birth weight at 0.05 level of significance.

The findings of present study are supported by a large number of other researches. Feleke and Enguoselassie (1999) revealed that maternal age had significant effects only on the birth weight of the neonates.

The baby birth weight increased as maternal age increased but this increase was not observed among advanced maternal ages (Malik et al. 1997, Kapilashrami et al. 2000, George et al. 2003, Demir and Demir, 2006 and Shajari et al. 2006).

As reported in daily news paper Dainik Jagran, Aligarh, June 14 2010, a 66-year-old Indian woman has become the oldest person in the world to give birth to triplets (2 male and 1 female) after IVF treatment (In Vitro Fertilisation) at the National Fertility Centre in Haryana. However, the doctors said the triplets, weighing 2lb 6oz, 2lb 4oz and 1lb 7oz, were being monitored in the intensive care unit of the centre in Hissar (Annexure-9). In the same way, ANI( Feb 14, 2011) reported that in London, A 61-year-old woman in the US made history after she gave birth to her own grandson that was being surrogate for her daughter.
In addition to the maternal age during pregnancy, maternal age at marriage was also significantly associated with birth weight. In the same way, Sawchuk et al. (1997) also reported that the overall mean birth weight was 3344.15 g in their study. After controlling for sex, gestational age, and socioeconomic status, the infants of mothers 20 years of age and over who conceived after marriage weighed 57.78 g above the referent group mean. Older mothers who conceived a child before marriage delivered infants weighing 75.67 g below the group mean. Mothers under 20 years of age who conceived within marriage had infants who weighed 37.32 g less than the mean, while those delivered by young mothers who conceived before marriage had infants weighing 133.66 g less than the overall mean birth weight.

Similarly, other studies regarding weight of newborn reported significant association between birth weight and socio-economic status (Hirve and Ganatra, 1994, Kapilashrami et al. 2000, Mathuravalli et al. 2001, George et al. 2003, Demir and Demir, 2006 and Joshi and Pai, 2007). On the other hand, in a cohort study, Tuntiseranee et al. (1999) found that the mean birth weight correlated with socioeconomic status and income but after adjustment for parity, maternal age and height, weight at delivery day, baby sex, obstetrical complications and antenatal care utilization, only family income remained correlated with birth weight.

Similarly, other studies reported significant association between birth weight and maternal educational level (Hirve and Ganatra, 1994, Kapilashrami et al. 2000, Mridula et al. 2002, Demir and Demir, 2006 and Joshi and Pai, 2007).

Several earlier studies revealed that the parity was associated with birth weight (Hirve and Ganatra 1994, Deshmukh et al.1998, Kapilashrami et al. 2000, George et al. 2003, Bisai et al. 2006 and Shajari et al. 2006).

However, MacLeod and Kiely (1988) have reported that birth weight was increased from parity 1 to parity 3, but dropped markedly in the higher parity groups. At the same way, Demir and Demir (2006) have revealed that the birth weight increased as deliver numbers increased (until 5 deliveries) and
this increase was statistically significant (p<0.001). But baby birth weights of women who delivered 5 times and over were low.

The literature regarding the correlation of gravida and number of children with weight of newborn is not available.

In the present study, maternal age at marriage, socioeconomic status, education and parity were found to be positive correlated to mode of delivery. Similar result was reported by Isaranurug et al. (2006) that teen age (<20 years of age) mothers had a higher proportion of normal deliveries compared to adult mothers.

On the contrary, Kumar et al. (2010) reported that the vaginal delivery was almost double in women with a higher order parity (>3), (OR 1.8, 95% CI 0.96-3.45). In a study of short interpregnancy interval: risk of uterine rupture and complications of vaginal birth after cesarean delivery, Stammlio et al (2007) have concluded that a total of 128 cases (0.9%) of uterine rupture occurred, and 286 (2.2%), 1109 (8.3%), 1741 (13.1%), and 2631 (19.7%) women had interpregnancy intervals of less than 6, 6-11, 12-17, and 60 months or more, respectively. An interval less than 6 months was associated with increased risk of uterine rupture (adjusted OR 2.66, 95% CI 1.21-5.82), major morbidity (adjusted OR 1.95, 95% CI 1.04-3.65), and blood transfusion (adjusted OR 3.14, 95% CI 1.42-6.95). Long interpregnancy interval was not associated with an increase in major morbidity.

