Maternal and child nutrition - intergenerational impacts?

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Pathways to chronic diseases begin *in utero*

- Intrauterine influences on health in later life
  - Fetal under nutrition
  - Fetal over nutrition (maternal diabetes)
- A life course approach to understanding the causal pathways
  - Amplification or attenuation in later life
    - Diet, physical activity
    - Other influences on insulin action
      - Obesity, psychosocial stress

Low Birth Weight

Causes?

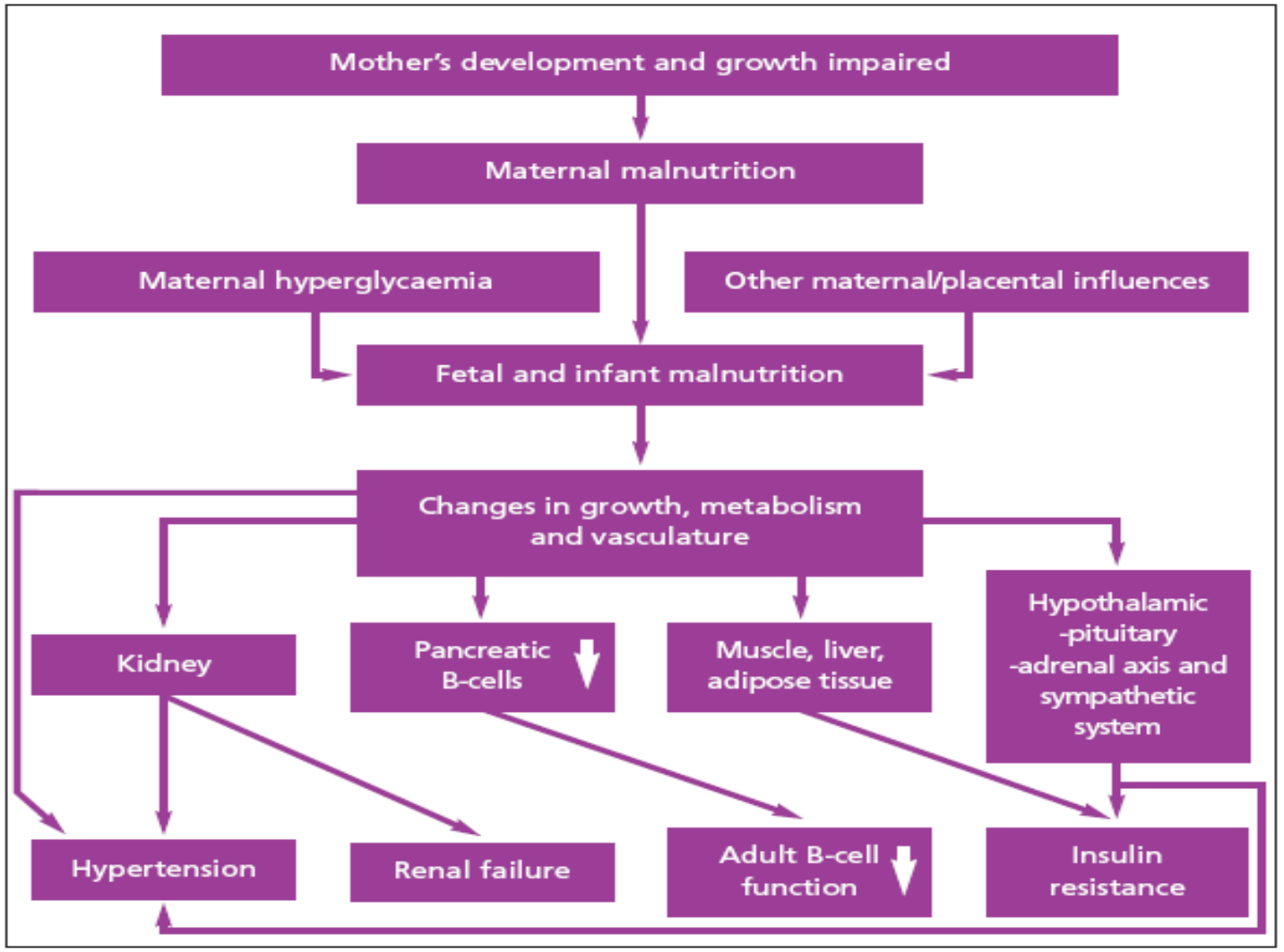
- Low birth weight associated with social disadvantage
  - Poor quality maternal diet
  - Maternal smoking
  - Overcrowded living conditions
  - Mother's perceived stress

