

# Overweight and Obesity in Pregnancy

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**Discipline Obstetrics & Gynaecology**

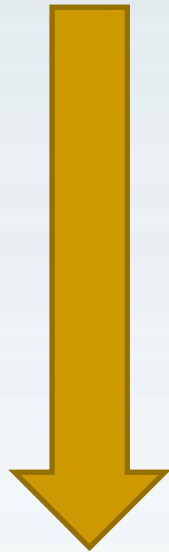
**The University of Adelaide**



# Outline

- Implications of obesity - general
- Obesity and pregnancy
  - Maternal complications
  - Infant complications
- Effective interventions
- Long term implications

# How is overweight and obesity measured?



$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

## Body Mass Index

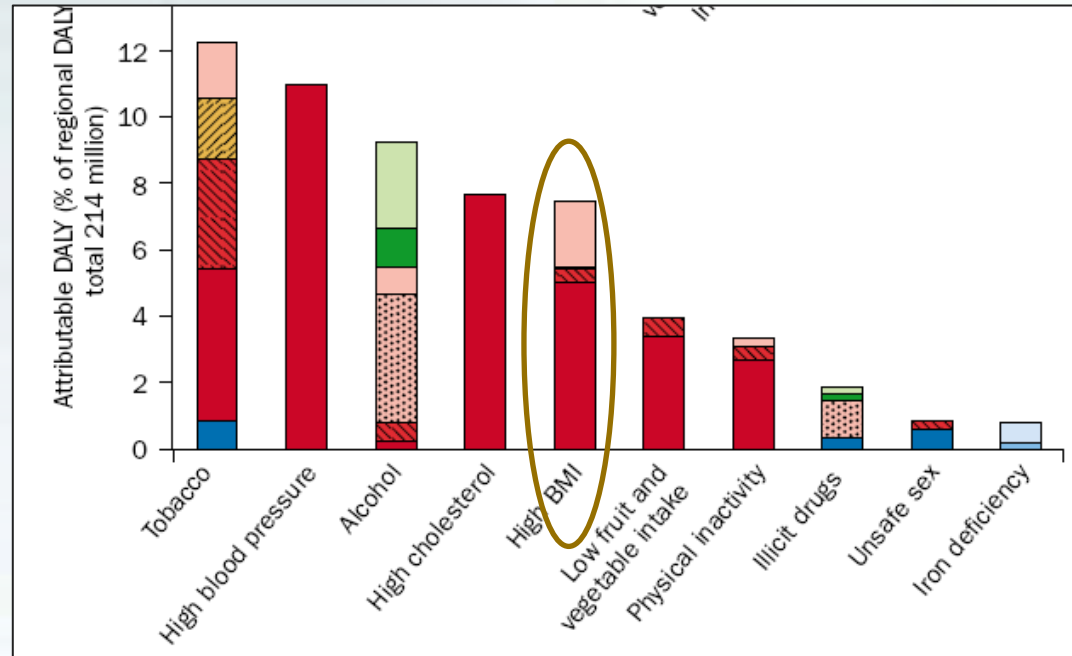
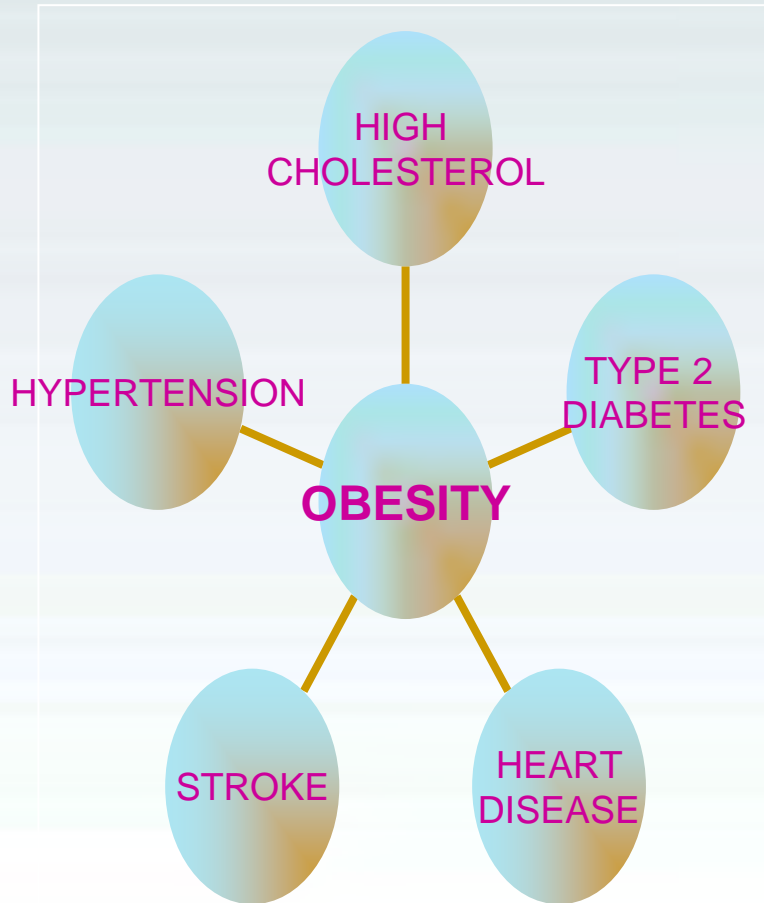
Weight  
Abdominal Circumference  
Waist : Hip Ratio