Maternal age was found to be insignificantly correlated with mode of delivery in this study. In the contrary, Vijayalaxmi and Urooj (2009) found that the caesarean as mode of delivery was comparatively more among women of more than 25 years age groups and the association between age-group and mode of delivery was statistically non-significant.

There is lack of available literature regarding the association between maternal education, socioeconomic status, gravida and number of children and mode of delivery.
5.5 Maternal Hemoglobin Status:

During the antenatal period, anemia 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 relation between the maternal hemoglobin status and pregnancy outcome.

The findings of the present study revealed that the mean values of maternal hemoglobin level during 1st, 2nd and 3rd trimesters were 9.41±0.94g/dl (moderate anemia), 9.59±0.99g/dl (moderate anemia) and 9.54±0.89g/dl (moderate anemia), respectively. Only 2.4%, 0.7% and 1.4% pregnant women had normal level of hemoglobin during 1st, 2nd and 3rd trimesters respectively. The 90.8%, 49.0% and 77.0% pregnant women were anemic during 1st, 2nd and 3rd trimesters, respectively. The results also reported that the 6.8%, 50.3% and 21.6% pregnant women did not undergo the hemoglobin test during 1st, 2nd and 3rd trimesters respectively because these women belong to poor socioeconomic status were not aware about the importance of the hemoglobin status of pregnant women. In this study, the inadequate amount of iron and folic acid intake, low socioeconomic status and lack of awareness related to health concerns may be the major determinants of anemia. Routine iron and folic acid supplementation is recommended during pregnancy to avoid the deleterious effect of anemia on pregnancy outcome.

Similarly, Shobeiri et al. (2006) also reported that in the first and second trimesters, 45% to 49% women were anemic, whereas 16% were anemic in the third trimester. Normal concentration of hemoglobin in all the 3 trimesters was found to have a significant influence on birth weight. Mothers having highest hemoglobin concentrations exhibited the lowest percentage of infants with low birth weight infants (7.1% and 1.2%). This indicates the importance of normal hemoglobin concentrations in the first trimester on pregnancy outcome.

Tables LVII-LIX depicted the distribution and correlation between maternal hemoglobin status during each trimester and pregnancy outcome. A progressive increase was found in the gestational period with increased maternal hemoglobin level during 3rd trimester. Thus, hemoglobin level during 3rd trimester was found to be positively correlated to gestational period at 0.05
significant level. Similarly, a number of studies have revealed an increased risk of preterm birth associated with anemia in pregnancy (Bondevik et al. 2001, Levy et al. 2005 and Ren et al. 2007).

On the contrary, recently Chumak and Grjibovski (2010) reported that the anemia was negatively associated with preterm birth.

The findings reported that a decreasing trend found in the crown heel length of newborn with increasing hemoglobin level of pregnant women during all trimesters of pregnancy. Therefore, the hemoglobin during all trimesters was negatively correlated to length of newborn at the 0.01 significant level. There is lack of available literature regarding the association between hemoglobin level and length of newborn.

In this study, as hemoglobin level of pregnant women during 1st trimester increased, the weight of newborn was found to be decreased. Thus, the results reported that the hemoglobin level during 1st trimester was negatively correlated to birth weight. Similarly, Amburgey et al. (2009) found that the maternal hemoglobin z-score was inversely associated with birth weight percentile (r=-0.18, p=0.03).

However, several studies revealed that the anemia was significantly associated with low birth weight (Hirve and Ganatra, 1994, Deshmukh et al. 1998, Bondevik et al. 2001, Malhotra et al. 2002, Levy et al. 2005, Ren et al. 2007, Varma et al. 2008, Kumar et al. 2010 and Mosha and Philemon 2010). Paul and Purushothaman (2002) also found that the birth weight was positively correlated with selected iron indices such as serum iron, total iron binding capacity and percent transferring saturation and babies with low birth weight were born to anemic mothers with hemoglobin levels lower than 8g percent. Placental weight was also found to be decreasing with decline in hemoglobin levels.

