LITERATURE REVIEW

Commonsense implies that it is better to prevent disease than to cure it, and antenatal care is a perfect example of preventive medicine. The aim of antenatal care is to ensure the well being of mother and child. This objective can be subdivided into the screening and/or prevention of maternal and fetal problems, and the preparation of couple for childbirth and child bearing.

Though all mothers and children are vulnerable to disease or disability, there are certain mothers and infants who are at increased or special risk of complications of pregnancy/labor or both. “A risk factor is defined as any ascertainable characteristic or circumstance of a person (or group of such persons) known to be associated with an abnormal risk of developing, or being adversely affected by a morbid process” (WHO, 1973). Risk factors can be used to predict causes or signal, which are identifiable before the chain of event and unforeseen complication that can follow.

2.1 INDICATORS FOR HIGH-RISK PREGNANCY

High-risk pregnancy identification is a challenging work. Many indicators have been developed to recognize high-risk pregnancy. Their prime importance is identification of those patients whose problems are severe enough warranting referral to a better center equipped with essential obstetric care facilities like operation theatre, anesthesia and SCBU. The determination of high-risk pregnancy indicators is aimed to help the obstetricians to identify the patients in need of special attention, and also to elaborate a prognosis for them. To fulfill this need, several high-risk identification systems have been developed, but they are not suitable for all population.

Identification of high and low-risk pregnancies begins at the first antenatal visit. The aim of the risk approach is to predict problems before they arrive so that women designated as high-risk can receive special attention and further care in hospital setting. Two of the important determinants of obstetric risk consist of maternal height and weight. Many studies and literature stress on the use of these indicators for identification of high-risk pregnancy.

In developing countries, there is a need for the development of indicators which can be utilized at primary health care level easily. According to WHO, very short women are at high-risk for fetopelvic disproportion and need to be referred to a center with capacity for operative delivery. Assessment of height for detection of these short statured women is recommended by WHO, as operative delivery in women with CPD can prevent maternal and fetal death and major morbidity. Several studies recommend the use of maternal height and weight as simple and sensitive indicators of pregnancy outcome. They are especially useful for prediction of mode of delivery, low birth weight babies and birth asphyxia.

For predicting fetal and maternal outcome of pregnancy, an indicator is required. In this context, WHO has proposed that an indicator should fulfill following criteria:
1. A simple single measurement (acceptable, low cost);
2. Strong predictability or effect (high odds ratio ORs);
3. Reliable (narrow confidence interval for ORs);
4. Timely (permitting effective intervention, including referral);
5. Sensitive and specific for screening;
6. Efficient in performance (low number of false classification)

B. Kappel et al\textsuperscript{9} studied the significance of short stature among Scandinavian mothers and confirmed it to be a risk factor for obstetric performance. They also stressed on its use as an indicator for adverse outcome in pregnancy. P. Desai et al\textsuperscript{10} emphasized that height should be taken as seriously as the weight because of its obstetric significance.

Use of simplified criteria like height was recommended by D. Sokal et al\textsuperscript{11} to be used by TBAs in West Africa for referral to higher centers. According to J. Van Roosmalen and R. Brand\textsuperscript{12} height is easy to measure and remains a useful tool to predict difficult childbirth and CPD.

WHO collaborative study\textsuperscript{13} of maternal anthropometry and pregnancy outcome recommend the use of maternal height and weight for screening in its service application.

A good weight gain during pregnancy, especially in last trimester, is associated with good baby weight. Similarly, perinatal mortality is significantly associated with low maternal weight at the time of delivery\textsuperscript{14}. T. Kamaladoss et al\textsuperscript{15} found that LBW weight was higher among Indian women weighing < 50kg in third trimester. Various other studies indicate that knowledge of weight gain during pregnancy is helpful in predicting LBW babies\textsuperscript{16,17,18,19,20}.

### 2.2 MATERNAL HEIGHT AND MODE OF DELIVERY

During the past few years, there have been attempts to identify risk factors that could place women at different levels of care, and therefore, improve their obstetric outcome. A physical parameter that was highlighted years ago but has received less attention recently is maternal height. Short stature is associated with an increased risk of obstructed labor due to CPD and its consequences like ruptured uterus, fetal and maternal death and vesicovaginal fistula.

