CHAPTER – II

REVIEW OF LITERATURE
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“The end of all learning is to know God, and out of that knowledge to love and imitate Him.” (John Milton)

This chapter deals with the review of related literature. Literature review provides a consideration of what has been studied previously. It identifies gaps in the current research, highlights areas of needed change, increases awareness about practice and helps sharpen and focus a research question.150

Literature review involves the systematic identification, location, screening and summary of written material that contains information on a research problem.151

Familiarizing with practical and theoretical issues related to a problem area often helps the researcher to generate ideas or focus on a research topic.

Review of literature help in collecting information as to what has been already done in selected research area, what methodology has been used, what needs to be done in future and what conclusions were drawn from the earlier studies.

An extensive review of literature from various disciplines like obstetrics, neonatology, maternal and child health nursing etc. were reviewed in order to develop insight into the research problem in general and various aspects of selected problem area under study in particular.

Literature review served the purpose of developing methodology, formulating conceptual framework, developing the tool for data collection, developing intervention program (low birth weight prevention program – LBWPP), organizing and analyzing the data.

The literature reviewed has been organized in following areas:

5. Studies related to association of various risk factors with maternal and fetal outcome.
II.1) Studies related to maternal risk factors during pregnancy responsible for low birth weight.

Behrman and Kramer\textsuperscript{152} carried out a study in US on risk scoring in pregnancy and classified the risk factors of low birth weight into seven categories namely genetic, constitutional, demographic, nutritional, medical and obstetrical risk factors. The presence of these risk factors in an individual woman indicates that the woman has increased chances of bearing a low birth weight baby.

Dutta and Dass\textsuperscript{10} studied 200 high risk pregnant women in West Bengal to find out relation of risk factors with low birth weight. They identified 5% of women as high risk and out of all low birth weight babies, 67.2% were born to these mothers and they have indicated higher rates of adverse perinatal outcome.

Talsania and Lala\textsuperscript{13} conducted a study in India on 900 pregnant women to identify the risks associated with pregnancy and its outcome using ICMR risk scoring system. The findings revealed that 81.6% of pregnant women had associated high risk factors. The higher the risk score, the less likely a woman had normal delivery. The incidence of premature birth was significantly higher among women with higher risk score (95.77%; \textit{p}<0.001).

Talsania and Lala\textsuperscript{153} conducted a study in India to evaluate antenatal risk scoring in prevention of preterm birth and perinatal loss. They scored women according to their level of risk i.e.; no risk, mild risk, moderate risk and severe risk based on socio demographic and obstetric data i.e.; pallor, maternal weight, two or more prior abortions, primiparity, grand multiparity, adolescent pregnancy, prior preterm delivery and prior perinatal mortality. They revealed that out of 696 deliveries, there were 71% preterm births, out of which 3% were among women with no risk, 11.8% with mild risk, 14.08% with moderate risk and 20% from severe risk group.

Bobak\textsuperscript{57} defines a high risk pregnancy as one in which the life or health of a mother or fetus is jeopardized. He categorized the factors responsible for high risk pregnancy as follows:

i. Maternal Characteristics like age: 20 years or less, weight: less than 45 kg, height: less than 145cm, poor socio-economic status and BMI > 26.
ii. Behavioral Risk Factors like dietary deficiency, smoking, exposure to illicit
drugs/coffee/smoke/pollutants etc.

iii. Pre-existing medical disorders like heart disease, hypertension, diabetes, anaemia,
hepatitis, thyroid disorders, pulmonary disease (e.g., tuberculosis), renal diseases
(e.g., Pyelonephrites), genital infection (e.g., STD), asymptomatic bacteriuria, any
major injury or accident, any surgery, premature rupture of membranes (PROM)
etc.

iv. Pregnancy disorders (in past or present pregnancy) like abortions, uterine
malformations, twin pregnancy, antepartum haemorrhage, gestational diabetes,
pregnancy induced hypertension, toxemia, birth of low birth weight baby/preterm
baby, baby with congenital defects, perinatal deaths.

Sunderka and Kacchap\textsuperscript{154} conducted a study in India on 200 pregnant women to screen
them for high risk pregnancy. They observed adverse outcome in high risk group women
with bad obstetric history or significant medical ailments like hypertension, diabetes,
renal disorder etc, current pregnancy disorders like antepartum haemorrhage, pregnancy
induced hypertension, premature rupture of membranes, breech etc. The incidence of low
birth weight was found increased from 3.06\% in low risk group to 53.85\% in high risk
group.

The risk factors associated with pregnancy leads to stunted growth of fetus due to low
fetal oxygen delivery, placental insufficiency, and effect of drugs, infections and poor
diet.\textsuperscript{9}

All pregnancies and deliveries are potentially at risk. However, there are certain
categories of pregnancies where the mother, the fetus or neonate is in a state of increased
jeopardy. About 20-30 percent pregnancies belong to this category. The risk factors
maybe pre-existing, prior to or at the time of first antenatal visit or may develop
subsequently in the ongoing pregnancy and are associated with demographic
characteristics, medical risk, obstetrical risk or behavioural risk.\textsuperscript{6}

Mufti\textsuperscript{8} studied correlation of high risk pregnancy with perinatal outcome in Srinagar,
India. This case control study was conducted on 400 women attending the outpatient
department or admitted for safe confinement in various units of LD Hospital Srinagar,
during their third trimester. She revealed that the incidence of low birth weight increased
from 1.5% in no risk group to 12.3% in low risk; 17.64% in moderate risk and 48.48% in high risk group. The incidence of low birth weight babies in women with risk factors was 17.11 times more than in women with no risk and this association was significant (p<0.00002). The incidence of low birth weight babies in women of high risk group was 61.8 times higher. The incidence of preterm births increased from 2% in control group to 12.32% in low risk group to 15.68% in moderate risk and 24.24% in high risk group. 44 babies in case group and 2 babies in control group had Apgar score <7 and majority of high risk women delivered by instrumental vaginal or caesarean section. Regarding perinatal mortality, it was found high in low (<16 years) or high age group (above 35 years), in grand multiparas (25%). The most common cause reported for perinatal morbidity and mortality were low birth weight (20.6%), birth asphyxia (17.3%) and prematurity (16.3%).

High risk pregnancy are the cases where the obstetric future is likely to be affected by the previous obstetric mishaps which include still birth/ neonatal deaths, congenital anomalies, third stage accidents, prematurity, postmaturity, intra-uterine growth retardation, multiple pregnancy, pre eclampsia, eclampsia, obstructed labour, injuries to rectum or bladder, previous abortion or previous caesarean section.  

All-Nsour conducted a historical prospective study of 260 pregnant women with 28 weeks gestation or more who attended Al-Bashir Hospital, Iran for delivery. Structured home visits and telephone inquiries/interview were conducted for each pregnant woman to collect information about risk factors that occurred during antepartum period. Based on this information, mothers were assigned to a high risk or low risk group using antepartum risk evaluation forms. The prevalence of high risk pregnancies was 28.1% and there was significant association of high risk pregnancy with neonatal low birth weight, low Apgar score, frequent admission to neonatal intensive care unit and prolonged stay over there. Neonatal mortality rate was 72.4/1000 of total live births.

Goldstein and Mayo-clinic conducted preterm birth prevention essays and reported that the most common risk factor for preterm labour include cigarette smoking or use of illicit drugs, poor socioeconomic status, lower genital tract infections, some chronic conditions like hypertension or diabetes, maternal age below 16 or above 35, low pre-pregnancy weight, twin pregnancy, stressful life events, poor diet, lack of prenatal care, abortions.
March of Dimes\textsuperscript{157} conducted preterm birth prevention program in South Carolina and reported several categories of preterm birth risk factors which included:

a. General Risks (previous preterm birth/ premature rupture of membranes, vaginal bleeding, multiple pregnancy)

b. Anatomical Risks (uterine or placental abnormalities)

c. Environmental Risks (poor nutrition, smoking, stress, advanced maternal age, adolescent pregnancy, late or limited prenatal care, dehydration.

d. Infectious Risks (STD, UTI, vaginal infections).

Krans\textsuperscript{158} conducted a study in New York on prenatal risk and failure to reinvent prenatal care with a view to prevent low birth weight. He divided risks into three broad categories:

i) Medical risk including maternal co morbidity e.g. hypertension, gestational diabetes.

ii) Psychological risk including chronic maternal stress, abuse, psychological problem, lack of social support.

iii) Low risk including absence of medical or psychological risk.

He referred first two as high risk because they are at increased risk of adverse birth outcomes. He further suggested that a standardized prenatal model can improve birth outcomes of high risk patients.
II.2) Studies related to effect of Anaemia on outcome of Pregnancy.

Roy and Chakraborty\textsuperscript{159} studied maternal and perinatal outcome among severe anaemia in West Bengal and showed that haemoglobin of <10g\% had increased the incidence of low birth weight by 46.31\%. They related anaemia with poor socio economic status and malnourishment. Mothers with severe anaemia (<6g \%) needed blood transfusion in higher proportion as compared to women whose haemoglobin was >8g\%. Their findings revealed that 2\% of women had still birth and 11.3\% mothers had premature rupture of membranes that further increased the incidence of having babies with low birth weight due to prematurity.

Bodole et al\textsuperscript{160} studied association of fetal growth with diet intake, haemoglobin and antenatal care and reported its direct impact on the fetal growth and their birth status. They observed fetal distress more in women who were anaemic (68.2\%), who had not completed their antenatal checkups (33\%) and who had poor dietary intake (22.14\%).

Swain\textsuperscript{161} studied effect of anaemia on maternal and neonatal outcome in Spain and reported that haemoglobin of <11.0g\% was significantly associated with low birth weight.

Nayar\textsuperscript{162} studied 216 live born infants for maternal determinants in low birth weight at Kasturba Health Training Centre, Sevagram and observed that low birth weight has a significant association with maternal haemoglobin level. Incidence of low birth deliveries was 39.8\%. The mothers who were anaemic with haemoglobin less than 11g\% were 86.2\%.

Saxena\textsuperscript{163} studied the effect of maternal anaemia on the newly born infant in Delhi and reported an increased incidence of low birth weight (47.3\%) in severely anaemic mothers as compared to only 12\% with normal haemoglobin mothers in Indian conditions.

Chandra and Agarwal\textsuperscript{164} studied nutritional aspect of anaemic women in Haryana with special reference to pregnancy and reported fetal distress and birth of premature distressed baby more in women (48.36\%) with inadequate dietary intake who needed emergency hospitalization for blood transfusions or fetal distress. They also revealed adverse labour outcome in these women. These included caesarean births, severe asphyxia of new born, haemorrhage.
Deshmukh et al. studied low birth weight on 827 neonates and associated maternal factors in an urban area of Uttar Pradesh. The associated maternal factors revealed by them included maternal haemoglobin level < 10g% (48%); hypertension (33%); young age <20 years (24%); advanced age >35 years (12%) etc. The association between maternal anaemia and low birth weight was significant (p<0.01).

Singh et al. did a hospital based case controlled cross sectional study to determine the prevalence and predictors of anaemia in pregnancy at National University Hospital Singapore. Data was collected with regard to their haemoglobin level, antenatal progress, and factors predisposing to anaemia in pregnancy. The most common cause of anaemia in pregnancy was due to iron deficiency (81.3%). Multiparous women of the lower socio-economic class who tend to book late in pregnancy were found to have the highest risk of anaemia. Multivariate logistic regression analysis revealed iron prophylaxis, haemoglobin level at booking, race and previous history of anaemia in earlier pregnancy as important predictors of anaemia at delivery. His findings further revealed that a pregnant woman with a previous history of anaemia had 2.6 times higher incidence of anaemia. Except for a higher incidence of preterm delivery, there was no other statistically increased risk of complications in the antepartum, intrapartum or postpartum periods.

Ali while carrying a study in Srinagar at SKIMS to identify association between early neonatal complications and low birth weight babies, showed a strong association of anaemia with low birth weight. The number of mothers whose haemoglobin was between 6-10.0 g% was 85.25% and they delivered low birth weight babies.

Gardosi and Francis reported growth restriction of fetus with low birth weight among anaemic pregnant women who were exposed to smoke actively or passively in Washington. Exposure to smoke and anaemia in pregnancy have been found to have direct impact on perinatal status. The baby was born distressed, with Apgar score of <7, low birth weight, and were born before they reached their maturity age.