Normal weight = BMI 18.5 – 24.9  
Overweight = BMI 25-29.9  
Obese = BMI 30 or greater

WHO, AIHW

# The effect of obesity on adult health



Risk factors for burden of disease in developed countries.

Worldwide, obesity is the 6<sup>th</sup> most important contributor to burden of disease.

# The 'cost' of obesity



The economic cost of obesity

**\$21 Billion per year**

Access economics – the economic costs of obesity, a report prepared for Diabetes Australia, 2008

**10% US health care costs  
\$147<sub>us</sub> Billion in 2006**

BMJ report August 2009



# Obesity in Pregnancy

- **35% of women aged 25-35 years are overweight or obese**
- **34% of pregnant women in Australia have a BMI greater than 25kg/m<sup>2</sup>**
- **Risk of adverse health outcomes increase with increasing BMI**

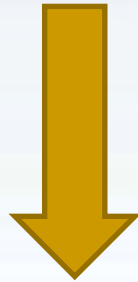
# Obesity and Early Pregnancy

- Increased risk early pregnancy failure
- Related to impaired oocyte development as well as altered endometrial receptivity
  - Risk early miscarriage
    - 1.2 times increased
  - Risk recurrent miscarriage
    - 3.5 times increased

# Obesity and Pregnancy

**COMMON OCCURRENCE OF PRE-EXISTING CONDITIONS THAT IMPACT ON PREGNANCY**

Diabetes  
Hypertension  
High Cholesterol



**INCREASED RISK OF ADVERSE PREGNANCY OUTCOME**

Hypertensive Disorders  
Abnormal Fetal Growth  
Operative Birth

# Practical Difficulties

- Assessment of fetal growth, lie and presentation
- Ultrasound examinations
  - Technical difficulties with increased adiposity
- Detection of fetal anomalies
- Manual handling & safety



# Maternal Risks

Pre-eclampsia	5.0 times
Gestational diabetes	7.5 times
Infection	1.3 times
Caesarean section	2.9 times

Risk of adverse outcomes with increasing BMI, compared with women with normal BMI

# Post-partum Complications

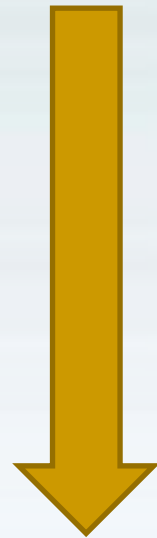
- Post-partum haemorrhage
- Wound infection
- Genital tract infection
- Thromboembolic disease