Consequences

- Low birth weight associated with higher risk (and early age of onset) of
  - Central obesity
  - Type 2 diabetes
  - Kidney failure
  - High blood pressure
  - Heart disease

The thrifty phenotype

Figure 2: The thrifty phenotype hypothesis

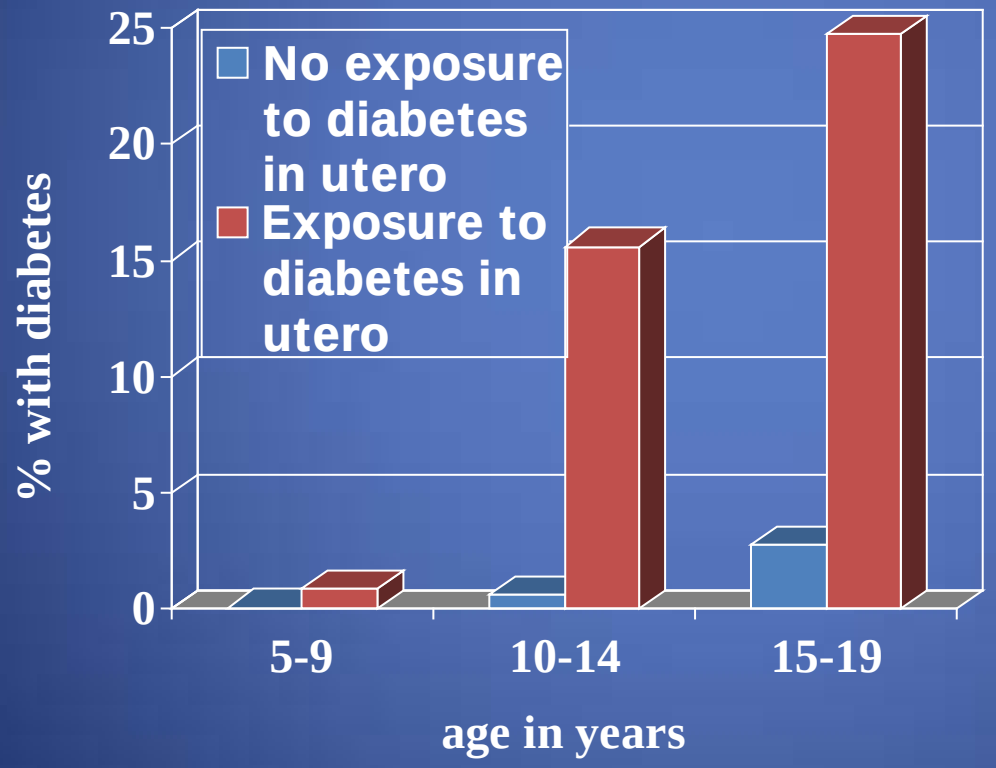


Source: Hales & Barker (2001) The thrifty phenotype hypothesis: type 2 diabetes. *British Medical Bulletin* **60**: 5-20.

Not just under nutrition *in utero*

- Impact of maternal diabetes
  - GDM
  - Pre-gestational diabetes
    - Usually type 1
    - Increasingly type 2
- Particular problem for high risk populations such as Indigenous Australians
    - Increasing prevalence and earlier age of onset of obesity and type 2 diabetes

Diabetes prevalence and exposure to diabetes *in utero* (Pima Indians)