Hemoglobin level during 1st trimester was significantly associated with mode of delivery at the 0.001 significant level in this study. Similarly, in a cohort control study, Nasiri-Amiri et al. (2007) revealed that the operative delivery in women with low and high hematocrit was more than those with normal hematocrit values (p<0.001).
However, there was a significant difference between the anemic groups in the mode of delivery. Surgically delivered babies were significantly more in anemic than in non-anemic group (16 vs. 1, p=0.021) but comparable between the iron deficient and iron adequate group (8 vs. 9) (Ugwuja et al. 2010).

5.6 Maternal Blood Pressure Status:

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) to be delivered prematurely and in very severe cases to be still born (death). So, the maternal blood pressure status will be associated with pregnancy outcome.

The findings of present study revealed that the majority of the pregnant women show systolic blood pressure (86.6%, 91.1% and 84.9% during 1st, 2nd and 3rd trimesters) and diastolic blood pressure (79.5%, 80.1% and 77.7% during 1st, 2nd and 3rd trimesters) in normal range. But only few pregnant women had maternal systolic blood pressure above 120 mmHg (4.8%, 6.2% and 11.3% during 1st, 2nd and 3rd trimesters) and diastolic blood pressure above 80 mmHg (6.5%, 7.9% and 13.4% during 1st, 2nd and 3rd trimesters) in above normal range. Factors of significance in these women may be the maternal age, under nutrition and low socioeconomic status.

The results reported that an increasing trend found in the gestational period, and crown heel length of newborn with increasing systolic and diastolic blood pressure of pregnant women during 3rd trimester of pregnancy. Therefore, systolic and diastolic blood pressures during 3rd trimester were significantly correlated with gestational period and length of newborn at the 0.01 level of significance in this study. There is lack of available literature regarding the association between blood pressure and gestational period and length of newborn.

In the same way, as normal range of systolic and diastolic blood pressure of pregnant women during 2nd and 3rd trimesters increased, the weight of newborn was found to be increased. Thus, positive correlations were found between systolic and diastolic blood pressure during 2nd and 3rd trimesters and birth weight. Similarly, in a prospective study Jaysree and Kavitha (2004)
revealed that the perinatal outcome in terms of type of birth and birth weight highly associated with pregnancy induced hypertension. They also revealed that the incidence of preterm babies delivered between the seven to nine months was 31 percent and among these 43 percent belonged to low birth weight.

In the present study, systolic and diastolic blood pressure during all trimesters was found to be significantly associated with mode of delivery (p<0.01). In the same way, Hauth et al (2000) was also observed 4302 women (to or beyond 20 weeks’ gestation), from which 1073 (24.9%) developed mild or severe pregnancy-associated hypertension or pre-eclampsia. 116 women of the 1073 with hypertension (10.8%) and 336 of the 3229 without hypertension (10.4%) were delivered before 37 weeks’ gestation. Fetal and neonatal mortality were similar in those groups; however, selected maternal and newborn morbidities were significantly greater in women with hypertension. Significantly increased maternal morbidities included increased cesarean deliveries, abruption placentae, and acute renal dysfunction; and significantly increased perinatal morbidities included respiratory distress syndrome, ventilator support, and fetal growth restriction.

5.7 Most Confounding Maternal Factors for Pregnancy Outcome

Tables LXVII, LXIX and LXXI pointed out the variables which found to be statistically significant on applying correlation coefficient test with pregnancy outcome such as gestational period, crown heel length and weight of newborn at 5% level of significance, respectively. The variables with p-value=0.00 are among the most significant factors.

The results revealed that the diastolic blood pressure during 3rd trimester was only the most significantly correlated variable with the gestational period. Whereas, maternal height, BMI in all trimesters, hemoglobin level during 1st and 2nd trimesters and systolic blood pressure during 3rd trimester were the most significantly correlated variables with the crown heel length of newborn.

The most significantly correlated variables with the weight of newborn were maternal height; weight in 3rd trimester; weight gain; meal pattern, calorie, protein, calcium, iron, fat intake during all trimesters; folic acid intake during
1\textsuperscript{st} and 2\textsuperscript{nd} trimesters; maternal age at marriage; socioeconomic status; gravida and SBP during 3\textsuperscript{rd} trimester.

