Prediction of Low Birth Weight infants with Ultrasound Measurement of Placental Diameter and Placental Thickness at 18 and 36 Weeks Gestational Age "Prospective Study"

A Thesis

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By

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List of Abbreviations

Abbr.	Full-term
AC	**:** Abdominal circumference
BM	**:** Basement membrane
BMI	**:** Body mass index
BPD	**:** Biparietal diameter
CS	**:** Cesarean section
EFW	**:** Estimated fetal weight
EPV	**:** Estimated placental volume
FGR	**:** Fetal growth restriction
FL	**:** Femur length
HC	**:** Head circumference
IGF	**:** Insulin-like growth factor
IUGR	**:** Intrauterine growth restriction
LBW	**:** Low birth weight
MHz	**:** Megahertz
MSAFP	**:** Maternal serum alpha fetoprotein
NPV	**:** Negative predictive value
PAPP-A	**:** Pregnancy-associated plasma protein-A
PPV	**:** Positive predictive value

SD **:** Standard Deviations

SGA **:** Small for gestational age

ß-hCG **:** β-human chorionic gonadotropin

VD **:** Vaginal delivery

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Abstract

Background: Birth weight is the first weight of the fetus or newborn obtained after birth preferably measured within the first hour of life before significant postnatal weight loss has occurred. **Aim of the Work:** The aim of the work is to predict low birth weight infants by ultrasound measuring of placental diameter and thickness at 18 and 36 weeks of gestation. **Patients and Methods:** Study site: Obstetric outpatient clinic of Ain Shams University Maternity Hospital. Study design: Observational prospective study that estimates the association of each maternal and placental variables with low or normal birth weight. Population: The total sample was consisted of one hundred and thirteen pregnant women at 18, 24 and 36 weeks of gestation. **Results:** This study showed that placental thickness at 18 wks has high diagnostic validity more than placental diameter at a cut-off ≤ 16.2 mm. It also showed that placental thickness at 36 wks has high diagnostic validity more than placental diameter at a cut-off ≤ 23 mm **Conclusion:** The placental thickness should be included in routine 2D ultrasound scans to improve the accuracy of ultrasound estimated fetal weight. **Recommendations:** Training of personals on 2D Ultrasound measurement of placental thickness is mandatory to maximize the accuracy.

Key words: Birth weight, postnatal weight, infants, gestation, placental diameter

Introduction

Normal fetal growth is a critical component of a healthy pregnancy and influences the long-term health of the offspring. Common adult diseases such as type 2 diabetes and cardiovascular conditions have been linked to abnormal fetal growth, particularly fetal growth restriction (FGR) (**Gluckman et al., 2008).**

Birth weight is the first weight of the fetus or newborn obtained after birth preferably measured within the first hour of life before significant postnatal weight loss has occurred **(Adamson and Harold, 2007).**

An ideal classification of fetal growth should have the ability to distinguish accurately between normal and abnormal growth determined by perinatal morbidity and mortality or even life-course morbidity. It is well established that at most gestational weeks, perinatal morbidity and mortality increase when the fetal size moves farther away from the "optimal" size **(Wilcox and Skjaerven, 1992).** However, fetal size alone cannot accurately predict perinatal mortality and morbidity. Integration of other indicators of fetal and placental health may enhance the accuracy in defining FGR **(Zhang et al., 2010).**

Weight at birth is a good indicator of the newborn's chances for survival, growth, long-term health and psychosocial development **(Zeleke et al., 2012).**

Despite careful antenatal surveillance involving scrupulous examination, an issue of considerable disappointment is that the majority of low birth weight (LBW) infants are not diagnosed until delivery. LBW infants are susceptible to hypoxia and fetal distress, long-term handicap and fetal death. Compounding the problem of the LBW infant is the need to identify the fetus failing to reach its growth potential **(Habib, 2002).**

Definition of fetal growth restriction (FGR) is not simple, and is usually based on birth weight <10 population-based centile **(Resnik, 2002)**.