Baig et al. conducted a study to find out the prevalence of anaemia and risk factors of pregnant women in Pakistan, where 1,369 pregnant women enrolled at 20-26 weeks of gestation. Of these subjects, 75% had mild anaemia (haemoglobin from 9-10.9g/dl), 14.8% had moderate anaemia (haemoglobin from 7-8.9g/dl) and only 0.7% was severely
anaemic (haemoglobin less than 7.0 g/dl). This study revealed that non-anaemic women were significantly taller, weighed more and had higher BMI. Anaemic women were found to drink more tea per day with low intake of eggs and meat.

Raman Kutty reported that 50% women had haemoglobin value below 11 g%. Low haemoglobin status, as shown by haemoglobin below 25\textsuperscript{th} percentile was seen associated with low birth weight (16.7\%) than with haemoglobin above 10.5 g% where the incidence of low birth weight was 14.1\%.

Jaleel and Ayesha conducted a cohort study in Lyari General Hospital, Dow University of Health Sciences, Karachi, Pakistan, from January 2007 to July 2008 to determine the association between severe anaemia and maternal and perinatal complications. Fifty one pregnant women, admitted for delivery and having severe anaemia were studied and compared with 108 non-anaemic women of similar demographic features. Pearson, Chi Square and Fischer Exact tests were used to calculate significance of results. They reported that Frequency of anaemia was 69.9\% and that of severe anaemia was 4.8\%. Post-partum haemorrhage occurred in 9.8\% of cases as compared to 0.9\% of controls (p = 0.013). Frequency of infection of surgical wound was 7.8\% in cases and none in controls (p = 0.010). Preterm birth was seen in 23.5\% cases and 10.2\% controls (p = 0.026). Of the severely anaemic mothers, 29.6\% babies were low birth weight (p = 0.022) and 27.8\% were small for gestational age (p = 0.001), as compared to 14.5\% and 8.2\% of controls, respectively. They concluded that severe maternal anaemia carries significant risk of haemorrhage and infection in the mother. It is also associated with preterm birth, low birth weight and small for gestational age infants, as well as low Apgar score and high perinatal mortality.

Kalaivani etal carried out a study at an urban institute in Delhi on 3698 pregnant women who attended antenatal clinic and were screened for anaemia. They reported that 2-7\% of pregnant women had haemoglobin values of< 7g/dl and 15-20\% had haemoglobin value of< 8g/dl. The results indicated that 80\% of women were anaemic and 20.1\% had haemoglobin between 5-7.9g/dl. The study concluded that anaemia in pregnancy remains major public health problem associated with increased risk of low birth weight deliveries.
Barbin et al\textsuperscript{170} investigated prevalence of anaemia during pregnancy in malaria endemic area in Papua, New Guinea. The study revealed high prevalence of anaemia in this population with 44\% in primigravidae and 29\% multigravidae having severe anaemia with haemoglobin less than 8g/dl after 28 weeks of gestation. The study also revealed that risk of severe anaemia was significantly associated with splenomegaly, iron deficiency for all gravida and increased number of low birth weight was shown for primigravida with values below 8g/dl but the prematurity rate was not significantly increased indicating that the majority of babies were growth retarded. Early pregnancy anaemia and iron deficiency were also related to the risk of low birth weight in primigravida.

Hiremath et al\textsuperscript{171} studied prevalence of anaemia among women in community health centre, Bagalkot. They revealed that anaemia was found in women married at <18 years, women who had first pregnancy at <20 years (72.62\%), women who were grand multipara (42.08\%), women with urinary tract infection (94.64\%) and respiratory tract infection (90\%). The pregnancy outcome was adversely affected in 64.11\% and incidence of low birth weight was 53\%.

Muhammad\textsuperscript{172} studied effect of maternal anaemia on birth weight to determine whether maternal anaemia would affect the birth weight of the baby and compare this with that of non-anaemic mothers. It was a cross-sectional comparative study carried out at the maternity ward of Fauji Foundation Hospital, Rawalpindi, Pakistan from May 2009 to October 2009. One hundred pregnant women with age 16 years and older and a singleton pregnancy with a complete medical record were divided into two groups each containing 50 subjects on the basis of consecutive non probability sampling were included in the study. Group-A included 50 anaemic pregnant women and Group-B 50 non-anaemic pregnant women. Information was collected by direct interviewing method through a pre-coded structured questionnaire. The haemoglobin level and birth weights were taken from the labour room record. The findings revealed by them included that the mean age of the mothers in anaemic group was found to be older than the non-anaemic group, i.e., (29.44 versus 27.98), though the difference was statistically non-significant. The number of low birth weight infants (64\%) was statistically very highly significantly more (p<0.001) in the anaemic group of mothers than the non-anaemic group (10\%). The results of this
study showed an association of maternal anaemia in pregnancy with increased risk of LBW babies.

Msuya\(^{173}\) conducted a study to determine the prevalence and possible risk factors for anaemia and its effect on perinatal outcomes among pregnant women attending antenatal care in Moshi Municipality in northern Tanzania. A cohort of pregnant women aged 14-43 years and in their 3\(^{rd}\) trimester, was recruited from two primary health care clinics between June 2002 and March 2004. Interviews, anthropometric measurements and haematological examinations were conducted on 2654 consenting women. Perinatal outcomes were recorded during delivery and at 1 week after delivery. Of the 2654 participants, 47.4% had anaemia (haemoglobin [Hb] <11g/dl), 35.3% had mild anaemia (Hb= 9–10.9g/dl), 9.9% had moderate anaemia (Hb =7- 8.9g/dl), and 2.1% had severe anaemia (Hb < 7 g/dl). Anaemia was significantly more prevalent in HIV-positive (56.4%) than in HIV-negative women (46.7%), \(P = 0.01\). In logistic regression anaemia was independently associated with maternal HIV (OR= 1.5), malaria (OR= 5.2), clinic of recruitment (OR= 1.5) and low income (OR= 1.9). Pregnant women with anaemia were more likely to have low birth weight (LBW) infants. Compared with non-anaemic women, the risk of LBW was 1.6 times and 4.8 times higher for children born to women with moderate and severe anaemia, respectively

Kumar etal\(^{174}\) studied maternal anaemia in various trimesters and its effect on new-born weight and maturity in India. An Observational Study of 1000 mothers admitted for delivery was recruited and their haemoglobin was measured. Haemoglobin in previous trimesters was noted from their antenatal record and these mothers were followed up till delivery. Descriptive statistics was used for baseline characteristics. Comparison of means was done using Student’s t-test. Qualitative variables were compared using Fisher’s exact test. The results indicated that more than 50% of the mothers were anemic at some point of time during their pregnancy and 39% of the mothers were anaemic throughout. Mean birth weight of babies born to anaemic mothers was marginally lower compared to that of babies born to non-anaemic mothers. This difference was statistically significant. There was 6.5% increase in the incidence of low birth weight babies and 11.5% increase in preterm deliveries in mothers who were anaemic in their third trimester.
II.3) Studies related to effect of Hypertension on outcome of Pregnancy.

Skyes\textsuperscript{175} studied fetal outcome in hypertensive pregnant women at Moscow and reported that fetal distress was strongly associated with hypertension during pregnancy (p<0.01). The numbers of the mothers who have undergone premature operation intervention and delivered asphyxiated babies were 12.4%. These babies needed emergency admission and intervention in neonatal intensive care unit.

Singh\textsuperscript{176} studied mortality characteristics of 143 neonates with birth weight less than 2000g at Shrimati Sucheta Kriplani Hospital, Delhi and found that neonatal complications were more common in neonates born to mothers with toxaemia of pregnancy (58.3%), antepartum haemorrhage (44%), prolonged labour (23.14%), vaginal leaking (11.6%) and syntocinon administration (6.54%).

Low\textsuperscript{177} conducted a study in Australia on 600 high risk obstetric patients for evidence of birth asphyxia and reported that intrapartum asphyxia was common in distressed babies born to severely anaemic or hypertensive mothers. The asphyxia was found 8 times higher than normal obstetric population. It further added high significant indicator as toxaemia of pregnancy.

Chabbra\textsuperscript{178} did a prospective study in India on 400 teenage mothers comparing them with 400 pregnant women in age group of 20-29 who were taken as controls. Toxaemia of pregnancy was present significantly in more women of younger age. Incidence of low birth weight babies was 11% and these women were found at higher risk of poor maternal and perinatal outcome.

Barker\textsuperscript{179} studied relation of type 2 diabetes mellitus, hypertension and hyperlipidaemia to reduced fetal growth which they revealed to occur due to placental insufficiency depriving the fetus of essential nutrients. The study was conducted at Perinatal Research Centre, Department of Public Health Sciences, University of Alberta and Edmonton, Canada. The incidence of intra uterine growth retardation related to diabetes was 16.87% and to hypertension was 43.12%.

Salafia\textsuperscript{180} at the University of Connecticut School of Medicine, USA, studied 249 singleton gestations yielding infants less than 1500g, who were investigated for placental
lesions in relation to clinical complications leading to preterm birth and evidence of growth impairment. The placental lesions in very low birth weight depended on the presence or absence of maternal hypertension.

Ananth\textsuperscript{181} studied effect of hypertensive disorders in pregnancy on birth weight, gestational duration and small for gestational age births and found these highly significant (p<0.001).

Chillo\textsuperscript{84} while studying epidemiological correlates of neonatal septicaemia in hospital born neonates at SKIMS Srinagar, revealed that it was strongly associated with low birth weight and small for gestational age babies born to mothers with pre eclamptic toxaemia, anaemia, uncontrolled gestational diabetes and antepartum haemorrhage (p<0.01).

Ali\textsuperscript{85} while studying early neonatal complications in low birth weight babies at Srinagar found out that 24.5% mothers who delivered low birth weight babies were toxaemic.

Martin\textsuperscript{182} conducted a retrospective study among 434 mothers with HELLP syndrome in South Africa to study the effect of increasing maternal weight on preeclampsia. The results revealed by them indicated a significant association between increasing maternal weight and occurrence of preeclampsia at the level of p<0.001. Increasing maternal age was also found to have significant association for occurrence of preeclampsia.

Al Muhim\textsuperscript{183} studied the perinatal outcome in Baghdad among 685 women with preeclampsia. They reported 30.2% premature delivery, 22.8% induced delivery, 14.9% caesarean deliveries and 69.2% spontaneous delivery. Regarding maternal outcome placental abruption was found among 12.6%, oliguria in 7.9% of women and coagulopathy among % 6.01 of women.

Ramussen and Irgens\textsuperscript{184} carried out a population evaluative based study to find out the effects of early and late onset preeclampsia on fetal growth and body proportion in Norway. They found that the birth weight, crown heel length and ponderal index (4.4%, 0.8% and 2.6%) were lower in infants born to women who had late onset preeclampsia.

Xiao\textsuperscript{185} examined the effect of preeclampsia on fetal growth among 155 Chinese women and found that preeclampsia was associated with a 3.8 fold increased risk of low birth weight babies (p<0.01) and 3.6 times increased risk for small for gestational age babies.
Malhotra conducted a retrospective study to compare the pregnancy outcome of 312 women having valvular heart disease with the pregnancy outcome of 321 healthy women at a tertiary care in Delhi. Women with valvular heart disease had higher incidence of hypertension (12.04% vs 9.3%), anaemia (8.65% vs 4.36%), gestational diabetes (0.3% vs 0%) and higher incidence of surgical interventions [13.6% (balloon mitral valvotomy) vs 0.6% (ovarian cystectomy)], congestive heart failure (5.1% vs 0%; p<0.001) and mortality [0.64% (two women) vs 0%] during pregnancy than control group (p<0.001). Perinatal outcome was also more adverse in women having valvular heart disease than in control group, with increased preterm delivery rate (48.3% vs 20.5%), intrauterine growth (5.7% vs 1.5%; p<0.001), reduced birth weight 2434 ± 599g; vs 2653 ± 542g; p<0.001), higher incidence of Apgar score less than 8 (8.3% vs 4%; p<0.01) and higher rates of instrumental delivery (9.9% vs 3.4%).