# Fetal & Neonatal Risks

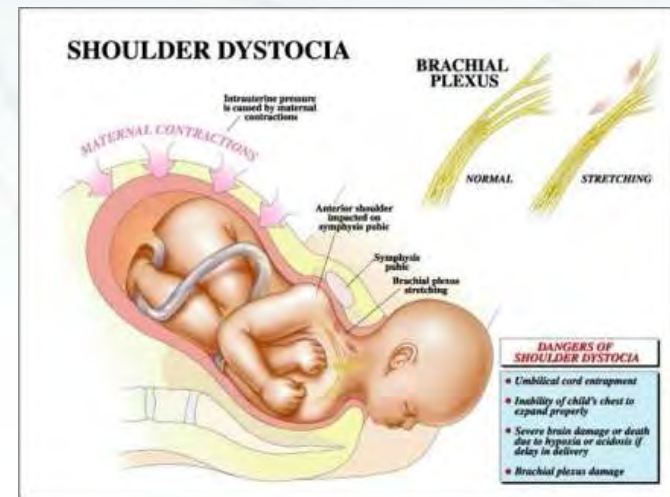
Macrosomia	2.4 times
NICU Admission	2.8 times
Congenital anomaly	3.4 times
Preterm birth	2.1 times
Perinatal death	3.4 times

Risk of adverse outcomes with increasing BMI, compared with women with normal BMI

# Infant Macrosomia

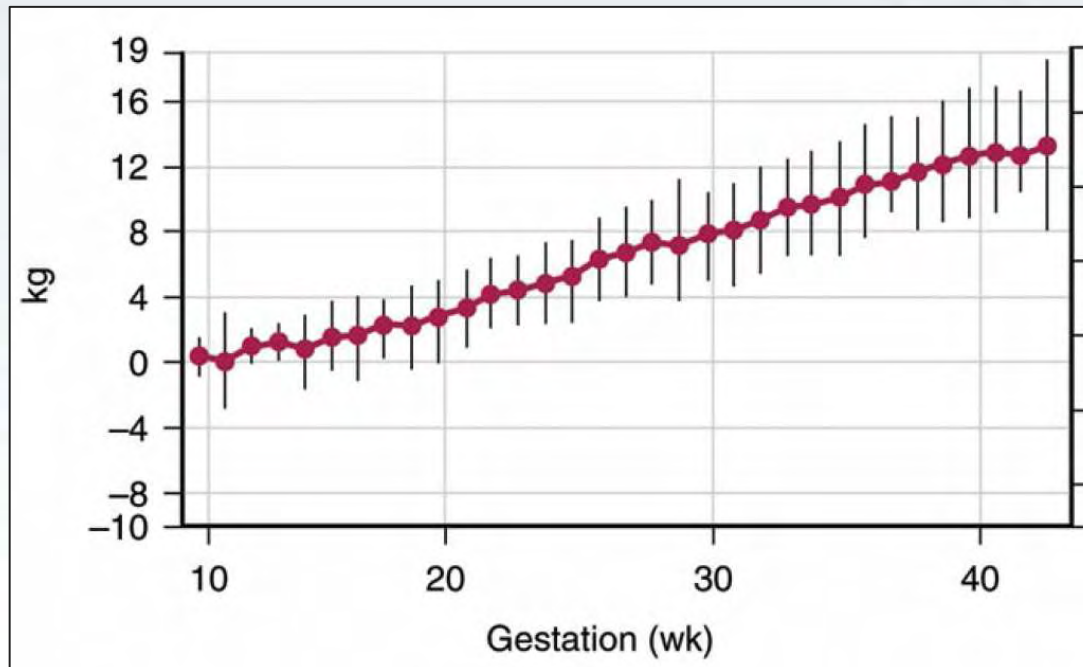


**Shoulder Dystocia**  
**Nerve Palsy & Fractures**  
**Maternal Perineal Trauma**  
**Caesarean Section**  
**Neonatal Hypoglycaemia**



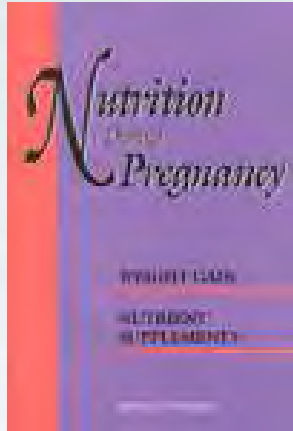
# Gestational Weight Gain

What is 'Normal' weight gain in pregnancy?



Dawes MG, Grudzinkas JG:  
 Patterns of maternal weight gain in pregnancy.  
 BJOG 1991;98:195–201.