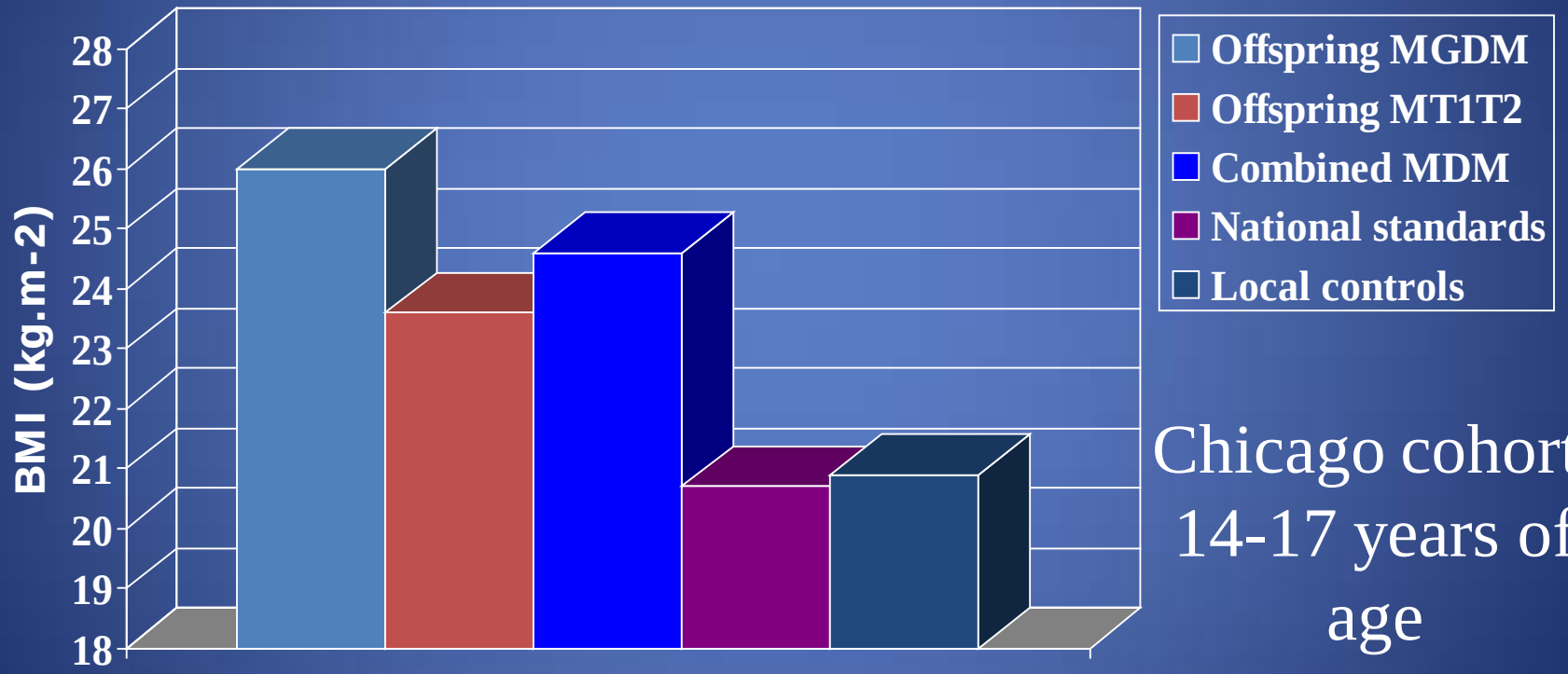
Pettitt. Diabetes 1988;37:622-628; Dabelea. Diabetologia 1998;41:904-910

Exposure to hyperglycemia *in utero*

- Hypothesis that maternal fuel metabolism may exert long term effects on the offspring (Freinkel, 1980)
- Comparison of offspring (10-16 yr) of diabetic mothers (mostly type 1) with controls (Chicago cohort)
  - higher BMI (22.8 vs 20.3)
  - higher 2-hr glucose (6.8 vs 5.2 mmol/l)
  - higher IGT (19.3 vs 2.5%)
  - higher 2-hr insulin (660 vs 455pmol/l)