Agarwal, Goswami and Temp conducted a retrospective study at a tertiary care hospital in New Delhi to find out maternal and perinatal outcome in women with antepartum eclampsia. The mother and baby were followed until discharge or death. They reported that out of 51 eligible women, majority (82%) did not receive antenatal care and 80% were primigravida. At admission systolic and diastolic blood pressure was 156±22 and 104±18 mmHg respectively. 22% mothers delivered by caesarean and 18% by forcep or vacuum and reason for assisted delivery was failed induction, decreased maternal efforts and fetal distress. Blood pressure was persistently high in 33% cases, mean birth weight was 2077±718 and low birth weight was found in 33.12%, asphyxia (Apgar score < 4 at one minute) in 14% and neonatal mortality was 143/1000 live births. Blood pressure above 139/89 mmHg was found high risk factor for low birth weight as 17% of such hypertensive mothers delivered babies with low birth weight in Kerala.

Coelho conducted a study in Brazil to identify maternal and perinatal outcome among hypertensive syndrome of 131 singleton pregnant women and to assess rate of proteinuria. The presence of proteinuria predicted adverse maternal outcome with increase of complications proportional to its elevation. HELLP syndrome was present among 30.5%, eclampsia among 3.8%, renal insufficiency with 0.7% and one maternal death occurred in women with elevated proteinuria. The perinatal outcome observed in comparison with women without proteinuria indicated prematurity (62.2% vs 3.5%),
birth weight of less than 2500g (6.5% vs 5%), 5 minute Apgar score <7 (30.4% vs 3.5%), IUGR (41.9% vs 6.5%), still birth was same in both 1.41%.

**Vreeburg**\(^ {187}\) conducted a retrospective study in South Australia to find out the risk factors for adverse maternal and perinatal outcome among women with hypertension. The perinatal data on 70386 live births were used in multivariate analysis. The risk for maternal, fetal, neonatal and infant morbidities was increased among women with hypertension as compared with normotensive women. They also revealed that operative deliveries (66.21%) preterm birth (35.7%) and small for gestational age (12.6%) were more common in women with older maternal age (35years) and nulliparity.

**Yocesoy**\(^ {188}\) studied maternal and perinatal outcome in 255 pregnancies complicated with hypertensive disorders of pregnancy at Turkey. Their findings revealed that severe preeclampsia was found among 54.11%, mild preeclampsia among 33.3%, IUGR among 29.4% and caesarean delivery among 58.8%. They also reported intra-uterine fetal demise in 24 cases and intrapartum death among 10 cases.

**Mir**\(^ {34}\) studied pregnancy outcome in oligohydramnios at Srinagar. She reported that 38.9% hypertensive mothers had reduced liquor by 30th weeks and 63.12% babies born were low birth weight.

**Arya**\(^ {28}\) studied growth restriction of fetus and its responsible factors in Uttar Pradesh. He reported that maternal nutrition, chronic vascular disease, perinatal hypertension and hypoxaemia, cigarette smoking, alcohol ingestion and intake of drugs were found significantly associated with intra-uterine growth restriction (p<0.01).

**Sushila**\(^ {5}\) studied effectiveness of self-care strategies on pregnancy induced hypertension, maternal and perinatal outcome among primigravidae in Sri Ramachandra Hospital, Chennai from 2003-2007. In study group 8.7% mothers had PIH but in control group 15.3% had PIH with associated complications more than study group. The comparison in the occurrence of PIH between the groups showed significant difference at the level of p<0.05 with a ‘t’ value of 2.391. Maternal complications were higher in control group and overall maternal outcome showed a significant difference between the groups at the level of p<0.001 with a ‘t’ value of 3.516. Though the perinatal outcome between the groups did not show any significant difference but intra-uterine growth retardation (IUGR) incidence was high in control group.
Xiong\textsuperscript{189} conducted a retrospective cohort study to evaluate the effect of different types of pregnancy induced hypertension on fetal growth of 16,936 births by means of a population-based perinatal database in Suzhou, China. Pregnancy induced hypertension was classified as gestational hypertension, preeclampsia or severe preeclampsia-eclampsia. Preeclampsia and severe preeclampsia increased the risk of intra-uterine growth restriction and low birth weight. The adjusted odds ratio of low birth weight was 2.65 (1.73-4.39) for preeclampsia and 2.53 (1.19-4.93) for severe preeclampsia, however low birth weight was not increased significantly for gestational hypertension. Adjusted odds ratio was 1.56 (1.00-2.41).

Magnussen\textsuperscript{190} studied hypertensive disorders in pregnancy and subsequent cardiovascular risk in Europe. They reported that hypertension in pregnancy was a grave factor to lead to maternal complications and found pre eclampsia in 41.2\%, bleeding disorders in 12\% and eclampsia in 6.2\%, perinatal deaths 23.71\% and these women were 25\% at more risk to have cardiovascular disorders in subsequent period of life.

Josjee\textsuperscript{191} conducted a 7 year retrospective analysis at of a national registry in order to study neonatal outcome of pregnancy complicated by hypertensive disorders between 34 and 37 weeks of gestation and revealed that children from mothers with pre eclamptic toxaemia and gestational hypertension had an increased risk of neonatal intensive care unit admissions as compared to children of normotensive women (O R: 2.0), caesarean births were more prevalent, small for gestational age (<37 weeks) was 27\% as compared to normotensive women (18\%). They further indicated that these neonates experience more morbidity which increased significantly as gestational age decreased.

Bateman\textsuperscript{192} studied a nationwide sample of delivery admissions for 14 years using large discharge data of chronic hypertension in pregnancy. Prevalence was high in women who were hypertensive in past pregnancy with recurrent abortions and who had family history of hypertension. Perinatal outcome was found poor and associated with fetal distress, birth asphyxia, still birth (p<0.01). They also revealed adverse maternal outcome with increase in weight, increased rate of hospitalization, renal failure in 21\%, pre eclampsia in 11\%, pulmonary edema in 21\% and 10\% hospital mortality.
II.4) Studies related to effect of Diabetes on outcome of Pregnancy.

Pyrolla\textsuperscript{193} studied diabetic complications in Sweden neonates and reported that babies born to diabetic women had hypoglycaemia (68.1%), congenital anomalies (29.8%), birth asphyxia (33.14%), infections (42.91%) and 34% were still births. Neonatal deaths were reported in 45.84% and it was related to prematurity, infections and gross malformations. Preterm babies were found more prone to birth asphyxia than full term babies.

Singh et al\textsuperscript{176} carried out a study in India on 546 women with gestational diabetes to find out their neonatal outcome. They reported that gestational diabetes was found responsible for polycythaemia (16.6%), preterm birth (68.4%), large for date (12%), asphyxia (33.2%) and poor survival rate of neonates (6.9%).

Berkowitz\textsuperscript{194} studied maternal characteristics, neonatal outcome and time of diagnosis of gestational diabetes. The associated factors reported by them included family history of diabetes, maternal weight, previous abortions and still births and previous birth of a baby with congenital defects. They had shown higher proportion of delivery of low birth weight babies (23.2%) in women with uncontrolled blood sugar as compared to women with controlled blood sugar (6.2%). The incidence of congenital defects was 9.3%, still births (7.8%), preterm (19.31%). The number of women who had babies more than 3Kg was 4%.

Catalano\textsuperscript{195} conducted a study in South Africa to find out weight gain in diabetic pregnant women. They reported that extra gain in weight of >18Kg in women with diabetes has shown adverse perinatal outcome. 25. 6% of these women had delivered prematurely, 58.9% women were hypertensive. About 34.82% had delivered big babies. There were reports of still birth (5.13%), congenital anomalies (7.64%) and preterm small babies (6.94%).

Bernstein and Catalano\textsuperscript{196} investigated the factors contributing to the risk of caesarean delivery in gestational diabetes. They reported that 17.83% women had undergone emergency caesarean section before 37 weeks of gestation and the neonates had birth weight less than 2500g.

Fraser\textsuperscript{197} compared prevalence and neonatal outcome of gestational diabetes among Bedouins of Jewish population in South Israel and revealed that prevalence was found
high (45.12%) in population with background family diabetics. They further reported adverse outcome among women with late recognition of diabetes (26.6%), higher rates of still births (31.9%), congenital anomalies (61.2%) perinatal deaths (25.4%) and asphyxiated babies (45%).

**Greco**\(^7\) studied obstetrical risk factor associated with gestational diabetes in Greece population. They reported that these mothers were at higher risk of still births (22.91%), perinatal deaths (53.6%), caesarean/instrumental delivery (68.71%), birth asphyxia (34.62%), preterm delivery (36.3%), termination of pregnancy due to associated fetal malformations, early neonatal deaths (32.57%), excessive weight gain of mother of more than 80 Kg associated with macrosomia (22.14%).

**Hawthrone**\(^1\) studied outcome of diabetic pregnancy in New Castle General Hospital and reported that 34.6% infants were born with birth weight of less than normal, congenital anomalies was revealed in 13%, and abortions were found in 9.53%.

**Greenberg**\(^2\) studied antenatal variables of gestational diabetes mellitus in Morco as predictors of postpartum glucose intolerance. Among various factors reported by them, weight gain of more than 18 Kg, uncontrolled blood pressure, uncontrolled blood sugar, associated complications, dietary intake without modifications, no glucose monitoring, continuous bed rest with no or very less physical activity, irregular prenatal follow ups were found as strong predictors of glucose intolerance during postpartum period.

**Gazzolo**\(^3\) studied Doppler velocimetry and behavioural state development in relation to perinatal outcome in pregnancies complicated by gestational diabetes in Canada. They reported that 31.83% women had to undergo emergency caesarean section before 37 weeks of gestation and 46.51% of the neonates had birth weight less than 2500g. They had shown higher rates of congenital anomalies (35.21%), perinatal deaths (31.2%) and asphyxiated babies (28.9%).

**China**\(^4\) studied obstetric and neonatal outcome among women in Switzerland with gestational diabetes in Singapore and reported that 58.62% women needed assisted vaginal delivery by application of forceps, 6.08% delivered still births and 32.1% mothers delivered babies by caesarean section. The neonatal complications included hypoglycaemia (22.05%), congenital anomalies (4.06%), Apgar score of less than 7 (12.64%), prematurity (15.34%) and infections (13.18%).
Di Cianni\textsuperscript{202} conducted a study in UK to find out effects of maternal body mass index on the neonatal outcome and obstetric complications in women with gestational diabetes and reported that the babies were born by caesarean section (34.21\%) and by assisted delivery (18.7\%) and about 10.65\% were soon admitted in neonatal nursery for observation or for treatment as the baby’s condition was.

Di Simone\textsuperscript{203} studied insulin plasma levels in pregnant patients with impaired glucose tolerance and its relationship with pregnancy outcome in UK. They found that these mothers had delivered still births (13.3\%), had undergone premature labour (8.97\%) and caesarean rates were 17\%. Babies (17.5\%) had Apgar score below 7, low birth weight (65.49\%), born before 36 weeks (5.43\%) and between 32-35 weeks (3.54\%)

Casey\textsuperscript{204} conducted a retrospective study to compare pregnancy outcome in a homogeneous group of gestational diabetic women with women without this disorder (the general obstetric population). This study consisted of all women with singleton cephalic-presenting pregnancies delivered at University of Texas Southwestern Medical Center during the period January 1, 1991, through December 31, 1995. During this period, women were screened selectively for glucose intolerance and National Diabetes Data Group thresholds were used to diagnose gestational diabetes. 874 women with class A1 gestational diabetes were compared with 61,209 non-diabetic women within the cohort. Women with class A1 gestational diabetes were significantly older, heavier, of greater parity, and more often of Hispanic ethnicity. Hypertension (17 versus 12\%), caesarean delivery (30 versus 17\%), and shoulder dystocia (3 versus 1\%) were significantly increased (all P < .001) in these women compared with the general obstetric population. Infants born to women with class A1 gestational diabetes were significantly larger (mean birth weight3581 ±/ 616 versus 3290 ±/ 546 g, P < .001), and this accounted for the increased incidence of dystocia. The attributable risk for large for gestational age (LGA) infants due to class A1 gestational diabetes was 12\%. The main consequence of class A1 gestational diabetes is excessive fetal size leading to increased risk of difficult labor and delivery.

Caruso\textsuperscript{205} studied insulin secretion in patients with gestational diabetes and its relationship with pregnancy outcome. They revealed that perinatal outcome was positive in women taking regular insulin and controlled meals in breaks. The women delivered
full term (87.2%), normal birth weight (66.9%), had fewer babies (1.2%) with congenital defects.

