Fractional Thigh Volume by Three Dimensional Ultrasonography for Birth Weight Prediction

Thesis

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✍ *Engy Samy AbdelGawad*

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List of Abbreviations

2D US ..... Two dimensional ultrasonography

3D US ..... Three dimensional ultrasonography

ABW..... Actual birth weight

AC ..... Abdominal circumference

AE..... Absolute error

AFI ..... Amniotic fluid index

APE ..... Absolute percentage error

AUC ..... Area under the curve

BMI ..... Body mass index

BPD ..... Biparietal diameter

CI ..... Confidence interval

E..... Error

EFW ..... Estimated fetal weight

EP ..... Error percentage

FL ..... Femur length

GHV ..... Growth hormone variant

HAPO ..... Hyperglycemia and Adverse Pregnancy Outcomes

HC ..... Head circumference

HS ..... Highly significant

IGF-I and II .....Insulin-like growth factor-I and II

IQR ..... Interquartile range

IUGR ..... Intrauterine growth restriction

LBW ..... Low birth weight

LGA ..... Large for gestational age

MCA ..... Middle cerebral artery

MPD ..... main paired difference

NS ..... Non-significant

PGH ..... Placental Growth Hormone

PI ..... Pulsatility index

PSV ..... Peak systolic velocity

r ..... Pearson’s correlation coefficient

ROC ..... Receiver operator characteristics

S ..... Significant

SD ..... Standard deviation

SGA ..... Small for gestational age

TVol ..... Thigh volume

VOCAL ..... Virtual Organ Computer-aided Analysis

INTRODUCTION

Estimation of fetal weight is essential in daily obstetric practice particularly close to term. It guides clinicians to finalize important obstetrical decisions. Low birth weight and excessive fetal weight at delivery both are associated with an increased risk of neonatal complications during labour and the puerperium. **(Owen *et al.*, 2003)**

Nowadays, ultrasound is the main diagnostic tool for fetal birth weight (BW) evaluation. The majority of birth weight prediction formulas rely on the fetal biometry data derived from 2-D ultrasound measurement. However, the precision of those conventional formulas remains unsatisfactory with a mean error of 7-10%. ***(*Schild *et al.*, 2007*)***

The majority of the commonly used formulae for estimating fetal weight include measurements of the head, abdomen and femur both alone and in combination. None of these formulae pays attention to the soft tissue mass of the fetus. However, since fetal weight depends not only on head and body dimensions but also on extremity size, it seems reasonable to investigate the role of other body measurements in improving fetal weight estimates. **(Rizwan *et al*., 2008)**

Considering that thigh and arm volumes are parameters that are well established as markers for fetal growth and

nutrition, several studies have utilized these limbs volume as a predictor for birth weight, with more reliable results than those from the traditional formulas utilized by 2D US **(Song et al., 2000)**

Initially, the fetal thigh volume (TVol) measurement was indirectly performed by means of two-dimensional ultrasound (2D US). However, 2D US cannot provide an accurate measurement of fetal limb volume. The majority of studies on fetal limbs volume evaluation by 2D US calculate the volume based on a cross sectional area in only one cutting plane that may not be the most appropriate, so the calculation is subject to error. **(Vintzileos *et al*., 1987)**

The arrival of the 3D US has allowed a more accurate volumetric assessment of several fetal organs, for an earlier and more precise diagnosis of fetal growth and developmental deviations. **(Edward *et al*, 2007)**

AIM OF THE WORK

The aim of this study is to introduce fractional limb volume as a new ultrasonographic parameter, validate reliability of fractional limb volume measurements, develop new birth weight prediction models, and examine their practical utility for estimating fetal weight during late pregnancy.

FETAL GROWTH

Human fetal growth is characterized by sequential patterns of tissue and organ growth, differentiation and maturation that are determined by maternal provision of substrate, placental transfer of these substrates, and fetal growth potential governed by the genome **(Cunningham et al., 2005).**

The process of fetal growth comprises three consecutive and somewhat overlapping phases.

The first phase is the phase of cellular hyperplasia and encompasses the first 16 weeks of gestation.

The second phase, known as the phase of concomitant hyperplasia and hypertrophy, occurs between the 16th and 32nd weeks and involves increases in cell size and number.

The third and final phase, called the phase of cellular hypertrophy, occurs between the 32nd week and term and is characterized by a rapid increase in cell size. Quantitatively, normal singleton fetal growth increases from approximately 5 g/day at 14 to 15 weeks of gestation to 10 g/day at 20 weeks and 30 to 35 g/day at 32 to 34 weeks, after which the growth rate decreases ***(Chiesa et al., 2008)***.

Although many factors have been implicated, the precise cellular and molecular mechanisms by which normal fetal