

**THE FETAL GROWTH STUDY –
A PROSPECTIVE COHORT STUDY OF FETAL GROWTH AND
BODY COMPOSITION IN OVERWEIGHT AND OBESE
PREGNANT WOMEN**

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LIST OF ABBREVIATIONS

AC : abdominal circumference
AA : abdominal area
AFM : abdominal fat mass
BPD : biparietal diameter
BMI : body mass index
CS : caesarean section
EFW : estimated fetal weight
FL : femur length
GDM : gestational diabetes mellitus
GWG : gestational weight gain
HC : head circumference
IOL : induction of labour
IOM : Institute of Medicine
LGA : large for gestational age
LR : likelihood ratio
LR+ : positive likelihood ratio
LR- : negative likelihood ratio
MTFM : mid thigh fat mass
MTLM : mid thigh lean mass
MTTM : mid thigh total mass
NICU : neonatal intensive care
PCOS : polycystic ovarian syndrome
PEAPOD : air displacement plethysmography
ROC curve : receiver operating characteristic curves
SSFm : subscapular fat mass
TOBEC : total body electrical conductivity
WHO : World Health Organisation

ABSTRACT

Background

Maternal overweight and obesity pose significant risks both for the woman and her infant, including high infant birthweight. Gestational weight gain may also be an important factor in determining pregnancy outcomes. The effect of high maternal BMI and gestational weight gain on fetal growth and fetal body composition with reference to population standards has not been well described to date.

Aims

The aim of The Fetal Growth Study was to describe fetal growth and body composition prospectively in a large group of overweight and obese women during pregnancy and to examine the influence of maternal BMI and gestational weight gain on these measures.

Methods

Fetal biometric growth measures (biparietal diameter, head circumference, abdominal circumference, femur length and estimated fetal weight) and fetal body composition (mid thigh lean and fat mass, abdominal fat mass and subscapular fat mass) were assessed prospectively using ultrasound at 28 and 36 weeks' gestation. Important maternal and fetal outcomes were collected including gestational weight gain and infant birthweight.

Results

The findings of The Fetal Growth Study indicate that maternal overweight and obesity is significantly associated with increased fetal growth, an effect that is evident from 20 weeks' gestation when compared with published normal values. Additionally, when compared with population standards, the relative contributions of head and abdominal growth change throughout pregnancy with abdominal growth dominating in the second trimester and head growth in the third trimester. Both maternal BMI

category and gestational weight gain contribute to increased measures of fetal growth, predominantly through a modification of abdominal and overall growth. Gestational weight gain above current recommendations was associated with further increases in abdominal and overall growth. Maternal overweight and obesity is associated with a significant increase in fetal measures of both lean and fat mass. At 28 and 36 weeks, AC and EFW growth were associated with birthweight above 4500g, whilst HC was associated with birthweight above 4000g but not 4500g.

Furthermore, EFW, head and abdominal growth were associated with mode of birth, with measures above the 90th percentile increasing the likelihood of caesarean section for women. The only predictor of clinical outcomes with a moderately useful positive likelihood ratio was fetal AC above the 90th percentile at 28 weeks (LR+ 6.56 for birthweight above 4500g, LR- 0.37).

Conclusions

Maternal overweight or obesity and gestational weight gain above recommended ranges influence fetal growth and fetal body composition from mid pregnancy. Gestational weight gain above current recommended ranges is associated with a further increase in measures of fetal growth and fetal fat mass. In women who are overweight or obese, growth above the 90th percentile in the third trimester is associated with high infant birthweight and an increased likelihood of caesarean section. Further research from ongoing prospective intervention studies will provide important information regarding the effect of limiting weight gain on fetal growth and body composition and important maternal and infant outcomes.

DECLARATION

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Rosalie Mignon Grivell and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

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AUTHOR'S CONTRIBUTION

I have been responsible for the development of the original fetal ultrasound protocols and methodology including the assessment of fetal body composition and obtaining research and ethics approval. I developed the ultrasound data collection sheets and coordinated the collection of all ultrasound data. I was responsible for training all research sonographers and for maintaining quality control. I personally performed 80% of the ultrasound examinations included in this thesis, including the assessment of interobserver variability. I have received statistical advice from Dr Helena Oakey regarding the analysis of interobserver variability. I conducted all other statistical analyses presented and accept responsibility for the veracity of the statistical analyses and their interpretation.