Coetzee and Levitt\textsuperscript{206} conducted a study on pregnant women with diabetes to observe their neonatal outcome. They reported high rates of low birth weight and prematurity (33.25%) among women with uncontrolled blood sugar and still births were found high in mothers (14%) who were detected diabetics after 24 weeks of gestation.

Dutta\textsuperscript{207} studied effect of diabetes during pregnancy with perinatal and neonatal outcome in a city hospital of Orrisa and revealed that diabetes during pregnancy was found associated with preterm labour (20%), preeclampsia (25%) and polyhydramnios (25-50%). Other associated risks included abortions, infections, maternal distress and fetal hazards like congenital malformations and perinatal loss.

Crowther [Australian Carbohydrate Intolerance Study in Pregnant Women (ACHOIS) Trial Group]\textsuperscript{208} conducted a randomized clinical trial to determine whether treatment of women with gestational diabetes mellitus reduced the risk of perinatal complications. The researchers randomly assigned women between 24 and 34 weeks’ gestation who had gestational diabetes, to receive dietary advice, blood glucose monitoring, and insulin therapy as needed (the intervention group) or routine care. Primary outcomes included serious perinatal complications (defined as death, shoulder dystocia, bone fracture, and nerve palsy), admission to the neonatal nursery, jaundice requiring phototherapy, induction of labor, cesarean birth, and maternal anxiety, depression, and health status. Results presented by them included that the rate of serious perinatal complications was significantly lower among the infants of the 490 women in the intervention group than among the infants of the 510 women in the routine-care group (1 percent vs. 4 percent; RR adjusted for maternal age, race or ethnic group, and parity, 0.33; 95%; confidence interval, 0.14 to 0.75; \(P=0.01\)). However, more infants of women in the intervention group were admitted to the neonatal nursery (71 percent vs. 61 percent; adjusted RR 1.13; 95%; confidence interval, 1.03 to 1.23; \(p=0.01\)). Women in the intervention group had a higher rate of induction of labor than the women in the routine-care group (39% vs. 29%; adjusted RR, 1.36; 95% confidence interval, 1.15 to 1.62; \(P<0.001\)), although the rates of cesarean delivery were similar (31% and 32% respectively; adjusted RR, 0.97; 95% confidence interval, 0.81 to 1.16; \(p=0.73\)). At three months post-partum, data on the women's mood and quality of life, available for 573
women, revealed lower rates of depression and higher scores, consistent with improved health status, in the intervention group.

Rosenberg examined associations between obesity, diabetes, and three adverse pregnancy outcomes i.e. primary caesarean delivery, preterm birth, and low birth-weight (LBW) among 4 racial/ethnic groups. Data were collected from the 1999, 2000, and 2001 New York City birth files for 329988 singleton births containing information on pre-pregnancy weight and prenatal weight gain. Separate logistic regressions for 4 racial/ethnic groups predicted the adverse pregnancy outcomes associated with diabetes. Other variables in the regressions included obesity, excess weight gain, hypertension, preeclampsia, and substance use during pregnancy (e.g. smoking). Results included for chronic and gestational diabetes were significant risks for a primary caesarean and for preterm birth in all women. Diabetes as a risk for LBW varied by group. For example, although chronic diabetes increased the risk for LBW among Asians, Hispanics, and Whites (adjusted odds ratios=2.28, 1.69, and 1.59), respectively, it was not a significant predictor of LBW among Blacks. In this large, population-based study, obesity and diabetes were independently associated with adverse pregnancy outcomes, highlighting the need for women to undergo lifestyle changes to help them control their weight during this child bearing years and beyond.

Langer, Oded conducted a study in USA to investigate the relationship between pre-pregnancy weight, treatment modality (diet or insulin), level of glycemic control, and pregnancy outcome. They recruited 4001 women with gestational diabetes (GDM) from inner city prenatal clinics. All women were instructed about the use of an intensified management protocol using memory reflectance meters. Outcomes were analyzed according to maternal pre-pregnancy body mass index (BMI, kg/m²) categories: normal weight (BMI 18.5-24.9), overweight (BMI 25-29.9), and obese (BMI ≥30), and by diet or insulin therapy and glycaemic control (mean blood glucose <100 mg/dL = good control). Pregnancy outcome variables included a composite outcome (at least 1 of the following: neonatal metabolic complications, large-for-gestational age or macrosomic infants, NICU admission for >24 hours, and the need for respiratory support) (not including oxygen therapy). In addition to composite outcome, a bivariate analysis was performed for each single variable, including preeclampsia and caesarean section delivery. Their findings indicated that obese women who achieved targeted levels of glycemic control had
comparable pregnancy outcomes to normal weight and overweight women only when they were treated with insulin. Normal weight women treated with diet therapy who achieved targeted levels of glycemic control had good outcomes, but obese women treated with diet therapy who achieved targeted levels of glycemic control, nevertheless, had a 2- to 3-fold higher risk for adverse pregnancy outcome when compared with overweight and normal weight patients with well-controlled GDM. Women with GDM who failed to achieve established levels of glycemic control had significantly higher adverse pregnancy outcomes in all 3 maternal weight groups. They concluded that in obese women with BMI ≥30 with GDM, achievement of targeted levels of glycemic control was associated with enhanced outcome only in women treated with insulin.

Ananth\textsuperscript{211} studied recurrence of spontaneous versus medically indicated preterm labour and found that gestational diabetes as well as severe preeclampsia was responsible for recurrent, spontaneous and induced preterm labour.

Jabeen\textsuperscript{212} studied prevalence and outcome of gestational diabetes in an associated hospital of Srinagar and reported that it was associated with obesity, family history of diabetes or hypertension. She further reported that these mothers either aborted the baby or had fetal loss. If born alive, babies were big in size and incidence of perineal injuries and caesaerean sections were high (33.1% and 14.89%).

Bell\textsuperscript{213} studied trends and prevalence and outcome of pregnancy in women with preexisting type I and II diabetes in England and reported higher rates of still birth (22%), abortions (13.8%), preterm (54%) and low birth weight (48.7%). The women who gained excess weight and required emergency hospitalization were 16.8%.

Shoba\textsuperscript{214} conducted a study in Orissa to find out contributory risk factors for the development of gestational diabetes. The risk factors reported by her included obesity, lack of exercise, inheritance, previous birth of big baby, previous still birth and age over 30 years. Similar factors were reported by Reece\textsuperscript{215} while studying need for common ground in gestational diabetes. They reported the incidence of low birth weight a 32.61% and 35% respectively.
II.5) Studies related to association of various risk factors with maternal and fetal outcome.

The literature included association of maternal and neonatal outcome with various risk factors like maternal body mass index (BMI) and maternal nutrition, maternal smoking, maternal age, and various other factors like parity, socio-economic status, social stressors, antenatal care, maternal diseases, previous obstetric factors etc. Early marriage or early conception is contributing factors to adverse maternal and perinatal outcomes.

Arora\(^{198}\) studied 700 single live born babies weighing less than 2000g at birth at All India Institute of Medical Sciences, New Delhi and observed that the commonest cause of intrauterine growth retardation was maternal infections (29%); maternal vascular diseases (12%); multifactorial etiology (28%). The mothers of IUGR babies were shorter, thinner and lighter with low haemoglobin levels between 6.5-9g%.

Kwang Sun Lee\(^{216}\) studied 184,567 singleton live births from Illinois, Chicago birth certificate data 1980-1984 to find out association of maternal age with birth weight. They observed an incidence of low birth weight of 3.2% in mothers below 17 years of age, which gradually declined with advancing maternal age to reach 1.3% in mothers aged 25-34 years.

Evaldson\(^{217}\) studied grand multiparas in modern obstetrics and reported the maternal complications associated with grand multiparity were found as anaemia, hypertension, haemorrhage and premature labour. He further revealed the bad fetal outcome including 67.4% small for date babies, 48% asphyxiated baby, 82.41% low birth weight babies and 76.4% preterm babies.

Bhaduri\(^{218}\) made a retrospective study of teenage pregnancy at West Bengal and revealed higher incidence of anaemia and hypertension with delivery of preterm babies (46%) and low birth weight (62.31%) among these teens.

Bhargava\(^{219}\) conducted a collaborative study to identify high risk families, mothers and outcome of their off springs with particular reference to the problem of maternal nutrition, low birth weight, perinatal and infant morbidity and mortality in Urban Slum Communities of Delhi, Calcutta, Madras and rural slums of Hyderabad, Varanasi and Chandigarh. The relationship of low birth weight with high risk pregnancies included 10-
12% of women with bad obstetric history, 32% with anaemia, 33.16% with bleeding, 28.7% with hypertension, 13% with toxaemia, and 45.21% with urinary tract infections. Findings revealed that majority of women were malnourished (body weight <40 Kg and height <145 cm), smoking, using alcohol, chewing tobacco and working, and 10-25% women who were not registered, were identified as high risk. Multiple regression analysis identified risk factors for fetal and neonatal mortality. These factors were maternal age, maternal anaemia, preterm birth, previous preterm or low birth weight, birth interval, and previous fetal and neonatal mortality.

Suser\textsuperscript{220} studied causal sequence of maternal weight, infant birth weight and diet. He revealed that it is insufficiency of diet which hindered gestational weight gain in 82% of women; thereby impeded their fetal growth and the infants were born with low birth weight.

Krishna\textsuperscript{221} conducted a study in Ahmedabad to predict low birth weight delivery using maternal nutritional and uterine parameters. Maternal nutrition was indicated by weight and height of mothers. They found that 36.87% mothers with BMI less than 19 had fetal growth restriction and delivered small for date babies and 14.2% mothers with less cervical length and incompetent cervix after circlage operation delivered babies between 35-37 weeks weighing between 1800-2200g.

Babies born to mothers who smoke cigarette were on the average 141g lighter than those born to non-smokers as reported by Peacock\textsuperscript{222} who studied type of cigarette smoking and its association with birth weight and Haste et al\textsuperscript{223} who studied the effect of nutritional intake on outcome of pregnancy in smokers and non-smokers.

Malik and Mir\textsuperscript{224} conducted a prospective study in Srinagar to identify preventable factors of perinatal mortality in high risk pregnancy. They studied 1600 consecutive deliveries over a period of one year and 1107 were considered at risk for adverse pregnancy outcome. They reported that advanced maternal age and parity, ante-partum haemorrhage, diabetes, anaemia were the major maternal and obstetric factors associated with poor outcome.

Singh and Singhal\textsuperscript{225} conducted a study in a referral hospital of North India to find out determinants of infant’s birth weight. They found a positive correlation between maternal weight and height with birth weight. Babies born to mothers with height of >150cms and
weight more than 50Kgs were heavier by 251g and 222g respectively as compared to babies born to mothers with height of <145cms and weight less than 45Kgs respectively.

Theodore\textsuperscript{226} studied 328 consecutive live births at Christian Medical College and Hospital, Vellore and observed a positive association between low birth weight and maternal age, maternal weight, maternal height, parity and antenatal care. The incidence of low birth weight increased with teenage pregnancy (age <17 years) increasing parity, short stature (<145cm) and poor antenatal care.

Nandi and Nelson\textsuperscript{227} studied maternal pregravid weight, age and smoking status as risk factors for low birth weight babies and reported 43.1% low birth weight related to low maternal age(<20 years), 16.54\% related to maternal BMI <19 and 33.94\% low birth weight babies were born to mothers who smoke cigarette.

Baveja\textsuperscript{228} studied maternal nutritional assessment and fetal outcome in Jaipur and found a strong and significant association between maternal weight and height with birth weight (p<0.001).

Thilothammal\textsuperscript{229} studied the nutritional status of south Indian women in child bearing age and found that 51\% of severely malnourished mothers, 27\% of moderately malnourished mothers and 25\% of average nourished mothers delivered low birth weight babies.

Swain\textsuperscript{161} studied effect of maternal biosocial and nutritional parameters on birth weight. They reported significant association of maternal weight and height with birth weight. Maternal weight <50Kg and height <150cm was found as strong indicators of hampered nutrition. They reported 42.15\% of such mothers who had delivered low birth weight babies.

Chhabra and Sharma\textsuperscript{230} studied maternal variables affecting fetal weight in South parts of Delhi and reported that the maternal size, her nutritional status and age doubled the incidence of having a fetus with weight less than normal which was found in 56.78\% of mothers.

Arora etal\textsuperscript{39} studied maternal biosocial factors and birth weight in Jullundur and reported significant association of younger age of mother (<18 years) and advanced age of mother
(>35 years) with the incidence of low birth weight which was 35.23% and 48.6% respectively for young and advanced age.