# Gestational Weight Gain



IOM recommendations for weight gain in pregnancy



Focus on prevention of fetal growth restriction rather than a recognition of poor outcomes in women of high BMI

Weight-for-Height Category	Recommended Total Gain	
	kg	lb
Low (BMI < 19.8)	12.5–18	28–40
Normal (BMI of 19.8 to 26.0)	11.5–16	25–35
High <sup>c</sup> (BMI > 26.0 to 29.0)	7–11.5	15–25

1990 Recommended Total Weight Gain Ranges for Pregnant Women, by Pre-pregnancy BMI

# Gestational Weight Gain



## Weight Gain in Pregnancy: Re-examining the Guidelines

Institute of Medicine, May 28 2009

Recommendations essentially unchanged from 1990 publication

	<b>Total Weight Gain (range in kg)</b>
Underweight ( $<18.5\text{kg/m}^2$ )	12.5 – 18.0
Normal weight ( $18.5\text{kg/m}^2 - 24.9\text{kg/m}^2$ )	11.5 – 16.0
Overweight ( $25.0\text{kg/m}^2 - 29.9\text{kg/m}^2$ )	7.0 – 11.5
Obese ( $\geq 30.0\text{kg/m}^2$ )	5.0 - 9.0

# Gestational Weight Gain

**Table 5** Obstetric and neonatal outcomes of women with gestational weight gain of more than 16 kg according to each BMI class

Outcome	Body mass index				
	<20	20–24.9	25–29.9	30–34.9	≥ 35
	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)
Preeclampsia	2.23 (1.83–2.71)	2.31 (2.15–2.49)	1.88 (1.72–2.06)	1.65 (1.43–1.92)	1.50 (1.17–1.92)
LGA	3.26 (2.76–3.86)	2.73 (2.60–2.88)	2.14 (2.01–2.28)	2.24 (2.00–2.51)	1.54 (1.24–1.90)
SGA	0.50 (0.41–0.61)	0.50 (0.45–0.56)	0.57 (0.47–0.68)	0.61 (0.40–0.93)	0.50 (0.20–1.24)
Cesarean section	1.29 (1.17–1.43)	1.24 (1.19–1.29)	1.23 (1.17–1.30)	1.22 (1.10–1.35)	1.27 (1.05–1.52)
Instrumental delivery	1.28 (1.15–1.43)	1.19 (1.14–1.25)	1.14 (1.06–1.23)	1.09 (0.93–1.27)	1.04 (0.77–1.40)
Post-term (>41 weeks)	0.88 (0.56–1.39)	0.87 (0.74–1.03)	0.82 (0.66–1.03)	0.78 (0.50–1.21)	1.11 (0.51–2.41)
Fetal distress	0.86 (0.57–1.29)	1.08 (0.92–1.26)	1.31 (1.05–1.53)	1.02 (0.65–1.62)	2.15 (1.10–4.20)
Low Apgar score	1.38 (1.07–1.79)	1.02 (0.91–1.14)	1.00 (0.84–1.17)	0.83 (0.60–1.15)	1.02 (0.63–1.69)

Gestational weight gain of 8–16 kg was set as reference.

<sup>a</sup> Adjustments were made for maternal age, parity, smoking in early pregnancy, and year of birth.

Cedergren 2006

Int J Obstet Gynecol 93; 269-74

# Gestational Weight Gain

**Table 4** Obstetric and neonatal outcomes of women with gestational weight gain of less than 8 kg according to each BMI class

Outcome	Body mass index				
	<20	20–24.9	25–29.9	30–34.9	≥ 35
	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)	OR <sup>a</sup> (95% CI)
Preeclampsia	0.90 (0.55–1.48)	0.73 (0.61–0.89)	0.64 (0.54–0.76)	0.52 (0.42–0.62)	0.63 (0.51–0.79)
LGA	0.43 (0.24–0.75)	0.53 (0.47–0.61)	0.48 (0.43–0.53)	0.66 (0.59–0.75)	0.54 (0.46–0.63)
SGA	2.35 (1.92–2.88)	1.99 (1.77–2.23)	1.75 (1.48–2.07)	1.68 (1.26–2.25)	1.71 (1.03–2.85)
Cesarean section	1.07 (0.89–1.29)	0.98 (0.92–1.05)	0.88 (0.82–0.95)	0.81 (0.73–0.90)	0.75 (0.66–0.87)
Instrumental delivery	0.89 (0.71–1.11)	0.88 (0.80–0.96)	0.85 (0.76–0.95)	0.75 (0.63–0.88)	0.83 (0.65–1.03)
Post-term (>41 weeks)	0.66 (0.27–1.63)	0.86 (0.64–1.16)	1.08 (0.87–1.42)	1.23 (0.84–1.79)	1.25 (0.66–2.37)
Fetal distress	1.05 (0.54–2.03)	1.06 (0.81–1.40)	0.96 (0.70–1.32)	1.21 (0.79–1.85)	0.59 (0.28–1.25)
Low Apgar score	1.01 (0.60–1.69)	1.05 (0.87–1.27)	1.05 (0.85–1.29)	0.92 (0.69–1.24)	0.84 (0.57–1.24)