Silverman et al Diabetes Care, 18:611-7, 1995

Obesity in the offspring



Chicago cohort, 14-17 years of age

Silverman. Diab Care 1998;21(S2) B142-B149

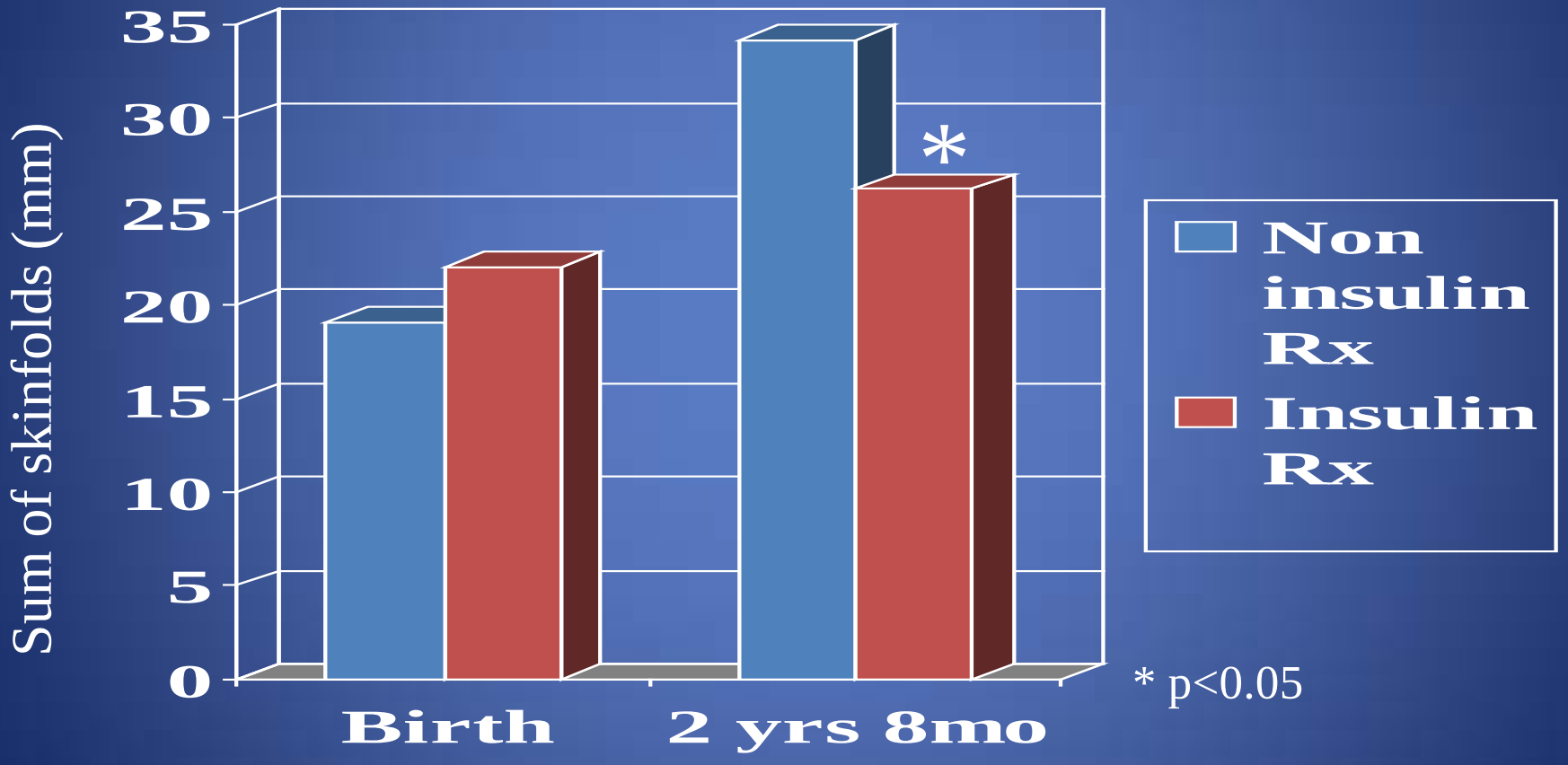
Implications for Indigenous health

- High risk population
  - High prevalence of LBW
  - High prevalence of smoking
  - Poor quality diet
    - Low in fresh fruit and vegetables
    - High in fat and sugar
  - Central adiposity
    - relatively more body fat for given BMI
  - High prevalence of diabetes, with early age of onset in reproductive years
    - likely high prevalence of GDM and pre gestational diabetes

Potential intervention points

- During pregnancy
  - Tight glucose control of the diabetic pregnancy
    - Circumstantial evidence from fetal insulin levels
- Post natal
  - Breast feeding
    - Minimise excessive energy intake?
      - Increased fat content of breast milk late in the feed
    - Improve insulin sensitivity?
      - Higher intake of highly polyunsaturated fat
        - » Impact on membrane composition?
      - Regular exercise throughout life

Can we prevent obesity in the offspring of the diabetic pregnancy by good glycemic control?