A stepwise multiple regression was performed to determine the combination of factors that best predict pregnancy outcome such as period of gestation, crown heel length and weight of newborns which represented in Tables LXVIII, LXX and LXXII respectively. The results of stepwise multiple regression reported the 14 percent combined effect of most significant factors on period of gestation \((r^2=0.140, F=9.324, p<0.001)\) in Table LXVIII. Maternal DBP in 3\textsuperscript{rd} trimester \((r^2=0.050)\) contributes the most to the regression variance, followed by meal pattern in 1\textsuperscript{st} trimester \((r^2=0.038)\), iron intake 1\textsuperscript{st} trimester \((r^2=0.019)\), calcium intake 3\textsuperscript{rd} trimester \((r^2=0.020)\) and hemoglobin level 3\textsuperscript{rd} trimester \((r^2=0.013)\). In this way, the results confirmed that the preterm birth associated with high diastolic blood pressure, decreased number of meal in 1\textsuperscript{st} trimester, low intake of iron intake in 1\textsuperscript{st} trimester and calcium intake in 3\textsuperscript{rd} trimester and anemic during 3\textsuperscript{rd} trimester.

Despite the various studies done on the different factors affecting gestational period, there is lack of enough research regarding the second and third most confounding factors for gestational period i.e. meal pattern and iron intake during 1\textsuperscript{st} trimester.

First most confounding factor for gestational period was found to be diastolic blood pressure. Similarly, in a prospective study, Jayasree and Kavitha (2004) studied that the perinatal outcome in terms of type of birth and birth weight highly associated with PIH. The incidence of preterm babies delivered between the months of seven to nine was 31 percent and 43 percent belonged to low birth weight. Generally prematurity was due to the severity of PIH and in some cases, when the diastolic pressure rose to 130 mmHg, were given syntocinon injection for contraction of uterine walls to deliver the baby immediately before the term.

Fourth most confounding factor found to be the calcium intake during 3\textsuperscript{rd} trimester. Similarly, Belizan et al. (1991) and Repke and Villar (1991) suggested that calcium supplementation may reduce the incidence of gestational hypertension, preterm delivery and, possibly, pre-eclampsia.
The last or fifth variable among the most confounding factors was found to be the hemoglobin level during 3\textsuperscript{rd} trimester. In the same way, a number of studies have revealed an increased risk of preterm birth (Bondevik et al. 2001; Levy et al. 2005 and Ren et al. 2007) associated with anemia in pregnancy.

Table LXX presented that the crown heel length of newborn found to be significantly related to maternal height, parity, body mass index and hemoglobin level during 1\textsuperscript{st} trimester, iron intake during 2\textsuperscript{nd} trimester, meal pattern and diastolic blood pressure during 3\textsuperscript{rd} trimester ($r^2=0.641$, $F=72.099$, $p<0.001$). Among these factors maternal height ($r^2=0.574$) contributes the most to the regression variance, followed by parity ($r^2=0.025$), BMI 1\textsuperscript{st} trimester ($r^2=0.014$), meal pattern 3\textsuperscript{rd} trimester ($r^2=0.009$), DBP 3\textsuperscript{rd} trimester ($r^2=0.008$), hemoglobin level 1\textsuperscript{st} trimester ($r^2=0.005$), iron intake 2\textsuperscript{nd} trimester ($r^2=0.006$). The results recognized that the low crown heel length was related with short stature of mother, high parity, undernourished mother (low BMI), less number of meal pattern, low and high diastolic blood pressure, low hemoglobin level and iron intake during pregnancy.

Despite the various studies done on the different factors affecting crown heel length of newborn, there is lack of enough research regarding almost all the confounding factors for crown heel length except iron intake during 2\textsuperscript{nd} trimester.

The last or seventh variable among the most confounding factors was found to be the iron intake during 2\textsuperscript{nd} trimester for crown heel length. Similarly, in a study of effect of different levels of iron supplementation on maternal iron status and pregnancy outcome, Mehta et al. (2004) observed a linear correlation between maternal hemoglobin, serum ferritin and infant’s birth weight and birth length. The highest level of iron supplementation had the heaviest and tallest infant.

