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South Australia

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# Future Health Challenges: An Intergenerational Perspective



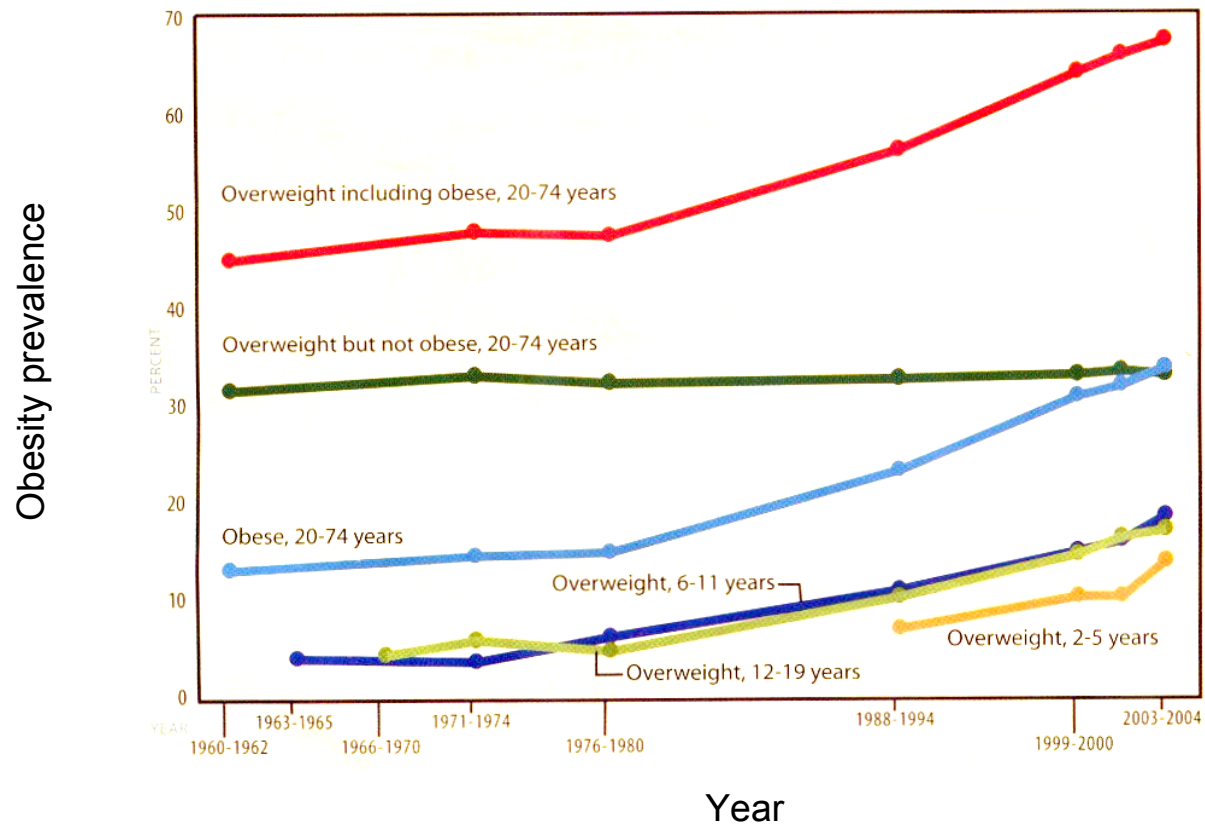
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Sansom Institute for Health Research  
University of South Australia

### Increasing burden of “lifestyle” diseases

1. Obesity
  2. Cardiovascular disease (hypertension, atherosclerosis)
  3. Type 2 Diabetes
- Associated with increasing morbidity and mortality in Australia
  - Appearing at younger and younger ages

# The global burden of obesity



WHO, 2005



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## The economic cost of obesity and its associated disorders

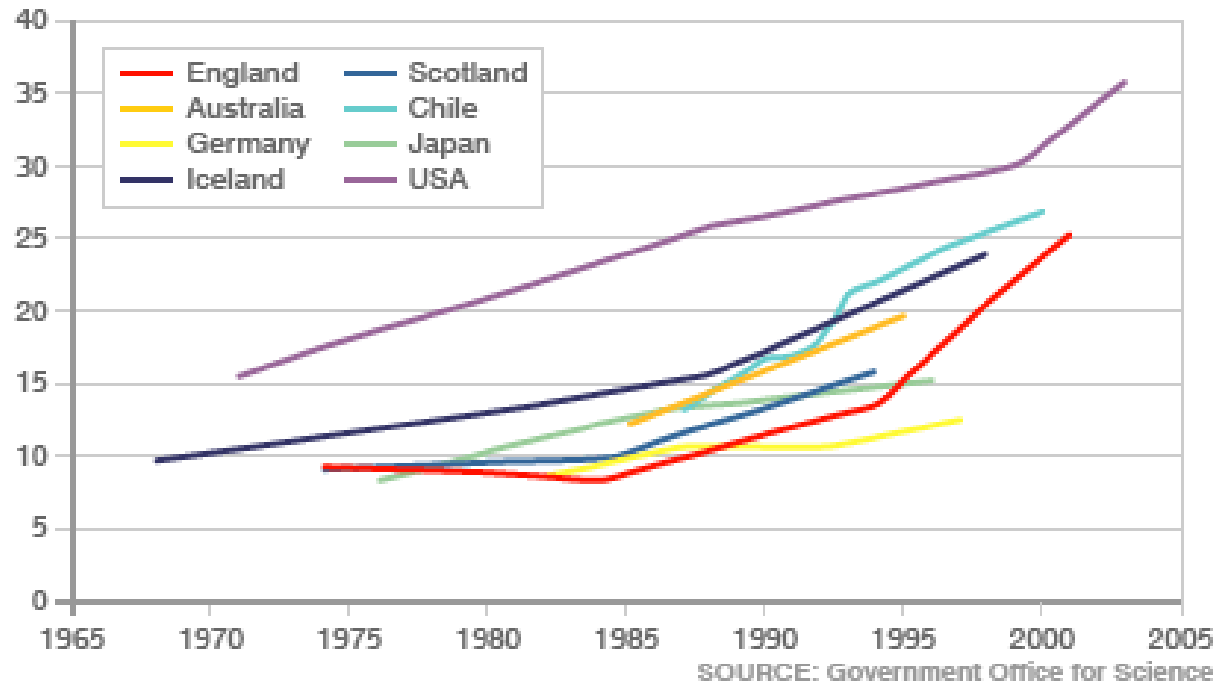
- Impact of obesity in the loss of productivity and quality of life – \$21 billion per annum (double the cost of medicare)
- Biggest cost is burden of disease, accounting for \$17.2 billion a year (non-financial costs of disability, loss of wellbeing and premature death).
- Obesity also generates \$873 million in health spending and \$804 million in carer costs to date
- **Prognosis:** 7.2 million Australians with obesity by 2025