Misra\textsuperscript{231} studied epidemiology of low birth weight in an Industrial area in India and associated low birth weight with low body mass index, low birth interval, infections, tobacco use, lack of antenatal visits (P<0.001).

Razzaq\textsuperscript{232} conducted a study to determine the incidence of risk factors of low birth weight on 3485 live births in Al/Ain, United Arab, during one year. They observed an incidence of 8.4% of low birth weight of which 24.9% were small for gestational age. Low birth weight infants were found associated with mother’s young age, their premature rupture of membranes, and previous low birth weight deliveries and association was statistically significant (P<0.001).

Dhall and Bagga\textsuperscript{233} studied 3293 uncomplicated singleton pregnancies over a period of two years at Nehru Hospital, PGIMER to reveal maternal determinants of birth weight of North Indian babies. They observed that mothers with age less than 20 years had babies 131gms lighter than those of the age group of 20-35 years which was statistically significant (p<0.01).

Goldenberg and Tamura\textsuperscript{234} conducted a study in Alexandria to reveal association of BMI with nutritional intake. They found that low pre-pregnancy BMI of woman was associated with a high risk of spontaneous preterm birth whereas women with high BMI developed preeclampsia and diabetes. They further indicated that preterm births were found associated significantly with these disorders of preeclampsia and diabetes.

Ali\textsuperscript{85} did a study in Srinagar at SKIMS to identify association between early neonatal complications and low birth weight babies. He found a strong association (p<0.01) between maternal weight/height and neonatal birth weight and reported that 39.34% of mothers weighing less than 45 Kg’s and 67.21% of mothers, measuring less than 150cm, delivered low birth weight babies. He further reported that maternal age, parity and antenatal care indicated significant association with low birth weight of baby, revealing an incidence of 34.42% below 20 years (OR=1.35); 19.68% in 21-35 years and 45.90% beyond 35 years of age (OR=13.29); and incidence of 44.26% in mothers with parity 3 or above. Regarding antenatal care 22.9% of mothers who delivered low birth weight
babies, had either no antenatal care or an incomplete antenatal care (2 or less antenatal checkups).

In a study conducted by Lalitha and Chakladar\textsuperscript{235} at Udupi and Manipal on 837 mothers with single live new born babies to study association of maternal risk factors and low birth weight. They found that maternal weight <45Kg, poor nutrition, teenage pregnancy, lack of antenatal care and illiteracy were the most important factors resulted in low birth weight.

Nuwayhid, et al\textsuperscript{236} studied effect of narghile (hubble-bubble) smoking, low birth weight, and other pregnancy outcomes in Muscat. They studied 106 narghile smokers, 512 non-smokers, and 277 cigarette smokers and found that smoking >1 narghile/day or smoking narghile in the first trimester is associated with a significant 100g reduction in the mean birth weight of new born. They also reported a higher incidence of low birth weight babies in women smoking narghile >1/day and first trimester smoking was associated with a three-fold increases in the risk of low birth weight babies. Other maternal complications associated with narghile smoking included premature rupture of membranes, placental abruption, preterm delivery and still birth.

Olausson\textsuperscript{237} studied teenage pregnancy and risk of late fetal death and infant mortality associated with pregnancy outcome at a city of Britian and Hoffman et al\textsuperscript{238} studied pregnancy outcome in pregnancy at or beyond 40 years at Los Angels. In both studies it was found that young age of 18-20 years increased the risk of preterm birth and low birth weight by 15% and 20.24%.

Hirve and Sath\textsuperscript{239} studied low birth weight in primigravidae in Poland and reported a significant association between low birth weight and maternal age of less than 20 years, but low birth weight was found to be associated with preterm birth than intra-uterine growth retardation.

Deshmukh\textsuperscript{165} conducted a study in an urban area of India to study low birth weight and associated maternal factors. The average birth weight was 2215g ±345g. About 15% were born with birth weight less than 2500gms. Low maternal age, weight, tobacco use, number of prenatal visits and discrimination due to parity were significant predictors of infant birth weight (p<0.001).
In a prospective study conducted at prenatal centre’s Sweden, **Ahlborg and Borin**\(^{240}\) and **Windham**\(^{241}\) reported the findings of the effects of tobacco smoke on pregnancy outcome among working women. They revealed that these women were at greater risk of preterm delivery (22%), and low birth weight (34.51%).

**Bhatnagar**\(^{133}\) studied epidemiological maternal factors for low birth weight neonate in a Military Hospital, Devlali. Hereported that extremes of age and parity, lack of antenatal care, low socio economic status, illiteracy, underweight, short stature of woman and obstetrical complications were the major epidemiological maternal factors for low birth weight neonate. His findings revealed that 10.59% babies were weighing 2000g or less with 50.9% babies as preterm and 45.1% as small for date. The associated factors included 18.96% teenager mothers, 9.4% above 30 years, 76.94% housewives, 5.96% addicted (tobacco chewing), 58.03% with less or no antenatal visits and 39.36%, bad obstetric history, 65.91% with anaemia and 16.10% with hypertensive disorders and 35.43% with premature rupture of membranes.

**Nucci**\(^{242}\) studied prevalence of pregnancy outcome and its association with nutritional status of pregnant women in Germany. They reported that the socio economic status, literacy, income, less birth interval etc. were the factors associated with nutritional status of pregnant women and poor nutritional status made these women anaemic, hindered growth of fetus and resulted in small baby with weight below normal. They reported 54.21% of such pregnancies who delivered infants with birth weight <2500g.

**Amin and Ali**\(^{35}\) studied influence of various epidemiological correlates on nutritional status of pregnant women in Srinagar, India. They revealed that low maternal age, poor socioeconomic status, big family size, high parity, less birth interval, pregnancy bleeding, improper antenatal care etc. were the risk factors which affected the nutritional status of women during pregnancy. They reported that these risk factors compounded the risk of anaemia which had directly affected their fetal growth by increasing the incidence of low birth weight to 14.54%.

The incidence of low birth weight is twice as high among smokers as non-smoker as indicated by **Messecar**\(^{243}\) who reported about 42.67% low birth weight babies born to smokers and incidence was still high in women who had low haemoglobin, were nutritionally deprived and were hypertensive.
Kumar and Badrinath\textsuperscript{244} studied grand multiparity as obstetrical risk factor for adverse birth outcome in Tripura. In their retrospective study on 389 women, they included women who had four or more viable births and grand multipara women who had 10 or more previous viable births. They reported that anaemia, hypertension, haemorrhage and premature labour were the major maternal complications associated with grand multiparity. The incidence of low birth weight and preterm births were high and comprised of 78.12\% low birth weight babies and 54.32\% preterm babies.

Bai, Jun\textsuperscript{245} conducted a study to evaluate the association between parity and pregnancy outcomes and to clarify the basis of the classification of risk based on parity. The study was a cross-sectional analysis on a large routinely collected data set of singleton births from 1992 to 1997 in New South Wales, Australia. Pregnancy outcomes were compared among parity groups. They found a significant association between different parity levels and pregnancy outcomes in terms of obstetric complications, neonatal morbidity, and perinatal mortality, after adjustment for potential confounders, including age, maternal smoking status, and socioeconomic status. In terms of obstetric complications, neonatal morbidity, and perinatal mortality, subjects were classified into 3 groups according to parity: nulliparity, low multiparity (parity 1, 2, and 3), and grand multipara (parity 4 to 8). Compared with low multiparity, mothers and babies of nulliparity and grand multipara were at higher risk.

Chahande, Jadhao\textsuperscript{246} and Thekkekara, Veenu\textsuperscript{247} made a hospital based comparison study of some epidemiological factors in teenage pregnancy in India. Their findings revealed 46.21\% of women with nutritional risk during pregnancy, 60\% anaemic and 22\% hypertensive mothers, 5\% of women were smokers, 17.89\% had sexually transmitted diseases and had early labour. The increase in incidence of low birth weight babies was 68.3\% and these babies were more prone to risks like perinatal, neonatal and infant mortality.

Lindbohm\textsuperscript{248} Kharrazi\textsuperscript{249} and Windham\textsuperscript{250} separately studied effects of environmental smoke on reproductive health, pregnancy outcome and birth weight on 422 women in Spain, 321 women in Iran and 645 women in Sweden respectively. They revealed that environmental smoke contains many harmful chemicals and in greater concentration than cigarette smoke inhaled through filter, which reduced mean birth weight by 28-60g and increased risk of low birth weight by up to 22\%.
Maroziene and Grazuleviciene\textsuperscript{251} did a population-based study on maternal exposure to low-level air pollution and pregnancy outcome in California and reported that exposure to ambient air pollution, such as particulate matters, ozone, carbon monoxide and nitric dioxide has increased the risk of preterm birth in dose-dependent manner. Similar findings are reported from Bisbane, Australia by Hansen et al\textsuperscript{252} while studying effect of low levels ambient air pollution exposure of mother on new born gestational age and birth weight.

Wasunna and Mohammad\textsuperscript{253} did a study at Kenyatta National Hospital, Nairobi to find out association of low birth weight with socio demographic and obstetric characteristics of adolescent mothers and reported that unfavourable socio demographic and obstetric characteristics like young age below 20 years, single parent and poverty were significantly associated with low birth weight (p<0.001).

Ehrenberg et al\textsuperscript{254} conducted study in Kenya on 321 pregnant women with low maternal weight in order to reveal their pregnancy outcome. They found that these women had failure to thrive in pregnancy with the resultant outcome as intra-uterine growth restriction (IUGR), small for gestational age (SGA), reduced birth weight and these baby’s were found with higher proportion of morbidity and mortality.

O’ Brien\textsuperscript{255} has evidenced consistently strong association between maternal obesity and risk of preeclampsia. The risk doubled with each 5-7 kg/m\textsuperscript{2} in pre pregnancy BMI. They conducted the study on 714 obese and overweight pregnant women in a city of Washington.

Al Turki, Abu-Heija and Al-Sibai\textsuperscript{256} the outcome of pregnancy in elderly primigravida above 35 years of age at Lebanon. They found that there was an increased incidence of hypertension and preeclampsia (41.2%), gestational diabetes (9.8%), antepartum haemorrhage (15.4%), preterm labour (72.16%), intra uterine growth restriction (11%). Due to prolonged labour, the risk to mother and fetus was doubled, the fetal distress was high and rate of early caesarean section or instrumental delivery was 31.3%, the rate of intra uterine deaths were 12.2% and neonatal morbidity was 18%.

Sharma\textsuperscript{257} conducted a community based study on pregnant adolescents at Shimla (India) to study their infants’ birth weight and gestational age. They observed an incidence of
41.36% of low birth weight babies, the babies were small and their gestational age was between 34-36weeks.

In India, Gupta and Sreevidya\textsuperscript{258} did a population based cohort study on 1217 women in Mumbai to find out impact of smokeless tobacco (snuff) on birth weight and gestational age and reported that use of snuff too is associated to reduce birth weight and gestational age. These findings are also reported from South African in a study conducted by Steyn etal\textsuperscript{259} who carried out a study in Brazil to reveal the influence of maternal smoking, snuff use and passive smoking on pregnancy outcome. It was found by them that the fetuses of these women were badly affected and effects were in the form of intrauterine growth retardation (IUGR-54.2%), low birth weight (60%), still birth (7.6%), asphyxia (58.9%), premature birth of baby (<32-34 weeks-64.31%) and these neonates had poor outcome in their early neonatal period.

Burgnet etal\textsuperscript{260} presented the results of epipage study while studying complex relationship between smoking in pregnancy and very preterm birth. They revealed that the gestational age of baby is reduced by 67.38% due to continuous smoking in pregnancy and effect is further increased if smoking frequency per day is increased by smoking 5-6 cigarettes.

Ramankutty\textsuperscript{30} did a preliminary exploration of why low birth weight is still a problem in Kerala. The most important variables revealed to have association with low birth weight was maternal age < 20 years, short stature of mother (height < 149cm and weight <49 Kg), gestational age < 38 completed weeks and nutritional deprivation with haemoglobin below 25\textsuperscript{th} percentile.

Robinson etal\textsuperscript{261} conducted a study in Brazil to find out maternal outcome in 544 pregnancies complicated by obesity. They reported that 43% developed hypertension, 17% developed gestational diabetes and perinatal outcome was asphyxia (22%), small for gestational age (14%), reduced birth weight (11%), and still birth (6%).