In addition to the above discussion on the combination of factors that best predicted the gestational period and crown heel length of newborn; Meal pattern in 3\textsuperscript{rd} trimester ($r^2=0.279$), weight gain during pregnancy ($r^2=0.069$), iron intake in 1\textsuperscript{st} trimester ($r^2=0.047$), SBP 3\textsuperscript{rd} trimester ($r^2=0.027$), fat intake 3\textsuperscript{rd} trimester ($r^2=0.011$), hemoglobin level 1\textsuperscript{st} trimester ($r^2=0.011$), fat intake in
1st trimester ($r^2=0.009$) and maternal age at marriage ($r^2=0.007$) had significant effects on weight of newborn. The result of stepwise multiple regression revealed the 46 percent combined effect of most significant factors on the weight of newborn ($r^2=0.460$, $F=30.267$, $p<0.001$) which depicted in Table LXXII. In this study, the low birth weight was associated with less number of meal pattern, low weight gain during pregnancy, lower intake of iron and fat intake, high and low systolic blood pressure, low hemoglobin level during pregnancy and low maternal age at marriage.

Despite the various studies done on the different factors affecting weight of newborn, there is lack of enough research regarding the first most confounding factor, meal pattern during 3rd trimester for weight of newborn. Second most confounding factor for weight of newborn was found to be weight gain during pregnancy. Similarly, in a longitudinal study of pre-pregnancy body mass index, gestaional weight gain in Urmia, Iran, Yekta et al. (2005) observed that 26% of pregnant women with normal weight gain belong to high risk age group (18 or >35), but did not differ significantly between age group and weight gain patterns. The abnormal weight gain during pregnancy was not related to an increased risk of preterm labor (6.1 vs 5.8%) or cesarean delivery (30.7 vs 26.9%). Researcher extent the findings and revealed that the abnormal maternal weight gain during pregnancy was highly associated with low birth weight (12.2 vs 6.1% $p<0.05$).

The third variable among the most confounding factors was found to be the iron intake during 1st trimester. In the same way, Mridula et al. (2002) found that the mothers' with iron intake ≤30 mg/d delivered the newborns of low birth weight.

Systolic blood pressure during 3rd trimester was the fourth most confounding factor for the weight of newborn. Similarly, Agarwal and Agarwal (2004), in their study found that the majority of the rural women to be in normal blood pressure range with less than 1% prevalence of pregnancy induced hypertension. They attributed the prevalence of 26.4% low birth weight found in their study to poor nutrition and low socio economic index along with prevalence of hypertension.
The fifth and seventh variables among the most confounding factors were found to be the fat intake during 3rd and 1st trimesters, respectively. In the same way, Olsen et al. (1992) reported that the fish oil consumption increases birth weight. Similarly, Weigel et al. (1991) also revealed that the higher dietary fat intake was associated with increased birth weight.

Hemoglobin level during 1st trimester was the sixth most confounding factor for the weight of newborn. The result of present study was similar to other studies on hemoglobin level. Abeysena et al. (2010) reported that the anemia during pregnancy was not adversely associated with any of the pregnancy outcomes but Hb level of >13.9 g/dl was adversely associated with maternal morbidities and LBW. Similarly, Singla et al. (1997) also revealed that all indices of fetal growth showed linear relationships with maternal hemoglobin, as well as with serum ferritin. The growth retarding effect of maternal anemia was more on fetal birth weight and mid-arm circumferences than on other anthropometric indices of the newborn.

Eighth or the last most confounding factor for weight of newborn was found to be maternal age at marriage. Similarly, in a community based longitudinal study, Joshi and Pai (2007) found that the mother’s age at marriage was significantly associated with birth weight. This may be due to the fact that an early marriage usually leads to early (teenage) pregnancy, when the body is still in the process of biological growth. Also early marriage leads to larger number of pregnancies with inadequate spacing, which may also lead to low birth weight babies. This factor lacks sufficient literature from India as well as other developing and under developed countries.

Sensitizing the pregnant women on the importance of above mentioned most confounding factors is a suggestion to the existing problems such as preterm birth, low crown heel length and low birth weight revealed in the study.