# Obesity and its associated metabolic problems are appearing at younger and younger ages

## INCREASING NUMBER OF OVERWEIGHT CHILDREN AROUND THE WORLD

Percentage overweight

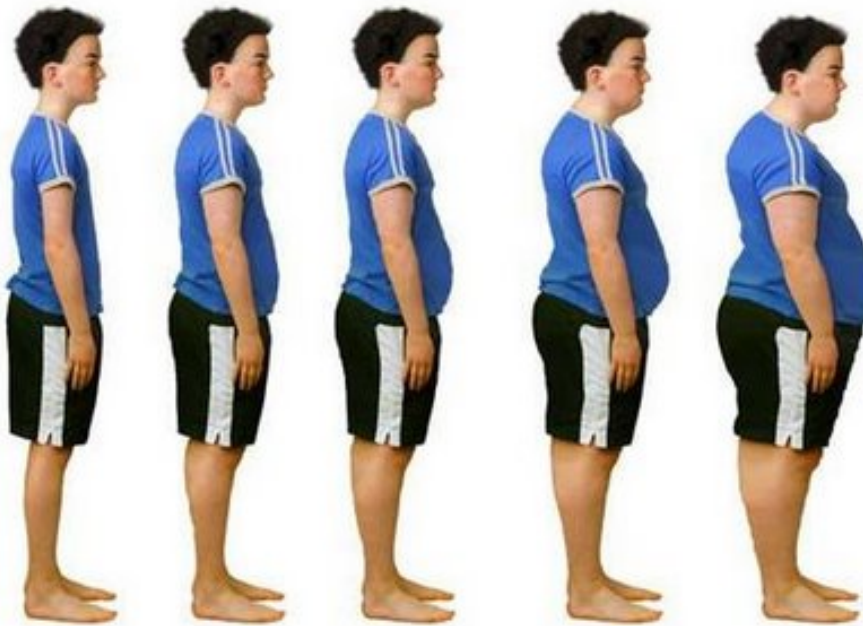


WHO, 2005



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## Health Challenges of the Future?





# The challenge of lifestyle diseases: Technology vs Physiology



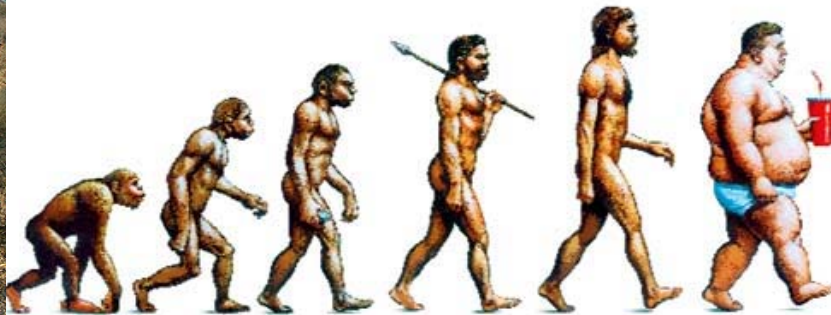


## The challenge of lifestyle diseases: the evolutionary perspective

- Neural network in the hypothalamus responsible for the regulation of appetite
- This system is more sensitive to signals of decreased energy supply than to signals of increased energy supply
- Principal function of this system was to protect from starvation – ability to lay down fat stores during periods of energy excess considered an advantage

## The challenge of lifestyle diseases: the evolutionary perspective

- Our physiology has not been able to adapt to advances in technology and food production.



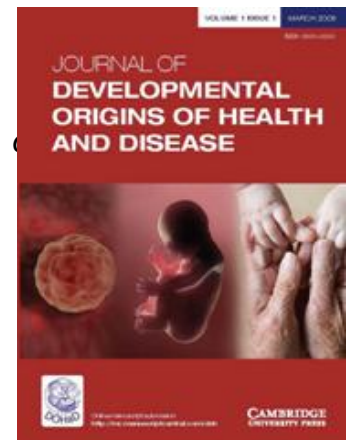


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# The Developmental Origins of Health and Disease

“A process whereby a stimulus or insult applied at a critical or sensitive period of development results in long term or permanent changes in the structure or function of the organism”