Jane, Cleary\textsuperscript{262} studied effect of maternal age on obstetric outcome on 36,056 women in Malaysia. The age groups were less than 35 years, between 35-39 years and 40 years and above. The results showed that among 36,056 women, 28,398 (79%) were < 35 years, 6,294 (17.5%) were between 35-39 years and 1,364 (4%) were > 40 years. They revealed that increasing age was significantly associated with miscarriage. The ratio was 2:2.4 for
miscarriage, 4:9.9 for chromosomal abnormalities, 1.4:1.7 for congenital anomalies, 1.8:2.4 for gestational diabetes, 1.8:2.8 for placenta praviae, and 1.6:2.0 for LSCS between 35-39 years and ≥ 40 years. The age group between 35-39 years also showed a risk for macrosomia in 1.4% of mothers, placental abruption in 2.3%, preterm labour in 1.4%, and low birth weight in 1.6% of mothers.

There was strong association between preterm birth and maternal body mass index as revealed by Hendler et al263 Iams264 Smith et al265 when they separately studied effects of increased body mass index on the gestational period and birth weight of neonates. They indicated that BMI of >26 in pregnancy had put a pregnant women at risk to go in early labour between 35-36 weeks of gestation and babies were found to be born with birth weight of 2200g (35.7%), 2400g to <2500g (64.3%)

While studying the assessment of risk factors for low birth weight deliveries, Larker et al266 reported maternal age, height, weight and medical co morbidities as strong factors in reducing the birth weight by about 12%.

Strang267 studied the effect of nutrition on weight of teenage mother and her fetus in Sweden. They reported that adequate nutrition intake is considered one of the most important factors affecting the health of teenage mother and poor weight gain has direct bearing on the birth weight of infant. They reported that 53.41% teenage pregnant women delivered babies weighing 2258g and 28.6% teenage women delivered babies weighing between 2300-2456g.

Madan268 conducted a study to compare perinatal risks and pregnancy outcomes in foreign and US born Asian-Indian and Mexican women through the evaluation of 6.4 million US vital records for births. The results indicated that with the exception of increased teen pregnancy and tobacco use, the favourable socio-demographic profile and increased rate of adverse outcomes seen in foreign born Asian-Indians persisted in their US born counterparts. In contrast, foreign born Mexicans had an adverse socio-demographic profile but a low incidence of low birth weight, whereas US born Mexicans had an improved socio-demographic profile and increased low birth weight, prematurity and neonatal deaths.

While studying the contribution of adolescent gestational weight gain towards obesity and fetal outcome, Groth269 reported that 67% adolescents who have taken more than
required nutrition during pregnancy, gained excessive weight which contributed to obesity, preeclampsia and diabetes and resulted in early labour and less gestational age of 36 weeks.

**Carter et al**²⁷⁰ conducted a birth cohort in a pacific island of New Zealand to study risks of maternal smoking on maternal asthma and reduced birth weight. Babies born to women who smoke weigh on average 180-200g less and maternal asthma is increased by 26.4%.

**Merlino et al**²⁷¹ reported from Australia that maternal weight loss between two consecutive pregnancies put a woman at risk of low pregnancy weight gain that have tendency to deliver prematurely. They studied 918 pregnant women who were second or multigravidae to find out impact of poor weight gain during pregnancy on the fetal gestational age.

**Buescher and Mittal**²⁷² studied racial disparities in birth outcomes at North Carolina and reported that the incidence of low birth weight (57.3%), preterm birth (46.1%), perinatal morbidity (22%) and mortality (6.4%) was significantly associated with adolescent pregnancy, elderly mothers and poverty.

**Collins et al**²⁷³ studied mother’s advanced age beyond 35 years and its effects on the birth outcome in Hong Kong. They reported the incidence of low birth weight as 38.61% and asphyxiated baby 12.1%. The effect became double fold in women with low socio economic status.

**Thompson**²⁷⁴ conducted a study at Norway to find out relation of prematurity with low birth weight and reported that that very low birth weight related to prematurity was twice as common among women living in most deprived areas as compared to women in least deprived areas.

**Moran**²⁷⁵ made a systematic review of dietary association of 646 pregnant adolescents in industrialized countries with fatal weight and size. He reported that pregnancy outcome depended on dietary intake and nutritional status of pregnant women. About 53% women with age less than 18 years and on inadequate diet were not able to have increase in fetal weight and size and babies born were small with weight < 2400.
Salhan and Bhatt\textsuperscript{276} carried out a study on various epidemiological factors associated with low birth weight in India and reported that strenuous work during pregnancy, high personal stress, low socio economic status, chronic ill health, maternal age below 20 years or above 35 years, maternal weight <45 Kg, anaemia, bacterial vaginosis, hypertension was found significantly associated with low birth weight (p<0.01).

Kiel et al\textsuperscript{277} and Cedergren\textsuperscript{278} studied gestational weight gain and pregnancy outcome in 700 pregnant obese women in Holland and reported that obese women who gained more than 10 Kg in their gestational weight was found as a co morbid factor for affecting the birth outcomes in pregnant women who are already obese.

Schempf, Branum, Lukacs et al\textsuperscript{279} carried out a study at Norway to find out association of preterm birth and low birth weight with parity and reported that the preterm birth and low birth weight was found highest in young multiparae women between 20-25 years (62.13\%) and older primiparae women of age 29 or above (55\%). The risk of preterm birth and low birth weight was doubled for multiparae women aged less than 18 years and for primiparae women aged more than 40 years.

Trivedi and Pasrija\textsuperscript{280} conducted a study to evaluate obstetric performance of teenage women at Lady Harding Medical College and Shrimati Sucheta Kriplani Hospital, New Delhi, India. The study included 13,210 women, of whom 840 (6.4\%) were teenagers (<19 years) and 12,370 (93.6\%) were ≥20 years. Antepartum, intra-partum and post-partum events were recorded and comparative analysis was done. It was found that teenage women were significantly at a higher risk for development of severe anaemia (relative risk [RR]=1.61, p value<0.02), eclampsia (RR=1.95, p< 0.05) , preterm labour (RR=1.25, p<0.001), intra-uterine growth retardation (RR=2.29, p<0.001), and low birth weight (RR=1.24, P<0.001). In teenagers assisted delivery was significantly more common and caesarean delivery significantly less common (p<0.001). Mothers who were ≥20 years had significantly higher rates of moderate anaemia, pregnancy induced hypertension, preeclampsia, premature rupture of membranes, antepartum haemorrhage and post-dated baby.

Kumar, Sharma and Prasad\textsuperscript{281} conducted a prospective case-control study involving 44 singleton pregnancies with intra-uterine growth restriction and compared it with other 44 healthy fetuses at a tertiary care centre at Patiala. The mean birth weight of control group
was 2640.07±428g while that of study group was 1865.45±270g. The mean height, weight and BMI of study group mothers were significantly less than the control group mothers.

Leung\textsuperscript{26} studied trends in maternal obesity and risks of adverse pregnancy outcome in a population of 1100 Chinese women. They revealed that obesity during pregnancy induced hypertension (PIH) and diabetes, and the baby born was at risk with 27.14% of low gestational age, 46.33% with low birth weight and 64.13% with birth asphyxia.

Tamim et al\textsuperscript{19} studied effects of narghile and cigarette smoking on new born birth weight in Canada and reported that exclusive narghile smoker constituted 4.4% of women. Multiparas were significantly more likely to smoke cigarette and narghile. Mothers smoking narghile more than once per day were at 2.4 increased odds of having low birth weight infants compared with non smoking mothers (O R=2.1, 95% CI 1.2-5.0). No difference was noted between women smoking narghile in the first trimester and those initiating smoking in the subsequent trimesters regarding low birth weight.

Jakobsson et al\textsuperscript{282} examined the trends and risk factors of preterm delivery by conducting register-based retrospective cohort study from Finland. The study population consisted of 1137515 deliveries, of which 59025 were preterm (5.2%). The greatest risk factors were multiplicity (OR:13.72, 95% CI:13.26-14.19), elective delivery (OR:1.86, 95% CI:1.82-1.89), primiparity (OR:1.39, 95% CI:1.31-1.47), maternal smoking (OR:1.31, 95% CI:1.29-1.34) and advanced maternal age (OR:1.02, 95% CI:1.02-1.03) for each additional year of age.

Johansson\textsuperscript{105} had studied the etiological aspects and short and long term outcome of very preterm births in Sweden. He reported that about 6% of all pregnancies end preterm. Very preterm births occurring before 32 completed gestational weeks account for about 15% of preterm births which means that 1-2% of all pregnancies end very preterm. In determining the risk factors of preterm births, he revealed them associated with family history, infections, maternal characteristics, socio economic status, multiple pregnancy, smoking, substance abuse, air pollutants and exposure to environmental smoke. Maternal smoking has dose dependent impact on risk of preterm birth and low birth weight. Heavy smoking (≥10 cigarettes per day) increased the risk more than two fold. Low birth weight
was found twice as common among women living in most deprived areas as compared to women living in least deprived areas.

Banerjee, Pandey, Dutt et al\textsuperscript{283} conducted a hospital based cohort study over 4 months among women admitted to a rural hospital in West Bengal comprising of teenage mothers between 15-19 years of age. They studied these teenage women to find out their pregnancy outcome and compared them with a control cohort of mothers between 20-24 years of age, admitted in the same hospital during the study period. Teenage pregnancy comprised of 24.17\% of total pregnancies occurring in the hospital during the study period. The study group had 58 subjects and control group had 91 subjects. The prevalence of anaemia was higher (p<0.05) in women of teenage group (62.96\%) than in women of control group (43.59\%). Preterm delivery occurred significantly more (p<0.001) in study group (51.72\%) than in control group (25.88\%). The incidence of low birth weight was significantly higher among the group of teenage (65.52\%) than among the women in control group (26.37\%). The mean birth weight was 2.36 Kg in the study group and 2.74 Kg in the control group, the difference was strongly significant (p<0.001).

Mortensen et al\textsuperscript{27} did a study of 1409339 births in Denmark to study time trends in the association between maternal social disadvantage and offspring fetal growth. They included all births from 1981-2004 and association between maternal social disadvantage and birth weight was examined for gestational age. They reported that all measures of social disadvantage were associated with decreased fetal growth (p<0.001). The association was strong for low education (-0.19z score), teenage motherhood (-0.14z score), single motherhood (-0.13z score) and poverty (-0.12z score).

Dailey\textsuperscript{284} conducted a study on social stressors and strengths as predictors of infant birth weight in low income, African-American women with the aim to broaden knowledge of predictors of infant birth weight by examining stress and other correlates of birth weight. A total of 119 pregnant women participated in that prospective study. Data was collected on socio economic status (income, education, marital status, and employment status), health behaviours and medical conditions including pregnancy induced hypertension, gestational diabetes, infections, bacterial vaginosis and anaemia. On average, the infants weighed 3,194 ±660gms at birth. Overall 14\% were born with birth weight less than 2500gms. Tobacco use, number of prenatal visits and discrimination due to age were significant predictors of infant birth weight (p<0.001)
Ehrenberg et al285 analyzed data from 253 women at risk for spontaneous preterm birth enrolled at 11 centers in California and found that obese and overweight women (BMI 25Kg/m²) were significantly less likely to experience spontaneous preterm birth before 35 weeks (8.3%) compared with 21.7% who went into spontaneous preterm birth (p<0.01).

Siega Riz et al286 made a systematic review of outcome of maternal weight gain according to Institute of Medicine recommendations regarding birth weight and fetal growth. They found strong and good evidence for an association between weight gains less than Institute of Medicine guidelines i.e. <12Kg for women with BMI of <19, >12Kg for women with normal BMI and <6Kg for women with BMI of >26. They reported strong association of maternal weight gain and birth weight of baby. The association was significant between weight gain below normal and low birth weight for both under weight and normal weight women.

Jehan et al2 did a prospective population based cohort study in Urban Pakistan from 2003-2005 to study the risk factors and causes of neonatal mortality. Study area women were enrolled at 20-26 weeks of gestation. These women had undergone physical examination, antenatal laboratory tests, anthropometric measures and interview to collect demographic and health data. The women and neonates were seen again within 48 hours postpartum and at day 28 after the birth. Birth outcomes were ascertained for 1280 (94%) of 1369 women enrolled. The 28 day neonatal mortality rate was 47.3 per 1000 live births. Some 45% of deaths occurred within 48 hours and 73% within first week. The primary obstetric causes of death were preterm labour which was 34%. He reported that exposure to smoke, poor nutrition, low maternal height/ weight (<145cm and 50Kg respectively), haemoglobin level less than 11g, maternal genital infections and few antenatal visits were predictors of poor pregnancy outcome and had shown high incidence of preterm births, low birth weight babies, asphyxiated babies.

