Maternal nutrition and offspring metabolic health in India: inter-generational programming of diabesity

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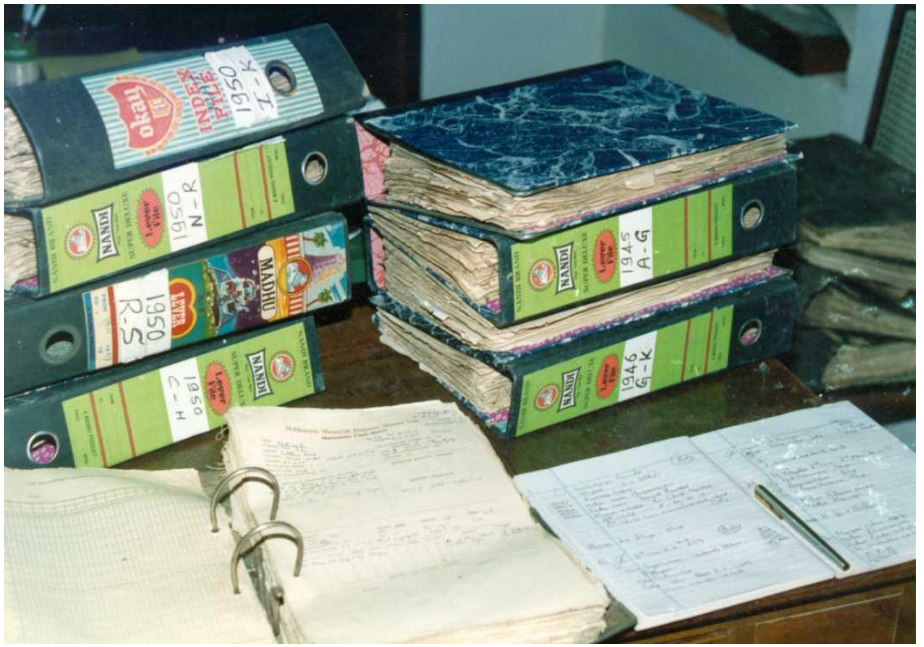
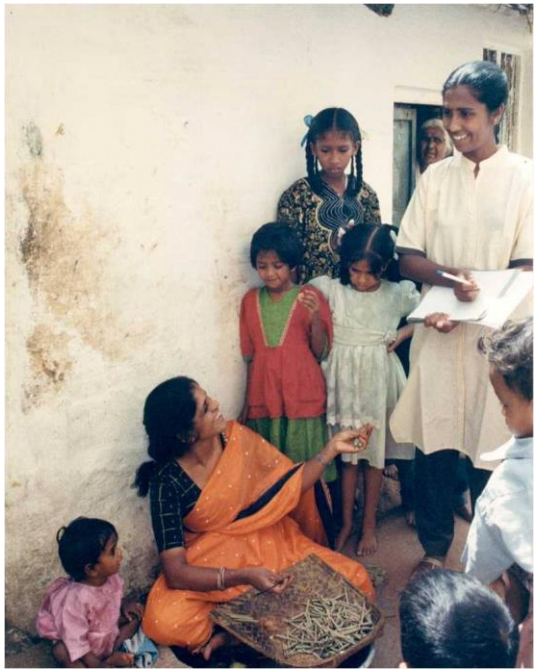
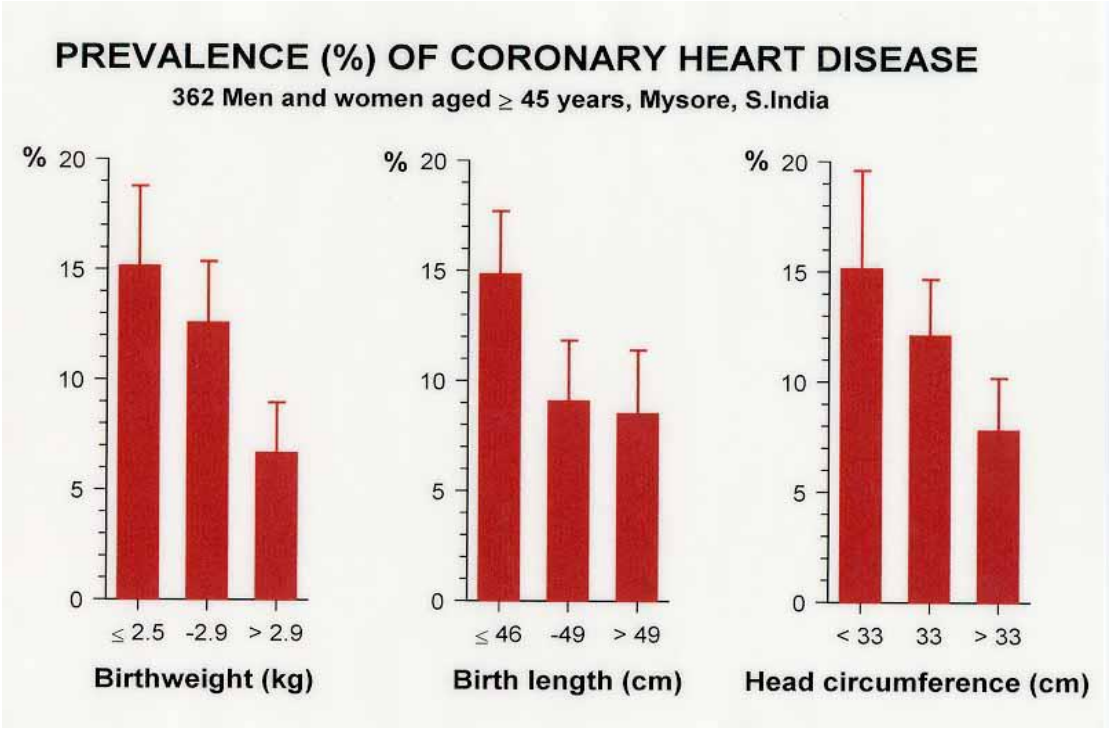
Mysore Studies