*Lucas J. The childhood environment and adult , 1991*

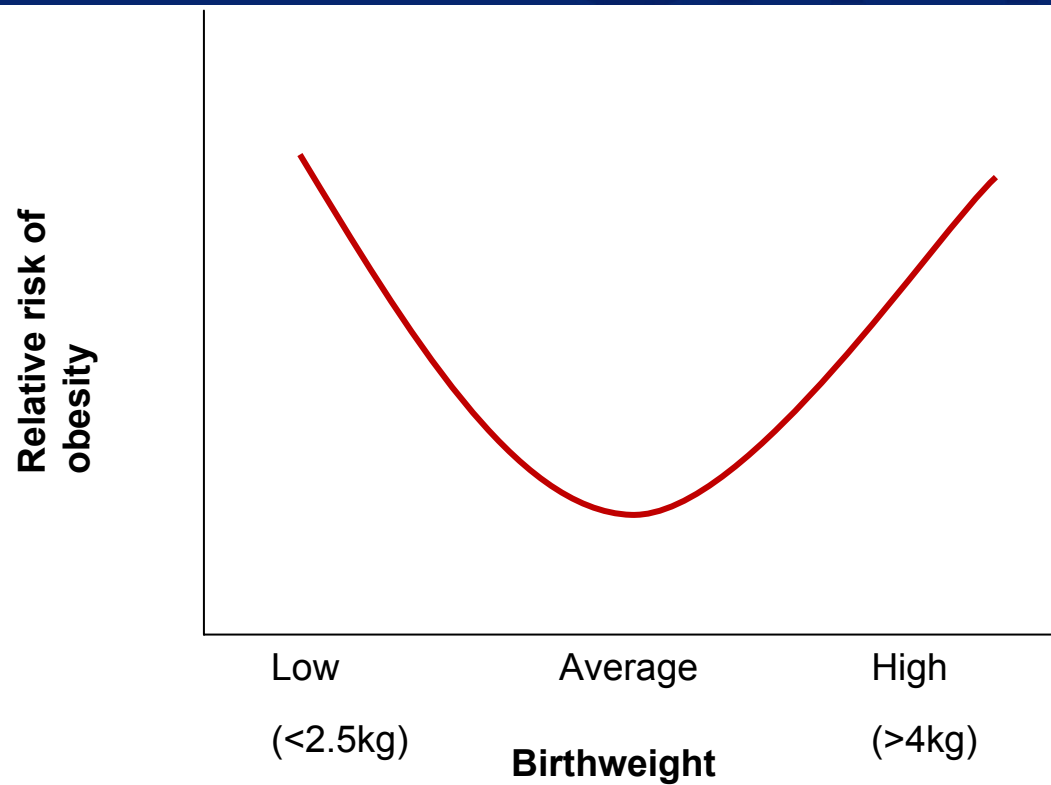




## Susceptibility to chronic lifestyle diseases: early life origins

- Different patterns of fetal and neonatal growth associated have associations with long term health
- Fetal undernutrition – associated with increased risk of abdominal obesity, cardiovascular disease and type 2 diabetes in adult life
- Fetal overnutrition – increased risk of obesity and type 2 diabetes in adult life

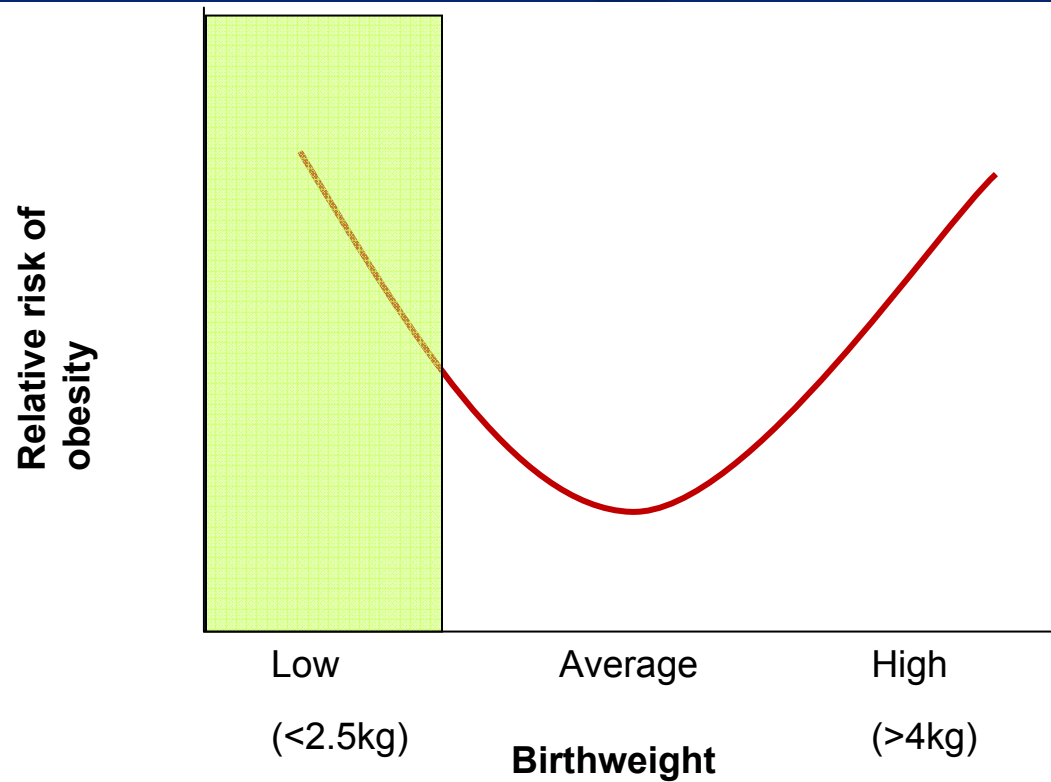
## The U-shaped relationship between birth weight and later obesity risk





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# Low birth weight and the early origins of disease