Paynee287 carried out a study at the University of Medicine and Dentistry, New Jersy, USA. She found that 46% of mothers who were exposed to air or traffic pollution delivered babies with low birth weight. She concluded that it was due to higher concentration of nitrogen dioxide in atmospheric air.
Ayoola et al\textsuperscript{288} while studying late recognition of pregnancy as a predictor of adverse birth outcome in Canada reported that lack of antenatal visits and lack of knowledge makes a pregnant woman ignorant about associated problems of pregnancy. The women who were recognized as hypertensive at 28\textsuperscript{th} gestational week delivered prematurely and the rate of preterm birth was 68.24\%, with birth asphyxia in 18\%, low birth weight in 76.34\% and still births in 11.12\%. Anaemia was a factor which was unnoticed till 28-32 weeks of gestation and birth weight was equally high in these women.

Wisbong\textsuperscript{289} conducted a study in Denmark to find out the effect of psychological stress on pregnancy. They reported that mothers with mental stress, work stress, social stress were highly predictive to delivery of preterm and low birth weight babies (p <0.01). About 50\% mothers were hypertensive and adhered to smoking.

Khodakarami\textsuperscript{290} carried out a descriptive analysis on the pregnancy outcome in 313 pregnant women abused and 160 non-abused in Israel. Abuse was statistically significantly correlated with low mean weight gain during pregnancy, low mean frequency of the prenatal care, prolonged labour (dystocia), premature rupture of membranes, low mean birth weight, and low mean gestational age at birth.

Crane\textsuperscript{291} conducted a retrospective cohort study in Canada to study the effect of environmental tobacco smoke on perinatal outcome of 11852 non-smoking women. The number of women who were exposed to smoke was 1202 (11.1\%) and those who were not exposed to smoke were 10650 (89.9\%). In exposure group there was intrauterine growth retardation (IUGR-55.2\%), low birth weight (23.4\%), still birth (9.54\%) asphyxia (12.2\%), premature birth of baby (<34 weeks) 20.1\%) and these neonates had poor outcome in their early neonatal period.

Gunatilake and Perlow\textsuperscript{292} conducted a study on 542 obese pregnant women in Mexico to find out relation of obesity with maternal diseases and perinatal outcome. They reported that obesity in pregnancy doubles the risk of heart diseases, hypertension and diabetes which in turn affects the perinatal outcome and 31.29\% of obese mothers are found to have adverse perinatal outcome. They suggested that obese gravida needs clinical management from early pregnancy to prevent from excessive weight gain, operative interventions, and to keep blood sugar and blood pressure under control.
Kour and Bansal\textsuperscript{293} did a hospital based study on 521 non-working prospective mothers attending antenatal clinics of four hospitals of Hoshiarpur district, Punjab, to find out maternal determinants of low birth weight babies. She reported association of low birth weight babies with primigravida mothers (49.3\%) and with matric as their education (36.62\%).

Khattar, Awasthi and Das\textsuperscript{294} carried out a case control study in a Public Tertiary Care Hospital in Lucknow, India from May to July, 2011 to determine whether residential environmental tobacco smoke (ETS) exposure during pregnancy was associated with low birth weight (LBW) neonates and establish a dose response relationship. They excluded women who were smokers and tobacco chewers, high parity (>3), multiple pregnancy and still births. Included were 100 cases and 200 controls, aged 20 to 30 years. Mothers who delivered low birth weight neonate (<2.5 kg) were cases and those whose neonates weighed > 2.5 kg at birth were controls. Information was collected on ETS exposure and other risk factors of low birth weight within 24 hours of delivery. Clinical information like maternal haemoglobin levels, birth weight and gestational age of the neonate was extracted from hospital records. On univariate analysis, preterm pregnancy, low socioeconomic status, previous LBW neonate, no utilization of antenatal care (ANC), severe anaemia and ETS exposure were statistically significantly associated with low birth weight neonate and controlling for these in logistic regression analysis, adjusted Odds ratio for ETS exposure association with LBW neonate was 3.16 (95\% CI=1.88-5.28). A dose response relationship was also found which was statistically significant (10-20 cigarettes smoked/day: OR = 4.06, 95\% CI=1.78-9.26 and >20 cigarettes smoked/day, OR = 17.62, 95\% CI= 3.76-82.43). They concluded that there is an urgent need to increase awareness about health hazards of ETS during pregnancy and bring about behavioural changes accordingly as a one of the strategies to reduce LBW deliveries in India.

Koura et al\textsuperscript{295} conducted a prospective study of 617 pregnant women and their children in Benin to determine the effect of maternal anaemia on pregnancy outcome and describe its impact on infant haemoglobin level in the first 18 months of life. Maternal anaemia was not associated with low birth weight [OR=1.2(0.6-2.2)] or preterm birth [OR=1.3(0.7-2.4)].
Hediger conducted a study to compile data about anaemia and effect of iron-deficiency anemia on pregnancy outcome at Department of Obstetrics and Gynaecology, University of Medicine and Dentistry of New Jersey. He reported that anaemia diagnosed early in pregnancy was associated with increased risks of low birth weight and preterm delivery. In several studies, the association between anaemia and outcomes reversed direction during the third trimester; maternal anaemia was no longer a risk factor for poor pregnancy outcomes. Camden study data were used to examine the probable cause of this observation. Maternal iron-deficiency anaemia, diagnosed at entry to prenatal care, was associated with low dietary energy and iron, inadequate gestational gain, and twofold or greater increases in the risks of preterm delivery and low birth weight. During the third trimester, these associations (except with inadequate gestational gain) were no longer present. The relationship between poor diet (with inadequate iron intake) and increased likelihood of preterm delivery persisted during the third trimester.
II.6) Studies related to effect of antenatal interventions on maternal and fetal outcome of pregnancy.

The literature reviewed includes studies related to the:

II.6.1) Effect of Dietary and antenatal counseling;

II.6.2) Effect of Information about low birth weight; and

II.6.3) Effect of Home care packages.

Heater\textsuperscript{115} made a meta-analysis of nursing research studies and found that patient outcome were better in experimental group who were given nursing intervention as compared to the group who received routine care (p<0.01)

Aaronson\textsuperscript{297} studied effect of several measures of social support on abstinence from alcohol, cigarette and caffeine during pregnancy on 529 pregnant women in Yugoslavia who completed written questionnaire and telephone interviews and found that pregnancy outcome improved by spouse support in 49.78%.

Pitzer\textsuperscript{298} studied patterns of fatigue and physiological factors during pregnancy and their relationship to preterm labour and preterm birth in Columbia. In her study she explored a significant relationship between low haemoglobin and haematocrit with preterm birth. The nursing care regarding careful assessment and advice was found effective in reducing the incidence of preterm birth by 43%.

Starn\textsuperscript{299} conducted a study on socially at risk mothers from pregnancy to six months who were exposed to different risks like alcohol, drug abuse, cocaine etc. during their first trimester. A counselling supportive approach was utilized to establish rapport and encourage women to develop and maintain life style during their pregnancy. This approach was supplemented with role modelling, referral, active listening and facilitation of support during weekly phone calls and monthly home visits. The counselling supportive approach allowed for relaxed and confidential relationship than in busy prenatal clinic. She revealed that there was complete cessation or substantial decrease of substance abuse, improved health behaviour and facilitation of trust and rapport by sharing concerns and problems.
**Freda** conducted numerous research projects concerning prevention of preterm birth through PROPP (program to reduce obstetrical problems and prematurity). The program was based on life style modification and stress reduction. 202 pregnant women at risk of preterm labour were assessed for prevalence of life style factors associated with preterm labour. Counselling and education was offered about ways to avoid and modify life stress including avoidance of climbing stairs and referral to social service. Interventions were tempered with an understanding of behaviour, social condition and personal characteristics of child bearing women. The program was found beneficial in reducing preterm births (58.63%).

**O’Sullivan and Jackobsen** carried out a randomized trial of a special health care program on 486 first time adolescent mothers (≤17 years) and their infants; where 243 mother-infant pairs were randomly assigned to one of the two groups. The health care program included the routine care, rigorous follow up, discussion with mother about her plans to return school, use of family planning methods, and extra health teaching to experimental group and routine care to control group. The drop-out rate (60%) and repeat pregnancy rate (12%) was significantly less in experimental group as compared to control group (82% and 28% respectively). The infants of experimental group were fully immunized (33%) after 12 months than infants in control group (18%). This comprehensive health care program was found to bring about better outcomes for both adolescent mothers and their infants.

**Goldenberg et al.** studied benefits of bed rest, limited work and reduced sexual activity in reducing preterm birth in women at risk of preeclampsia, intrauterine growth restriction and spontaneous preterm births in New York city. They revealed that preeclampsia was reduced by 35% and preterm birth by 68.74%. The average birth weight of 85% babies born was 2840g±300g.

**Fiscella** made a critical review about improvement of birth outcome with prenatal care in Russia. She reviewed that early and regular prenatal visits with advice on diet, immunization, iron and folic acid intake and associated antenatal information with demonstration had shown significantly better pregnancy and birth outcome in women of the intervention group (p<0.001)
Alexander and Korenbrot\textsuperscript{304} studied the role of prenatal care in preventing low birth weight in Finland on 945 anaemic and hypertensive pregnant women. The prenatal care provided by them was associated with education, verbal and written information, early detection of risk factors and medical care of associated disorders and had resulted in improved birth outcomes with normal birth weight babies in 56.91%.

Villar et al\textsuperscript{305} conducted a study to assess the effectiveness of interventions for the prevention or treatment of nutritional and infectious disorders during pregnancy on preterm birth rates in US. Eighteen systematic reviews (10 nutritional and 8 antimicrobial) were considered. Results indicated that the treatment of asymptomatic bacteriuria reduced the incidence of preterm birth or low birth weight (RR=0.67; 95% CI: 0.52-0.85). Routine iron supplementation prevented maternal anaemia and preterm birth. Calcium supplementation had shown promising results in reducing preterm birth.

Mani\textsuperscript{306} conducted a study to evaluate the effects of relaxation technique on maternal and neonatal outcome in primipara mothers at West Bengal. She reported that experimental group had more normal delivery (59.4%) and mean Apgar score of neonate at birth was higher 8-10 than control group (6-7).

Garcia-Patterson\textsuperscript{307} did a randomized trial on 512 women in Poland to evaluate the effect of light exercise on gestational diabetes. They reported birth of normal weight babies (57%), full term (75.41%) and very few congenital defects (3.1%).

Bull, Mulvihill and Quigley\textsuperscript{124} did a case control study in Spain to assess the effectiveness of quitting smoking during pregnancy on their prevention of low birth weight. They indicated that smoking was the major modifiable risk factor contributing to low birth weight. These interventions were part of antenatal care and brief interventions were found more effective. Calcium supplementations, has evidence of effectiveness. There was increase in birth weight of babies among pregnant women who quit smoking as a result of intervention. Babies born to women who smoke, weighted on average 200g less than babies born to women who were non-smokers.

LuMe\textsuperscript{308} conducted a study on 587 women in Czechslovakia to find out if prenatal care prevents low birth weight. They found that the women who received complete antenatal care got screened for high risk factors with prompt intervention. These women also
received both verbal and written information and resultant outcome was birth of normal weight babies as compared to women who received less or no prenatal care.

Petroci\textsuperscript{309} explored the relationship between the numbers of antenatal visits and perinatal outcome among 1358 high risk pregnant women in Europe. They reported a significant association between the number of visits and low birth weight (p<0.001), the number of visits and mode of delivery (operative caesarean delivery). The more the mothers visited antenatal clinic, fewer were the incidences of low birth weight and operative deliveries.

Dernspey\textsuperscript{310} did a prospective study of gestational diabetes mellitus risk in relation to maternal recreational physical activity before and during pregnancy in Austria. They reported that weight of 12-15 Kg was gained by 75.98% of mothers, whereas about 12.32% of mothers had gained weight between 15-18 Kg who had shown higher blood glucose levels and were hypertensive.