Gestational weight gain of 8–16 kg was set as reference.

<sup>a</sup> Adjustments were made for maternal age, parity, smoking in early pregnancy, and year of birth.

Cedergren 2006

Int J Obstet Gynecol 93; 269-74

# Gestational Weight Gain

**Table 3. Optimal Total Weight Gain in Pregnant Women by Prepregnancy Body Mass Index Based on Odds Ratio for Adverse Maternal and Perinatal Outcome for Different Maternal Weight Gains\***

Body Mass Index	Optimal Gestational Weight Gain (lb)	Optimal Gestational Weight Gain (kg)	Recommended Gestational Weight Gain (lb) <sup>†</sup>
Less than 20	9-22	4-10	28-40
20-24.9	5-22	2-10	25-35
25-29.9	Less than 20	Less than 9	15-25
30 or more	Less than 13	Less than 6	More than 15

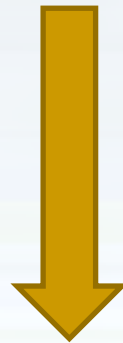
\* Adjustments were made for maternal age and parity.

<sup>†</sup> Institute of Medicine, 1990.<sup>1</sup>

Cedergren 2007 Obstet Gynecol 110(4):759-64

# What can be done?

Extensive literature describing the risks associated with obesity in pregnancy and childbirth



Effective intervention to improve maternal and infant health???

# **Dietary and Lifestyle interventions to limit weight gain in pregnancy for women who are overweight or obese: a systematic review**

**Dodd JM, Crowther CA, Robinson JS**  
**Acta Obstet Gynecol Scand**  
**2008; 87(7):702-706**



# Dietary Intervention



Author	Population
Magee 1990	12 obese women with gestational diabetes
Rae 2000	125 obese women with gestational diabetes
Polley 2002	49 overweight women
Hui 2006	Targeted women all BMI categories; no separate reporting of outcomes
Wolff 2008	50 obese women
Asbee 2009	40 overweight or obese women
Thornton 2009	232 obese women

# Dietary Intervention

- Intervention
  - Generally intensive dietetic advice (up to 10 sessions during course of pregnancy)
- Combined sample size 538 women
- Variable reporting of outcomes
- Methodological quality
  - Generally fair

# Meta-analysis



Outcome	Studies	No.	Effect	95% CI
LGA infant	2	281	2.25	0.71 to 7.10
Weight Gain	3	331	WMD -6.25	-7.60 to -4.90
Pre-Eclampsia	4	455	0.76	0.46 to 1.26
Hypertension	3	331	0.42	0.19 to 0.95
GDM	3	331	0.57	0.30 to 1.08
IOL	2	356	0.89	0.64 to 1.22
CS	2	99	1.61	0.48 to 5.37

# Exercise Intervention

Author	Population
Brankston 2004	20 overweight or obese women with gestational diabetes
Santos 2005	92 women with BMI 26-31

Outcomes focussed on cardio-respiratory markers of exercise tolerance.