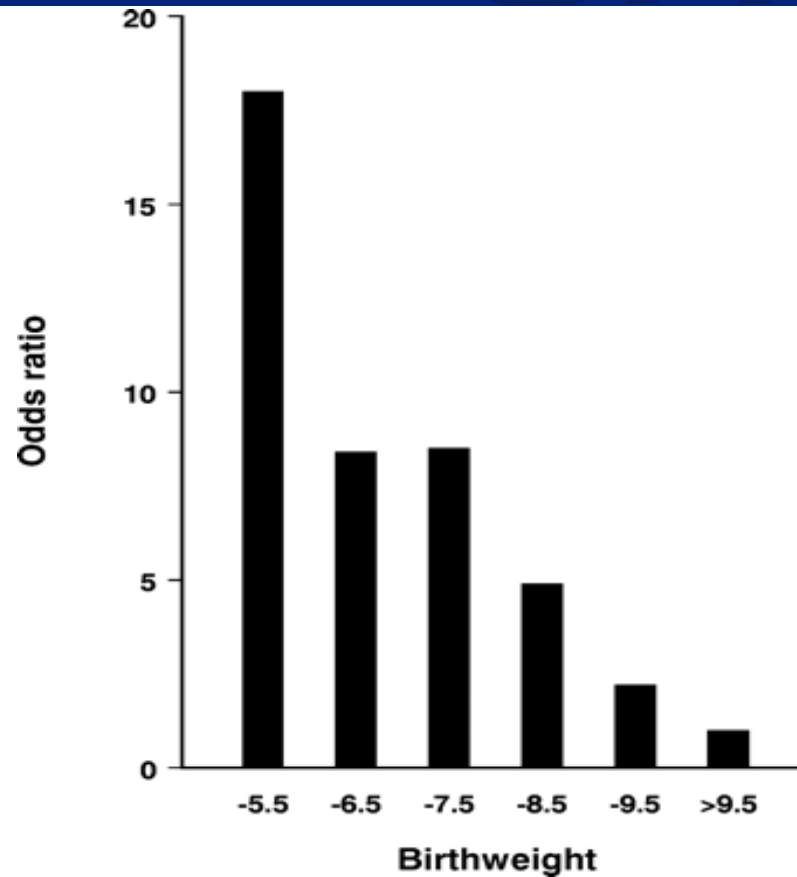
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## Intrauterine growth restriction (IUGR)

- Defined as birth weight less than the 10<sup>th</sup> centile for gestational age
- IUGR affects ~7% of births in Australia (higher in indigenous communities) and up to 17% of births in developing countries
- Common causes:
  - Maternal malnutrition
  - Maternal smoking
  - Placental pathology (reduced nutrient transfer)



## Low birthweight increases the relative risk of metabolic syndrome



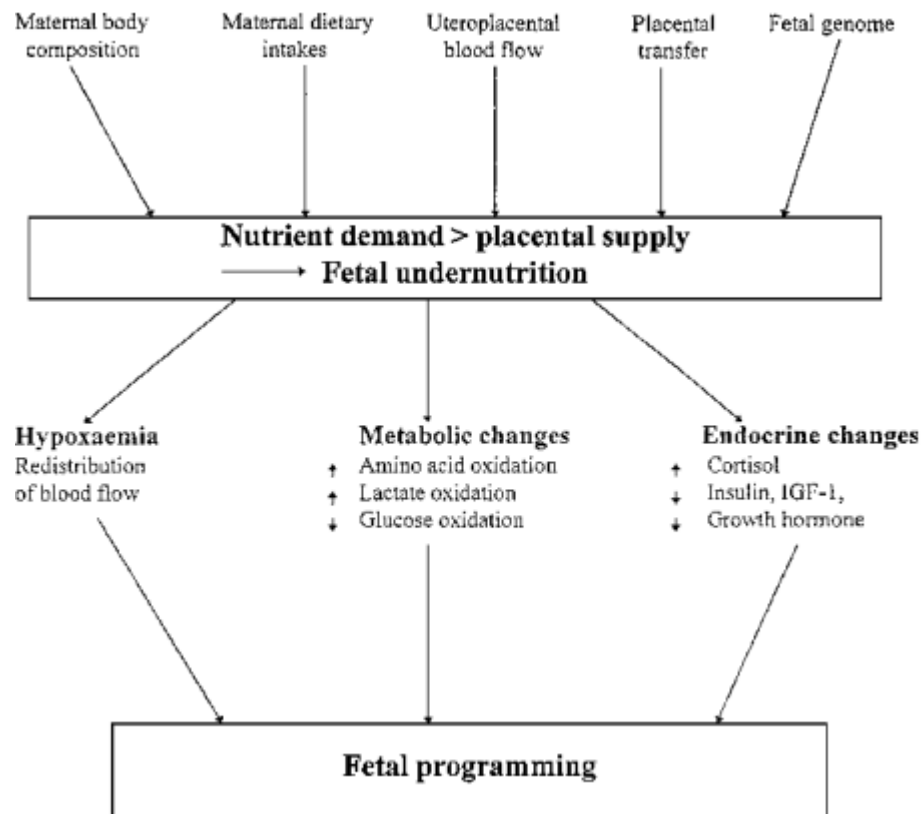
n=407 men born in the same Week in Hertfordshire, UK

Hales, C N. et al. Br Med Bull 2001



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# The Developmental Origins of Health and Disease