The importance of height as an index of pelvic adequacy and, moreover, of reproductive efficiency has been especially studied by Baird\textsuperscript{5}. He has shown that reproductive performance is best in women who are 162cm or more in height. Bernard\textsuperscript{21} working with Baird made a comprehensive radiological study of the pelvis in Aberdeen women. His results amply confirmed the belief that pelvic size and shape are related to stature.

As the height of mother decreases, the rate of cesarean section rises. In a Scandinavian study, acute LSCS was performed in 11% of short statured mother and in 3.3% of control\textsuperscript{9}. In this study, the major indication for LSCS in short mothers was intrauterine asphyxia (25%) and CPD (20%). CPD was also indication in 42% of elective LSCS.
In an Indian study, 22.6% abdominal delivery was found among women < 145cm in comparison to 3.5% among control group\cite{10}.

K. Mahomed et al\cite{22} conducted a study in Harare to determine the magnitude of the risk of poor pregnancy outcome in women with short stature and also to attempt to identify if there is a critical height below which normal delivery may not be advisable. They found 37.8% LSCS rate among women < 150cm in comparison to 20.2% among women > 150cm. They concluded that women who were 150cm or less in height constituted a high-risk group and preparation should be made beforehand for their referral to the hospital if there was delay in progress during labor.

In Burkina Faso, West Africa, women of short stature were 4.9 times more likely to undergo LSCS than taller women\cite{11} (p < 0.001). The authors suggested that TBAs in Burkina Faso should refer all short women to higher center.

To arbitrate the predictive value of mother’s height on the likelihood of emergency LSCS, L.Y. Hin et al\cite{23} in their study came across a risk of emergency LSCS almost twice among short statured women. A.P. Camilleri\cite{24} found a similar result in his study. The LSCS rate for tall mothers was 3.3% and rose progressively as the maternal height diminished.

In a study from Nepal, N. Pradhan and S. Dali\cite{25} in a combined retrospective and prospective study, found 36.6% LSCS rate in less than 140cm height group. In three groups of 140-144cm, 145-149cm and 150-154cm height percentage of LSCS decreased to 18.72%, 13.94% and 11.34% respectively.

The WHO study\cite{13} ascertain that height is the only anthropometric indicator that indicates a significant relative risk for assisted delivery with an Odds Ratio of 1.6.

Bo Moller and Gunilla Lindmark\cite{26} carried out a comparative study in two villages of Tanzania to determine the influence of short stature as an obstetric risk factor and found that it appreciably influenced the mode of delivery. J. Van Roosmalen\cite{12} also found similar results among rural Tanzanian women.

The rate of instrumental delivery is also influenced critically by maternal height. In Scandinavia 11.3% babies of short mothers were delivered by ventouse and/or forceps, where as only 7.2% of the control had instrumental delivery\cite{9}. In study of Pradhan and Dali\cite{25}, rate of instrumental delivery dropped down from 3.03% in the below 140cm group to 2.55% in the 140-144cm height group, and to 1.26% in the 145-149cm height group. Many other studies show a similar increase in instrumental delivery as maternal height decreased\cite{10,24}.

### 2.3 Maternal Height and Preterm Delivery

There exists a definitive relationship between preterm delivery and maternal height. Not many studies have been conducted to establish a relationship between the two.
In an important study, Michael S. Kramer et al.\(^{27}\) found that women with short stature had a significantly increased risk of spontaneous birth before 37 weeks. The Odds Ratio of short stature for preterm delivery was 1.17 with a 95\% confidence interval 1.05-1.30. Women who delivered prior to 37 weeks, on average were 1.3cm shorter (\(p < 0.0001\)) than those who delivered at term.

E.A. Wright\(^{28}\) found a three-fold increase of preterm birth among short stunted Nigerian women in comparison to control. In India, 20.58\% short stunted women had preterm birth in comparison to 15.29\% among control\(^{10}\).

To assess the etiologic role of short stature in idiopathic preterm labor, Michael S. Kramer et al.\(^{26}\) in their study found a moderate and significant association of short stature with idiopathic preterm labor. An OR of 1.83(1.17-2.86) was found for association of short stature with idiopathic preterm labor. In a WHO study\(^{13}\), maternal height had an OR of 1.2(1.0-1.3 CI) for predictability of preterm birth.