Simmons. Diab Med 1997;14:762-765

Lower prevalence of Type 2 diabetes in breast fed Pima Indians

- 257 Pima women, 684 offspring 10-39 yr
- Comparison of offspring breast fed for at least 2 months with those not breast fed
  - Breast fed offspring were less obese ($p<0.01$)
  - Lower diabetes prevalence in breast fed offspring (OR 0.51, 95% c.i. 0.28-0.93) after controlling for age, sex, birth weight, parental diabetes and diabetes in pregnancy
  - After controlling for relative weight, the difference was not quite significant (OR 0.51, 95% c.i 0.3-1.03)

Pettitt et al, 1995

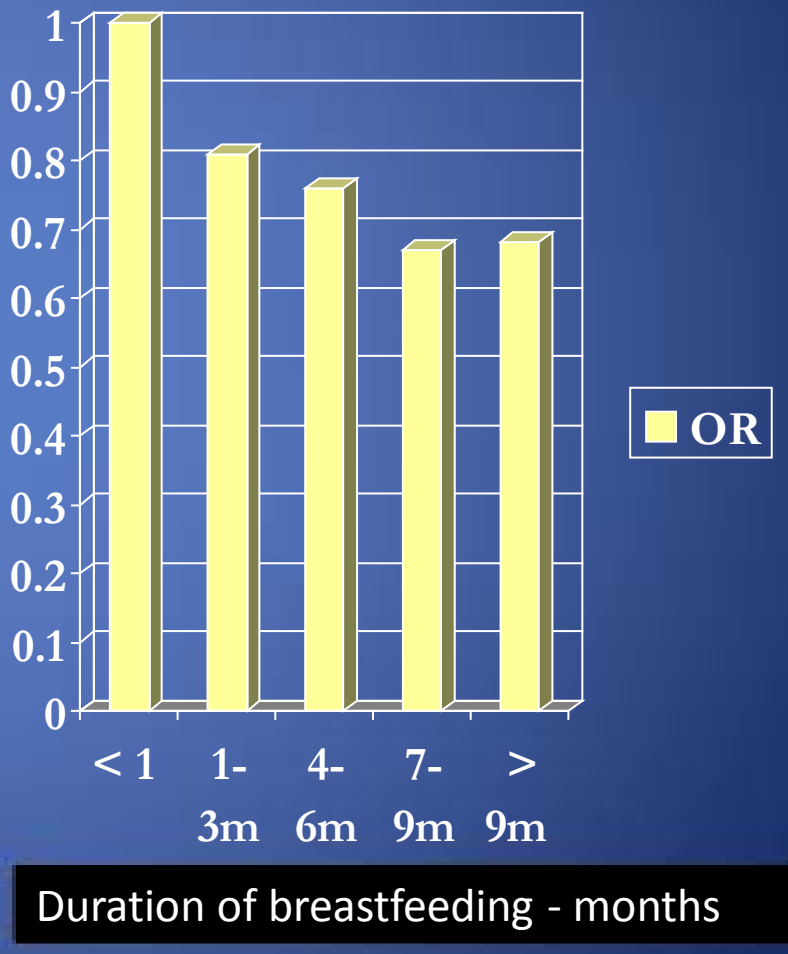
Type 2 diabetes in adolescent Native Canadians

- Case-control study in 46 patients, 92 age- and sex-matched controls aged younger than 18 yr
- Maternal diabetes the strongest predictor
  - OR = 4.4 (1.38-14.1) for GDM
  - OR = 14.4 (2.86-72.5) for pre-existing
    - Associated with high birthweight, and obesity, dyslipidemia, hyperinsulinemia in adolescence
- Exclusive breast feeding protective
  - OR = 0.24 (0.07-0.84) for $\geq$ 12 months

Young et al, Arch Pediatr Adolesc Med. 156:651-6, 2002.

Duration of breastfeeding and risk of overweight: a meta-analysis (Harder et al, Am J Epidemiol 162:397-403, 2005)

- Seventeen studies met inclusion criteria
  - Exclusively formula-fed subjects were the referent
  - Duration of breastfeeding was inversely associated with risk of overweight
  - Risk of overweight was reduced by 4% for each month of breastfeeding



Preventive strategies relevant to Indigenous Australian populations

- Strong focus on maternal and child health
  - Reduce LBW
  - Smoking cessation – young women in particular
  - Screen and manage GDM and diabetic pregnancy
    - Promote breastfeeding
  - Reduce the heavy burden of infectious diseases
    - eg, link between PSGN and later renal disease
  - Improve diet quality, regular physical activity
- Minimise excessive weight gain in adolescence and throughout life
  - Incorporate regular physical activity into daily routines
  - Diet derived from a wide variety of plants foods, whole grain cereals, lean meat, fish

Cycles of disease risk

Figure 7: Cycles of disease risk