## Prenatal undernutrition and Thrifty Phenotype Hypothesis

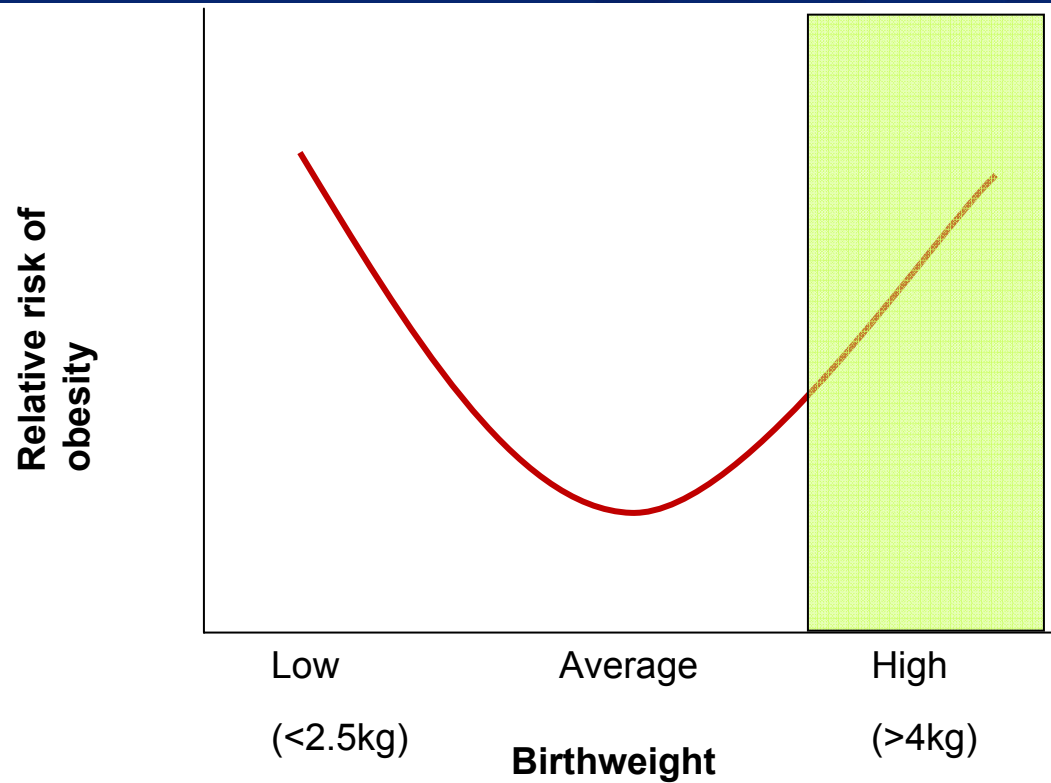
A fetus which receives a poor nutrient supply *in utero* makes physiological adaptations which enable to survive in a low nutrient environment.

This is advantageous if the fetus is born into an environment of poor nutrition, but becomes maladaptive if the individual is instead born into a postnatal environment of abundant or excessive nutrition and manifests in metabolic disease.



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# Maternal overnutrition, high birthweight and the early origins of obesity





# High birthweight is associated with an increased risk of later obesity

A photograph of a baby's face and upper torso, showing a slightly chubby appearance. The baby is looking towards the camera with a neutral expression. The background is a soft, light-colored fabric.

American Stroke Association  
A Division of American Heart Association

American Heart Association  
Learn and Live.

**Don't supersize him.**

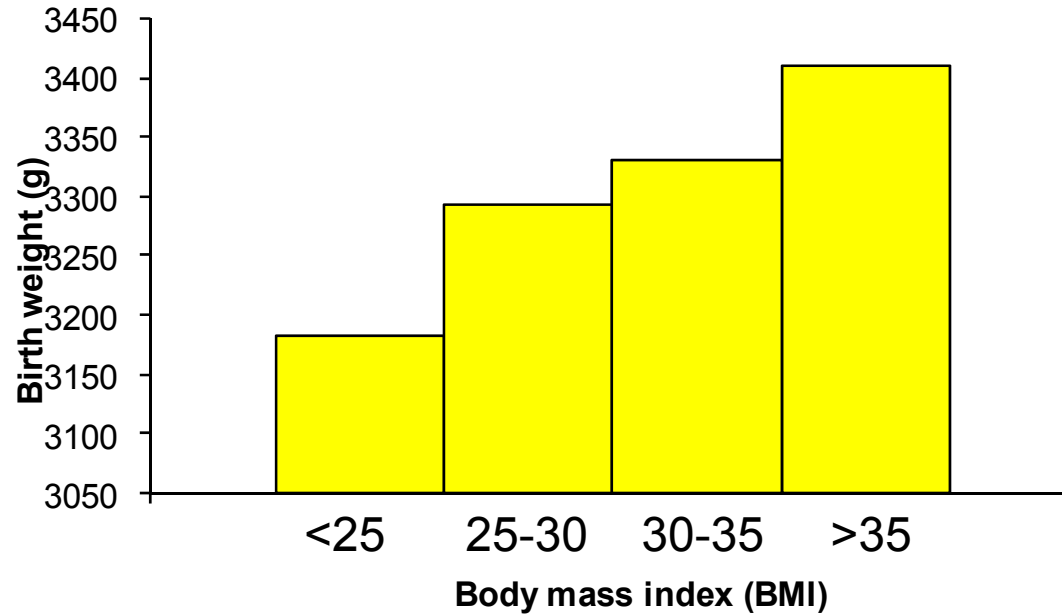
Childhood obesity is a growing epidemic that increases death and disability from heart disease. Requiring minimum standards for physical education, such as 150 minutes per week of physical education for elementary schools and 225 minutes for middle schools, gives children a fighting chance against obesity and heart disease. And, coordinated school health programs will ensure that children have sound minds and healthy bodies. You can prevent supersized children who suffer more health problems and grow into unhealthy, less productive and disabled adults. Don't miss your chance to shape a whole new generation of Americans and stop the nation's No. 1 killer—heart disease.