In a risk scoring system evaluation designed to predict preterm birth, John Owen et al.\(^{29}\) stressed on the importance of short stature. A score of 3 was given to short stature. In another high-risk scoring system for pregnancy outcome among Indian women in Mumbai, short stature was included as high-risk score point.

### 2.4 INFLUENCE OF MATERNAL HEIGHT ON BIRTH ASPHYXIA

Though birth asphyxia is influenced by many factors, many studies indicate that birth asphyxia occur more significantly among babies born to short stunted mothers.

Kappel et al.\(^{9}\) analyzed perinatal outcome among Scandinavian women and found that 12.5\% babies belonging to short mothers had intraterne asphyxia in comparison to 6.4\% among control mothers. OR for developing birth asphyxia was 11.4 among vaginally born babies of short stunted mother, which indicate that the risk of neonatal asphyxia was more than 11-fold greater among the babies of short mothers than of control mothers.

Camilleri\(^{24}\) described the finding of an Apgar score of 7 or less as the shorter height was encountered. Birth asphyxia was also noted in 7.79\% of short stunted mother in comparison to 4\% among tall mothers.

### 2.5 CUT-OFF POINT FOR HEIGHT

In different literatures different heights are mentioned as cut–off point for identification of short stunted women, which ranges from 145cm among Indian women to156cm among Scandinavian women. There is no uniform standardization. In African studies, for example, cut-off point of height as risk factor differed from 146cm in Tanzania to 155/160cm in West Africa instead of commonly quoted 150cm.

Everett\(^{30}\) in Tanzania found that it was impossible to apply the 150cm height as a standard for risk approach, which was used in other countries, because the average height of Tanzanian women was very short. After having studied Tanzanian women and the risk of LSCS, they set their high-risk
criterion at 146cm. In contrast, in Burkina Faso, West Africa, D.Sokal et al\textsuperscript{11} found women taller than that of most other African countries and criteria of either 155cm or 160cm was proposed by them as cut-off point instead of commonly quoted 150cm.

The same interesting point was noted while comparing two villages’ population in Tanzania by Bo Moller and G.Lindmark\textsuperscript{26}. They found that the same cut-off point was not applicable to both population. According to Braveman and Tarimo\textsuperscript{8}, height should be assessed according to appropriate population criteria. Many more studies also conclude that the distribution of maternal height in population should be considered when cut-off height for the "at risk" designation is chosen.

J. Van Roosmalen et al\textsuperscript{12} opined that the cut-off point between high and low-risk is influenced by the mean height in the community under survey, and by the available resources in the community. Choosing a lower cut-off point would increase the percentage of primigravida considered to be at risk.

Socio-economic status and ethnicity influences height. B.Kappel\textsuperscript{9} et al found that average height was 142cm among Guatemalan Indians. Women of Australian and South African origin were relatively taller. A. P. Camilleri\textsuperscript{24} points out that a height of 5ft (152.4cm) is a significant cut-off point in the obstetric performance of British women. The corresponding point for Maltese women is more correctly in region of 4ft. 10inch (146.32cm) because they are genetically short statured. Desai et al\textsuperscript{10} justified 145cm as cut-off point for Indian women as they tend to be shorter by various predisposition.

2.6 INFLUENCE OF MATERNAL HEIGHT ON FETAL WEIGHT

Increasing maternal height influences fetal birth weight positively. Many studies vouch to it.

In Arhus Municipal Hospital, Risskov, Denmark frequency for “light-for-date” was significantly higher in babies of short mothers than in control (15.4 % and 5.6 % respectively)\textsuperscript{9}. In this study, relative risk of a “light-for-date” baby in short mother was 2.8.

In Nepalese women, an increase in the number of LBW was found when mothers’ height decreased\textsuperscript{25}. The incidence was 45.45 % among women less than 140cm height group, to 28.08 % in the 140-144cm group, 19.62 % in the 150-154cm group and 12.78 % in 155-160cm group.

Desai, Hazra and Trivedi\textsuperscript{10} reported increased LBW among short statured mothers of Baroda, India. Identical result was found among Maltese women\textsuperscript{24}.