Raddi\textsuperscript{81} carried a study to evaluate perinatal care among high risk mothers in selected hospitals of Belgaum, Karnataka. Among other risks anaemic pregnant women constituted 90% and hypertensive pregnant women constituted 30%. She reported that maximum neonates were born alive (91%), 14% were preterm births, 23% babies needed neonatal intensive care admission.

Ricketts\textsuperscript{311} reported results from Colorado’s prenatal plus program that proportion of low birth weight infants was lower for women who stopped smoking than for women who continued smoking (8.5% vs 13.7%). The rate of low birth weight was lower in women who achieved adequate weight gain than in those who did not (6.7% versus 17.2%).

In a prospective observational study at Brunn (Russia), Oken etal\textsuperscript{312} studied association of physical activity and inactivity before and during pregnancy with glucose tolerance. They have shown that light-to-moderate physical activity during pregnancy reduced glucose levels both in women with gestational diabetes mellitus and in non-diabetic pregnant women and improved birth outcome.

Lumley and Donohue\textsuperscript{313} did a randomized trial of pre-pregnancy information, advice and counselling in inner–urban Melbourne. These midwives paid home visits aimed at reducing low birth weight in 1579 women. The information and counselling was given daily for 45 minutes and it reduced birth weight in 87% women.
Zhang\textsuperscript{314} did a prospective cohort study in about 22000 women at Vienna to assess whether the type, amount and intensity of pre-gravid physical activity and sedentary behaviours are associated with the risk of developing gestational diabetes. Women who spend 20 hour per week or more watching television and did not do any vigorous activity had a higher risk of developing the condition than women who spend less than 2 hours per week watching television and did physical activity. Women with gestational diabetes who exercised regularly during pregnancy were less likely to deliver low birth weight / a large for gestational age infant than those who did not exercise.

Petersen\textsuperscript{315} studied effect of smoking cessation programmes in Brazil on 642 women and reported that a 5-15 minute counselling session delivered by a trained midwife who offered pregnancy-specific counselling significantly reduced smoking rates ($RR = 1.7$; 95% CI, 1.3-2.2).

Barton\textsuperscript{316} evaluated cost savings of outpatient management services for women with pregnancy-related hypertensive conditions in Philippines. The outpatient management program included verbal and written patient education related to the hypertensive disease process during pregnancy as well as self-care procedures. Biometric data (i.e. automated blood pressure measurement, qualitative urinary proteins) were collected daily by the patient and transmitted telephonically to the nursing call centre, which also included subjective symptoms. Electronic records were maintained and reports provided to the prescribing physician and case manager. The mean gestational age at the starting of program was 32.6 weeks. Antenatal hospital admission was required by 24.8% of patients, with a mean length of stay of 2.3 days per admission. Progression to severe preeclampsia occurred in 14.3% of patient. Mean gestational age at delivery was 37 weeks. Antepartum charges were saved by 2.50 US dollars by this program. Thus it was concluded that utilizing outpatient management services for women with pregnancy-related hypertensive conditions reduces the need for in-patient care and is cost effective.

Metzger\textsuperscript{317} presented the findings of a study conducted by The Australian Carbohydrate Intolerance Study (ACHOIS) trial group during the Fifth International Workshop Conference on Gestational Diabetes Mellitus. ACHOIS had carried out a randomized clinical trial to assess whether treating women with gestational diabetes reduced the risk of perinatal complications. 1000 pregnant women with gestational diabetes at 24-28 weeks of gestation were randomly assigned to receive dietary advice, blood glucose
monitoring, insulin therapy or routine care. Serious perinatal outcomes were reduced from 4% to 1% in pregnant women treated for gestational diabetes. However, rate of admission to the neonatal nursery was high in intervention group.

**Mattoo**\(^{318}\) conducted a study in Delhi to evaluate the effectiveness of a planned health education programme on knowledge, skill, stress and glycaemia level, maternal and neonatal outcome of mothers with gestational diabetes and compared them with a control group of mothers with gestational diabetes. In her planned health education programme, she included brisk walking for 30-45 minutes, dietary prescription and health teachings and reported that knowledge was gained significantly in experimental group who also showed reduced glycaemia levels (86.4%) than control group (13.6%). There was spontaneous onset of labour with vaginal delivery of full term, alive and normal weight babies more in experimental group whereas control group had more preterm deliveries. She reported higher rates of caesarean births, polyhydramnios, perineal injury, big baby and congenital abnormality in control group as compared to experimental group.

**McLachlan**\(^ {319}\) analysed the effectiveness of continuous glucose monitoring systems in 68 pregnant women with diabetes (37 with gestational diabetes, 10 with type II diabetes and eight with type I diabetes). These investigators reported that there were altered clinical management decisions taken for almost two thirds (62%) of intervention cases because continuous glucose monitoring could help in continuous assessment of diabetic cases and accordingly the cases were treated. 45% women were treated with insulin, 39.78% with insulin and dietary management, rest needed exercise and controlled diet.

**Claesson**\(^ {320}\) did a case control intervention study on weight gain restriction for obese pregnant women in San Francisco. This intervention programme was based on extra visits with a specially trained midwife and consisted of a motivational talk in early pregnancy to change her behaviour and attending aerobic classes once/twice a week. Schedule of midwife included assessment of pregnant women’s knowledge of obesity as risk factor for pregnancy and birth, offering information about consequences of obesity and how to change their regular eating habit and food intake, providing written information, and 30 minutes individual session every week including weight control and supportive talk. It was found effective in controlling weight gain in 57.6%.
Ickovics\textsuperscript{321} did a randomized controlled trial in Italy on 538 pregnant women to study the effect of group prenatal care on their perinatal outcome. It contained dietary education, care of minor disorders, effect of walking, music and rest. The study revealed birth of full term babies (92%), normal Apgar score (78.3%), and normal birth weight (88.51%).

Wen Shi Wu et al\textsuperscript{322} carried a prospective cohort study on 2951 women in Canada to evaluate the association between folic acid supplementation in early second trimester and the risk of developing preeclampsia. Compared with women using supplementation, subjects who had not taken folic acid were more likely to smoke cigarettes during pregnancy, and to be younger, multiparous and with low education and income. Results indicated that 92% women had supplementation with folic acid or multivitamins containing folic acid in the early second trimester which was found associated with increased serum folate levels and 63% had reduction in risk of preeclampsia.

Murphy\textsuperscript{323} analyzed the effectiveness of continuous glucose monitoring systems in 71 pregnant women with type I (n=46) or type 2 (n=25) diabetes allocated to antenatal care and continuous glucose monitoring (n=38) or to standard antenatal care (n=33). Women who were randomly assigned to continuous glucose monitoring systems devices had lower mean birth weight SD scores (0.9 vs 1.6), decreased median customized birth weight centiles (69% vs 93%) as compared with the control group.

An interdisciplinary committee set by the UN Institute of Medicine\textsuperscript{125} conducted a study on high risk antenatal mothers and found reduction in infant mortality and improved child health as a result of impact on pregnancy outcome of special program offering prenatal care and related services. It is found by committee that prenatal care is most effective in reducing the chance of low birth weight among high risk women.

Thailamlong\textsuperscript{324} systematically reviewed the evidence related to nursing interventions regarding prevention of preterm birth in Thailand. Her study included both published and unpublished studies where researchers have utilized combined techniques like relaxation and social support, telephone calls, home visits, psychological support, seeking family care givers which have proven effective in prolongation of pregnancy. She also focused on techniques which included simple antenatal care like registration, screening, regular follow up and antenatal advises. She revealed that preterm births were reduced to 46.87% and neonates had shown good outcome during whole neonatal period.
Lee Mitchell\textsuperscript{325} reported the effect of home visitation on reducing the number of low birth weight by conducting a randomized controlled trial on 1194 pregnant women in Ireland. She revealed that home visits enhanced the woman to stick to the prenatal care regime. The weight gain was within normal limits, blood pressure was under control, none had fever and 77.52% delivered babies with normal birth weight.

Shelly\textsuperscript{326} studied the effect of an organized consistent programme of dietary and lifestyle counseling given to a group of 57 pregnant women (study group) and compared it with a control group of 43 pregnant women who received routine prenatal care in Brussels. They reported that the study group gained significantly less weight than the routine prenatal care group who had more caesarean deliveries due to failure to progress and had heavier neonates.

Owe\textsuperscript{327} studied association between regular exercise and excessive new born birth weight in Belgium and reported inverse association between regular exercise and excessive new born birth weight.

Reece et al\textsuperscript{215} studied women with gestational diabetes for their outcome in North America. They carried out their regular assessments including weight, blood pressure, blood sugar and fetal monitoring and found that these women had less perinatal complications and child birth was free of complications.

Tilve\textsuperscript{328} carried a case study in India on a second gravida with haemoglobin of 6.4gm% at 22-23 weeks of gestation and with pallor + + +, who was advised parental iron (4 injections) every third day with injectable vit B12 and folic acid. After 7 days of completing the dose, haemoglobin rose to 9.1gm% and rise of 2.7gm% within 3 weeks was noted with this regime. After 8 weeks of completing the dose, haemoglobin rose to 10.8gm% and rise of 4.4gm% was noted after starting the treatment.

Kenneth\textsuperscript{329} carried a study to examine preterm birth in an inner city public hospital, America. They reported decline in preterm births by 65.87% at Parkland Memorial hospital after they exposed 389 women to counselling with special emphasis on bed rest and timely reporting of signs of early labour.

Skelly\textsuperscript{330} made a controlled trial of nursing interventions at Australia to improve health outcome of 432 women with type 2 diabetes mellitus. It included home visit, 5 booster
telephone calls, self-care, diet and weight management counselling and was evaluated at baseline, 3, 6 and 9 months. This self-care intervention significantly improved their quality of life and impact of diabetes as compared to control group.

Dodd\textsuperscript{331} did a systematic review of an intervention for 300 overweight and obese Dutch pregnant women, where exercises and diet counselling with follow up was supported with verbal and written information. The fetus was born term with no or very few complications.

Ling-Ling Lee\textsuperscript{332} made a systematic review about the effect of walking intervention on BP control in Canada. In this systematic search of literature, randomized controlled trial design with a non-intervention control group was used. Different walking intervention includes strolling, brisk walking, aerobic walking, progressive walking, moderate/high intensity walking, walking short/long bouts, 3 or 5 day exercise, walking 30 minute, walking 10 minutes three times, walking once or twice a day, 20 minute walk, self-paced walking, progressive walking, walking within tasks, walking extra. The intervention which included moderate to high intensity walking and longer intervention periods was found effective in keeping the blood pressure under control and resulted in good perinatal outcome.

Xiong, Zhang and Fraser\textsuperscript{333} studied effect of quitting smoking during early versus late pregnancy on the risk of preeclampsia and adverse birth outcome in a case control study of 86 preeclamptic women and 239 controls and reported that early smoking cessation ( quitting before 20 weeks) women who were compared with women who never smoked was not associated with a reduced risk of preeclampsia (adjusted OR1.03;95% CI 0.42-2.60). Both late smoking cessation ( quitting after 20 weeks of gestation) and persistent smoking (smoking before and during pregnancy) were associated with a non-significant reduction in preeclampsia (OR 0.78; 95% C I 0.12-5.02 for late quitting and OR 0.62; 95% CI 0.16-2.37 for persistent smoking). However, persistent smoking was associated with an increased risk of other adverse pregnancy outcomes, such as low birth weight (OR 10.2; 95% CI 2.49-41.8) and preterm birth (OR 3.59; 95% CI 1.06-12.1).

Nascimento\textsuperscript{334} studied the effect of exercise programme on maternal and perinatal outcome in Berlin and reported that it was beneficial to reduce gestational weight gain in
overweight women and gestational weight was increased to 11-12Kg and had shown no adverse effect on the pregnancy outcome.

Strenling\textsuperscript{335} made a meta-analysis of intervention trials in Germany about physical activity and gestational weight gain. The interventions included running, aerobics, cycling and muscle strengthening for 20 minutes to one hour in first / second trimester. They reported low gestational weight gain in intervention group.

**Summary**

This chapter dealt with the review of literature about the selected and related areas of selected high risk factors, other risk factors responsible for adverse birth outcomes, maternal outcome, neonatal outcome and effect of interventions on the pregnancy outcome. The literature reviewed has been organized in following areas:

5. Studies related to association of various risk factors with maternal and fetal outcome.