**Heart disease. You're the Cure.**



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## High Maternal BMI – High Birth weight

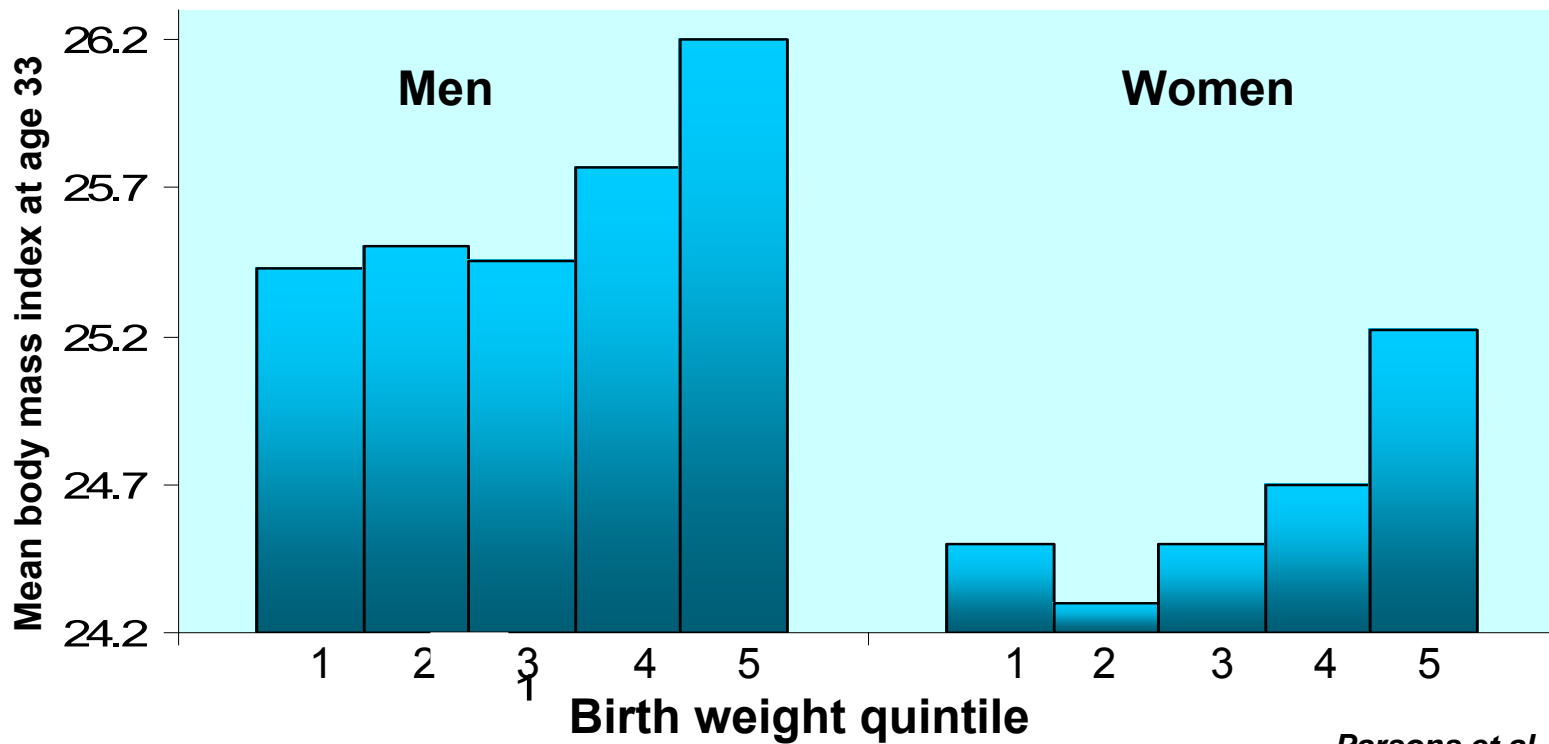


*Jensen et al Am J O&G 2003*  
*Pietilainen et al Am J Epidem 2001*  
*Stettler et al Am J Clin Nutrition 2000*



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## High Birth Weight is Associated with an Increased Body Mass Index in Adult Life