Much effort has been directed toward the detection and assessment of intrauterine growth restriction (IUGR) **(Azpurua et al., 2010).**

An ideal definition of FGR should take into account the growth potential of the fetus, current fetal size, fetal and placental health, and, if available, fetal growth velocity. However, as FGR has a multifactorial etiology **(Maulik et al., 2006)**, none of these factors alone seems able to discriminate between constitutionally and pathologically small fetuses with great certainty **(Zhang et al., 2010).**

Fetal growth depends on the interactions of genetic and epigenetic determinants functioning against an environment of maternal, fetal, and placental influences. Intrauterine growth restriction (IUGR) is a failure to achieve the growth potential promised by these factors. IUGR manifests as a variable

syndrome of suboptimal growth and body disproportions rather than a well-defined etiologic entity. Causes for IUGR are diverse and include aneuploidies, non-aneuploid syndromes, infections, metabolic factors and placental disorders **(Scifres and Nelson, 2009).**

Growth restriction may be symmetrical or asymmetrical depending on the time of insult during pregnancy **(Deorari et al., 2008).**

Although only 20 percent of growth-restricted fetuses demonstrated sonographic head-to-abdomen asymmetry, these fetuses were at increased risk for intrapartum and neonatal complications. Symmetrically growth-restricted fetuses were not at increased risk for adverse outcomes compared with those appropriately grown. These investigators concluded that asymmetrical fetal growth restriction represented significantly disordered growth, whereas symmetrical growth restriction more likely represented normal, genetically determined small stature **(Dashe et al., 2000).**

Risk factors for fetal growth restriction include constitutionally small mothers, poor maternal nutrition, social deprivation, maternal and fetal infections, congenital malformations, chromosomal aneuploidies, disorders of cartilage and bone, drugs with teratogenic and fetal effects, vascular disease, renal disease, pregestational diabetes, chronic hypoxia, anemia, placental and cord abnormalities, infertility, extrauterine pregnancy, antiphospholipid antibody

syndrome, genetics and multiple fetuses **(Cunningham et al., 2014).**

A healthy baby at term is the product of three important factors: a healthy mother, normal genes, and good placental implantation and growth **(Kliman, 2001).**

The placenta is a highly vascular organ. Its major function is to provide the essential connection between the mother and the developing fetus **(Spirt and Gordon, 1996).**

Adequate fetal growth depends on the efficient delivery of nutrients from the mother to the fetus and therefore requires normal uterine perfusion, normal transplacental exchange of nutrients and waste, and normal umbilical blood flow **(Azpurua et al., 2010).**

Adequate blood supply is of major importance for fetal growth and well-being; therefore placental vascular maladaptation, as a result of placental infarcts, tumors, abnormal uteroplacental vascularity, low placental weight, and placental inflammation, is an important cause of fetal growth restriction (FGR) **(Villar et al., 2006)**.

The placenta is the principal influence on fetal birth weight, and it is thought that abnormalities of placental growth may precede abnormalities in fetal growth **(Thame et al., 2001).**

Because the placenta may be the first organ to manifest changes of disease in pregnancy, placental features may have

a role in screening for pregnancy complications **(Lee et al., 2012).**

Examination of the placenta plays a foremost role in the assessment of normal and abnormal pregnancies. A methodical sonographic evaluation of the placenta should include: location, visual estimation of the size (and, if appearing abnormal, measurement of thickness and/or volume), implantation, morphology, anatomy, as well as a search for anomalies, such as additional lobes and tumors **(Abramowicz and Sheiner, 2008).**

Patterns of placental growth, relating to different functional dimensions of the placenta, deliver a different birth weight for a given placental weight **(Salafia et al., 2007).**

Sonographically, the normal placenta is homogenous and 2 to 4 cm thick, lies against the myometrium, and indents into the amniotic sac. The retroplacental space is a hypoechoic area that separates the myometrium from the placenta's basal plate and measures less than 1 to 2 cm. During prenatal sonographic examinations, placental location and relationship to the internal cervical os are recorded. The umbilical cord is also imaged, its fetal and placental insertion sites examined, and its vessels counted **(Cunningham et al., 2014).**

Attempts made to predict small-for-date infants from placental volume at the second trimester did not yield satisfactory result, however, the fact that small placental size