Holdsworth Memorial Hospital Mysore

Mysore Birth Records Study



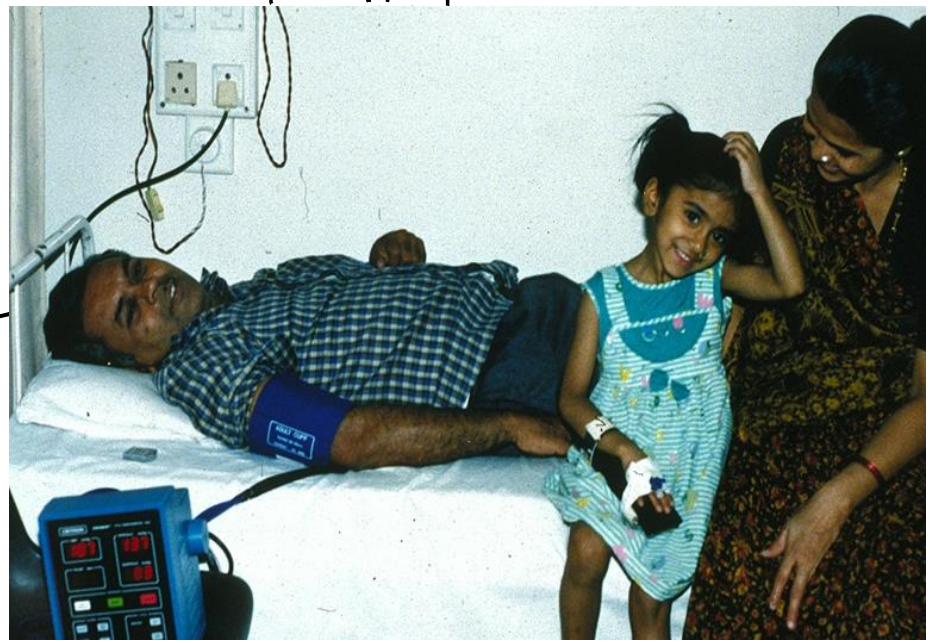