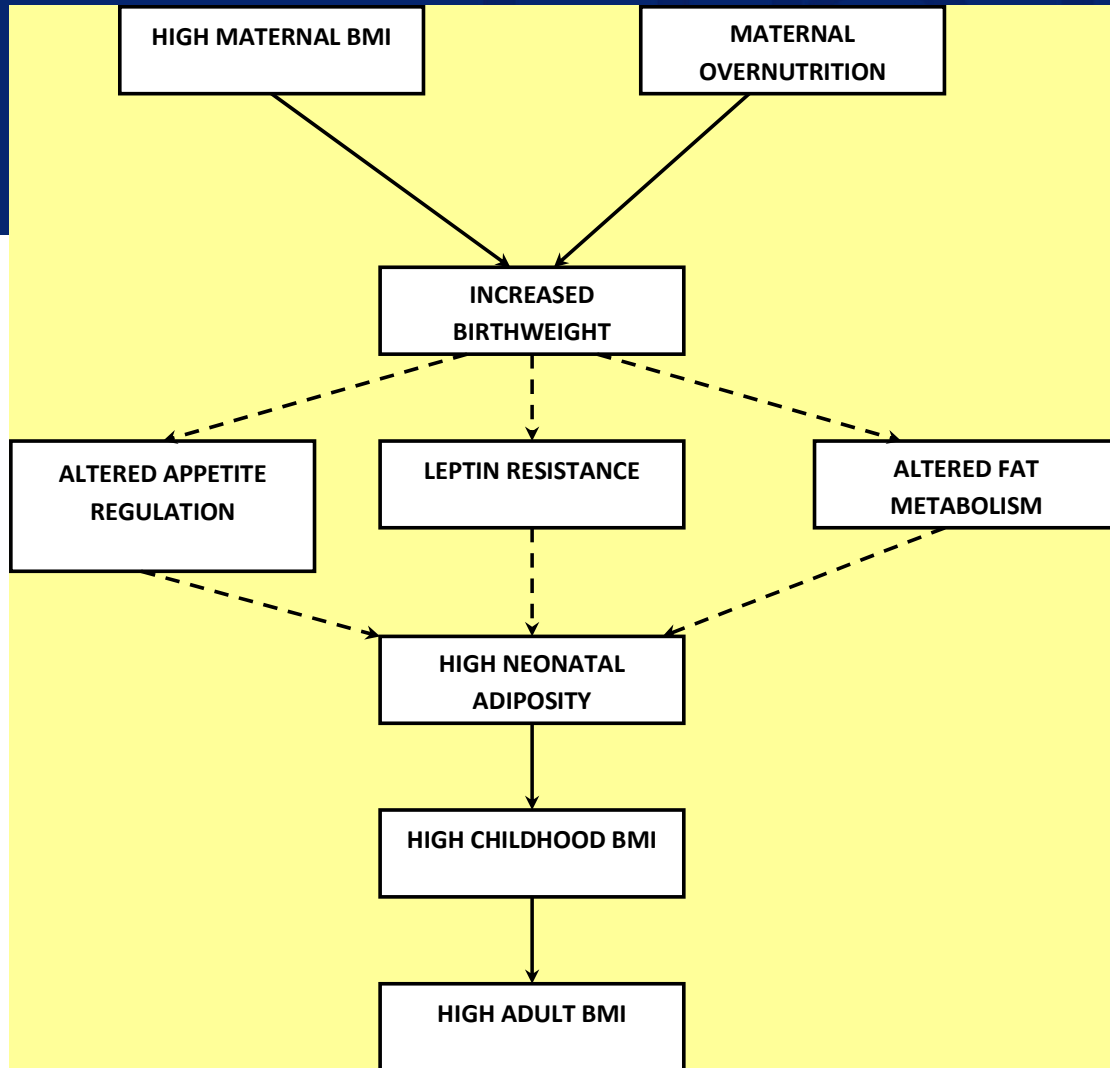


*Parsons et al, BMJ 2001*



## Long term effects of maternal diabetes

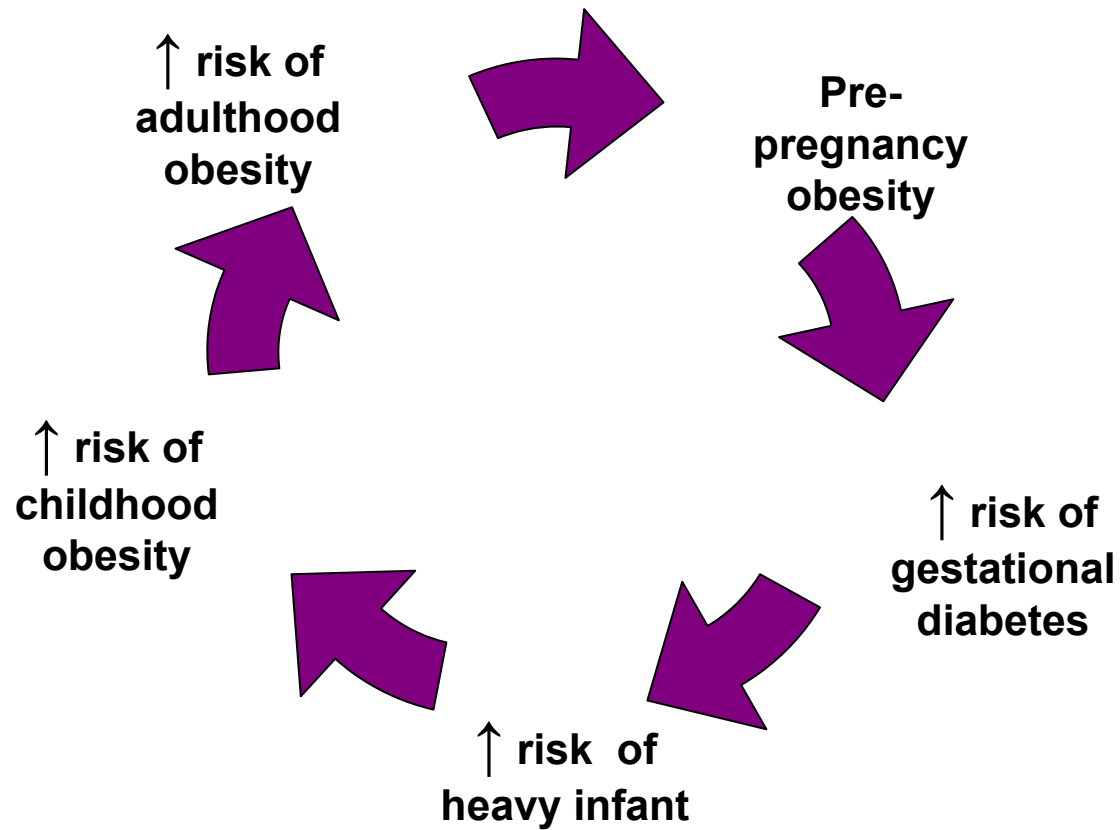
- More prevalent in overweight and obese women
- Glucose and insulin increase fetal fat deposition and increase infant adiposity
- Leads to multiple pregnancy complications including Macrosomia (birth weight > 4000g) and increase in C-section delivery, neonatal hypoglycemia





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# The inter-generational cycle of obesity





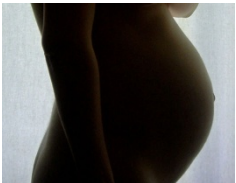
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## Nutrition in infancy is also important

<b>INCREASE RISK</b>	<b>DECREASE RISK</b>
Formula-feeding	Breast-feeding
Maternal obesity	???Specific Nutrients???
Maternal diabetes	
Early introduction of solid food	
Poor family eating habits	

## Conclusion

- Reducing burden of chronic disease requires optimal nutrition at all stages of life
- Need to emphasise importance of nutrition during pregnancy and infancy for long, as well as short term, health





## Future Challenges

- Increased burden of chronic disease is one of the most significant health challenges of the coming decade.
- How to reach at-risk populations (indigenous, low SES)
- More research – infant formulas, breast vs bottle feeding, timing of introduction of solids, what type of solids etc, etc.
- Need more information about nutrients that might be protective