In a study conducted to determine the prevalence of LBW and its association with maternal factors, J.S. Desmukh et al\textsuperscript{17} recognized an association between LBW and mothers below 144cm in height. In another Indian study, less than 145cm height was significantly more common amongst the mothers of LBW babies\textsuperscript{16}. K. Dhall and R. Bagga\textsuperscript{19} found that among Indian women birth weight of babies increased with increasing maternal height. It was observed that the birth weight in mothers < 145cm tall and between 145-150cm were 155g and 37g less than those of the reference
category. In TamilNadu, India, T. Kamaladoss et al\textsuperscript{15} found that the rate of LBW was high for mothers with \(< 145cm\ (29.7 \%)\) than mothers with \(\geq 145cm\ (24.2 \%)\). It was noticed that mothers with \(< 145cm\) height had 1.32 times risk of giving birth to LBW in comparison to mothers \(> 145cm\) in height.

Among Tanzanian women 10.1 \% LBW babies belonged to the group of short stunted mothers, whereas only 6.5 \% belonged to tall women\textsuperscript{31}.

In Nigeria, A. H. Dawodu and A. A. Laditan\textsuperscript{32} observed a significant relationship (\(p < 0.001\)) between the mothers’ height and the incidence of LBW. The incidence was 9.1 \% among short stunted women and 4.0 \% among tall mothers. E. A. Wright\textsuperscript{28} found that in the plateau region of Nigeria, short stunted mothers had the largest number of LBW babies.

Max Mongelli\textsuperscript{33} observed that though birth weight is determined by multiple interrelated factors, maternal height is an important and significant variable with a \(p\) value of \(< 0.005\).

The proportion of newborn with normal birth weight rises with the maternal height. About 70 \% of babies of women 160cm or more in height were of normal birth weight according to a study\textsuperscript{34}. Nearly half of the babies of 150-159cm tall women were of normal birth weight, but two-third of the newborn were LBW when maternal height was below 150cm.

The height of the mother is a well-known predictive index of perinatal mortality and morbidity. A high incidence of LBW infants has been shown in mothers with height less than 140cm\textsuperscript{14}. Since there is a high perinatal mortality in LBW infants, height has an indirect influence. However, WHO meta-analysis\textsuperscript{13} shows only an OR of 1.7 for LBW, which is not very significant.

2.7 MATERNAL WEIGHT AND FETAL WEIGHT

Maternal weight gain within recommended parameters reduce the risk of adverse outcome. According to Williams Obstetrics\textsuperscript{35} (1997), low weight gain is associated with preterm or otherwise LBW infants.

A significant increase in perinatal mortality was observed when the maternal weight gain was 5.0kg or less. In addition it was observed that the incidence of LBW increased significantly in mothers with weight gain of 5kg or less when preterm birth was excluded\textsuperscript{14}.

According to WHO meta-analysis\textsuperscript{13}, weight attained at different lunar months has significant ORs for predicting fetal birth weight.

Chadha V. K. et al\textsuperscript{34} found an increase of 150g in fetal birth weight with every kg rise in maternal weight gain.

T. Kamaladoss et al\textsuperscript{15} demonstrated that the rate of LBW was high for mothers whose gestational weight at third trimester was \(\leq 50kg\) (68.6 \%) than mothers whose gestational weight was \(> 50kg\) (31.4 \%). This was significantly high (\(p < 0.001\)). K. Dhall and R. Bagga\textsuperscript{19} reported that babies of mothers weighing \(< 50kg\) were 87g lighter than those between 51-60kg. A similar observation was made by J.S. Desmukh et al\textsuperscript{17}.

In a study in Tanzania, maternal post delivery weight less than 45kg had an OR of 2.03 for LBW\textsuperscript{31}. 
To find out pregnancy hazards associated with low maternal body mass indices, a study was conducted by S. Cattanach et al\textsuperscript{36} at Mater Misericordiae Mothers’ Hospital, South Brisbane. The results showed significant evidence to support the view that underweight women are at greater risk of obstetric hazards. An OR of 2.26 and 2.16 was found for birthweight < 1500g and < 2500g respectively for underweight women.

A strong positive correlation exists between maternal health and reproductive performance, and weight gain during pregnancy\textsuperscript{39}. Higher incidence of prematurity or dismaturity and increased perinatal mortality show a close association with poor weight gain during pregnancy.