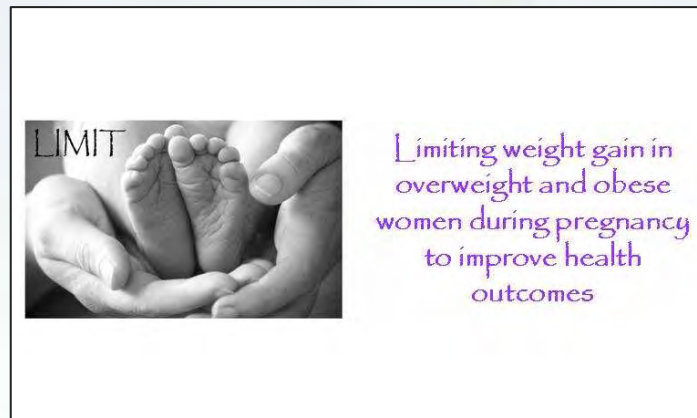
Brankston reported reduction in insulin requirements in overweight or obese women.

# Summary: Effect of Interventions

- Dietary and lifestyle intervention in pregnancy for women who are overweight or obese can limit the amount of weight gained
- However, its impact on maternal and infant health outcomes is less clear

# Limiting weight gain in overweight and obese pregnant women to improve health outcomes: a randomised trial

**Jodie Dodd**  
**Deborah Turnbull**  
**Andy McPhee**  
**Gary Wittert**  
**Jeffrey Robinson**



# Inclusion Criteria

- **Obese or overweight pregnant women (BMI >25kg/m<sup>2</sup>)**
  - **Live, singleton pregnancy**
  - **Gestational age 10<sup>+0</sup> – 20<sup>+0</sup> weeks**

# Treatment Schedules



- **Intervention Group**
  - Series of inputs by study dietician and research assistants
  - Written dietary and exercise information
- **Control Group**
  - Current standard antenatal care
  - Limited dietary input

# Outcomes

- **Primary**
  - **Infant large for gestational age**
- **Secondary**
  - **Adverse outcomes for the infant**
  - **Adverse outcomes for the woman**
  - **Maternal quality of life and emotional wellbeing**
  - **Health care costs**

# Sample Size

- Primary Outcome
  - Incidence LGA 13.3%
  - 27% reduction to 9.7% ( $p=0.05$ ; power 80%)
  - Sample size **2574 women**
- For maternal outcomes
  - Able to detect
    - 15% difference caesarean section; 30% difference pre-eclampsia; 46% difference gestational diabetes

# Trial Recruitment

- 773 women recruited to date
- Participating centres
  - Women's & Children's Hospital
  - Lyell McEwin Hospital
  - Flinders Medical Centre
  - The Queen Elizabeth Hospital
  - Modbury Hospital

## More information...

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  - Andrea Deussen
    - [andrea.deussen@adelaide.edu.au](mailto:andrea.deussen@adelaide.edu.au)
    - Phone 8161 7657

# Development of Obesity

- Environmental factors
  - Increase energy intake
  - Reduced energy expenditure (exercise)
- Genetic factors
  - Epigenetic modifications
  - Single nucleotide polymorphisms (SNPs)
- Interaction between the two

# The Barker Hypothesis

- Wide variation in deaths from coronary heart disease across England & Wales
- Mortality from CHD strongly correlated with areas that had in past had high rates of neonatal mortality, LBW infants and poor maternal health



# The Barker Hypothesis

- Increasing recognition that being born large or small for gestational age are both significant risk factors for development of
  - Obesity
  - Cardiac disease
  - Diabetes



# In-Utero Programming



- Changes to an individual's in-utero environment have potential to modify body composition and metabolic pathways
- Increasing recognition that maternal dietary modification during pregnancy can alter infant
  - Gene expression (methylation changes to key promotor regions)
  - Particularly genes that regulate appetite, metabolism and energy expenditure



# Epigenetic States



- Alteration in gene expression
  - Mediated by methylation changes to promotor genes
  - Methylation changes can be heritable
  - Most rapid changes occur during periods of high cell division
    - Prenatal environment
  - Methylation influenced by
    - High glucose & insulin concentrations
    - Oxidative stress or inflammatory environment

# How is this relevant?

- Primary question
  - Effect of maternal diet manipulation on infant health (large for gestational age infants)
- Secondary questions
  - Effect of maternal diet manipulation on
    - Childhood growth and body composition
      - Development of childhood obesity
    - Epigenetic and genetic modification of key obesity related genes

# Summary

- Obesity is a significant health problem
- Risks associated with pregnancy & childbirth are well documented
- There is limited information currently available about effective interventions that may improve maternal and infant health