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# Acknowledgements

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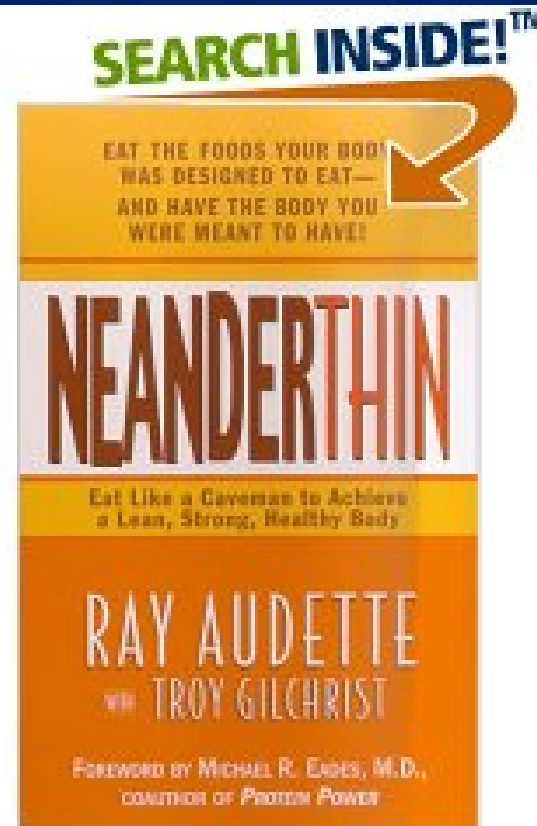
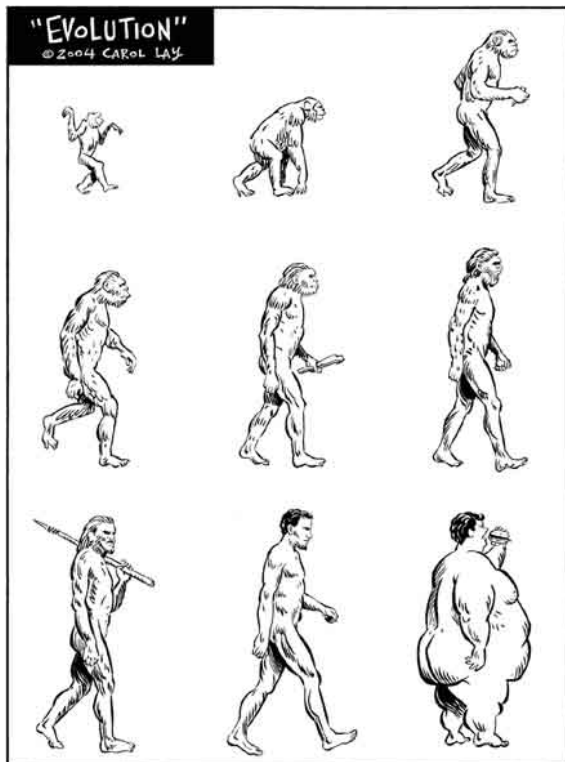
## Acknowledgments

- Early Origins of Adult Health Group, Sansom Institute for Health Research, The University of Adelaide

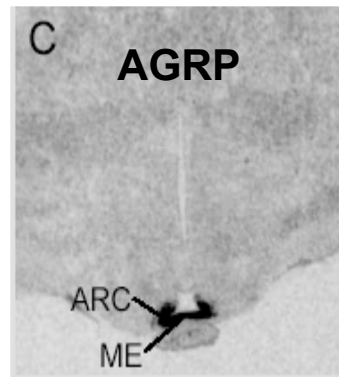
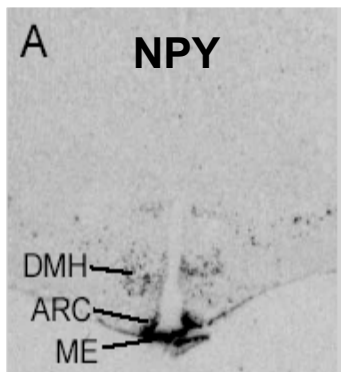
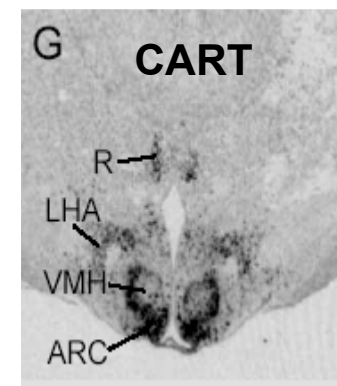
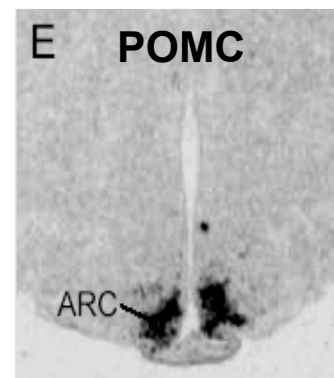
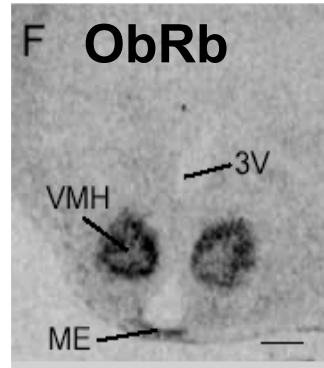
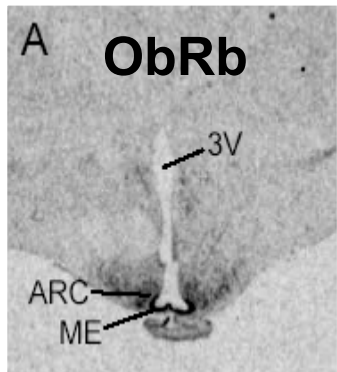


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# How do we break the intergenerational cycle of obesity



# Evidence for an 'Appetite Regulatory' Network in the Fetal Sheep Hypothalamus From ~ 110d Gestation



*Muhlhausler et al J Neuroendocrinology, 2004*