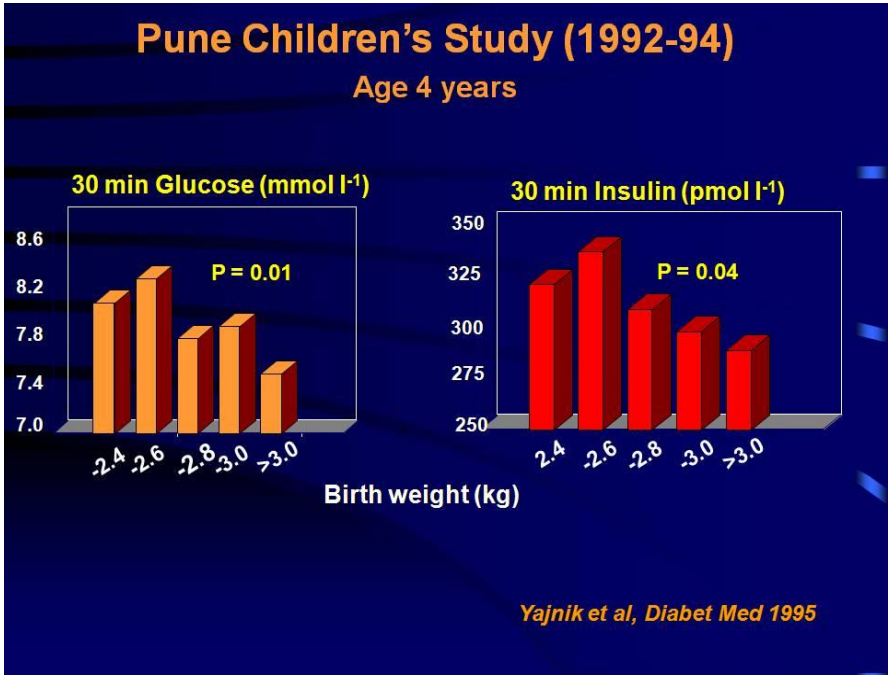
Stein et al, Lancet 1996

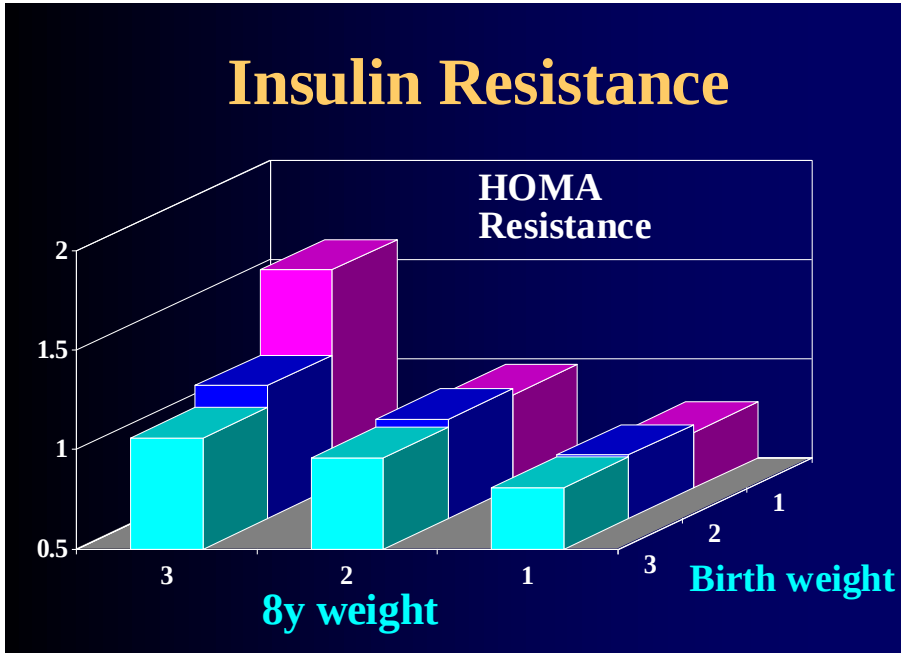
Pune Studies

KEM Hospital
Pune



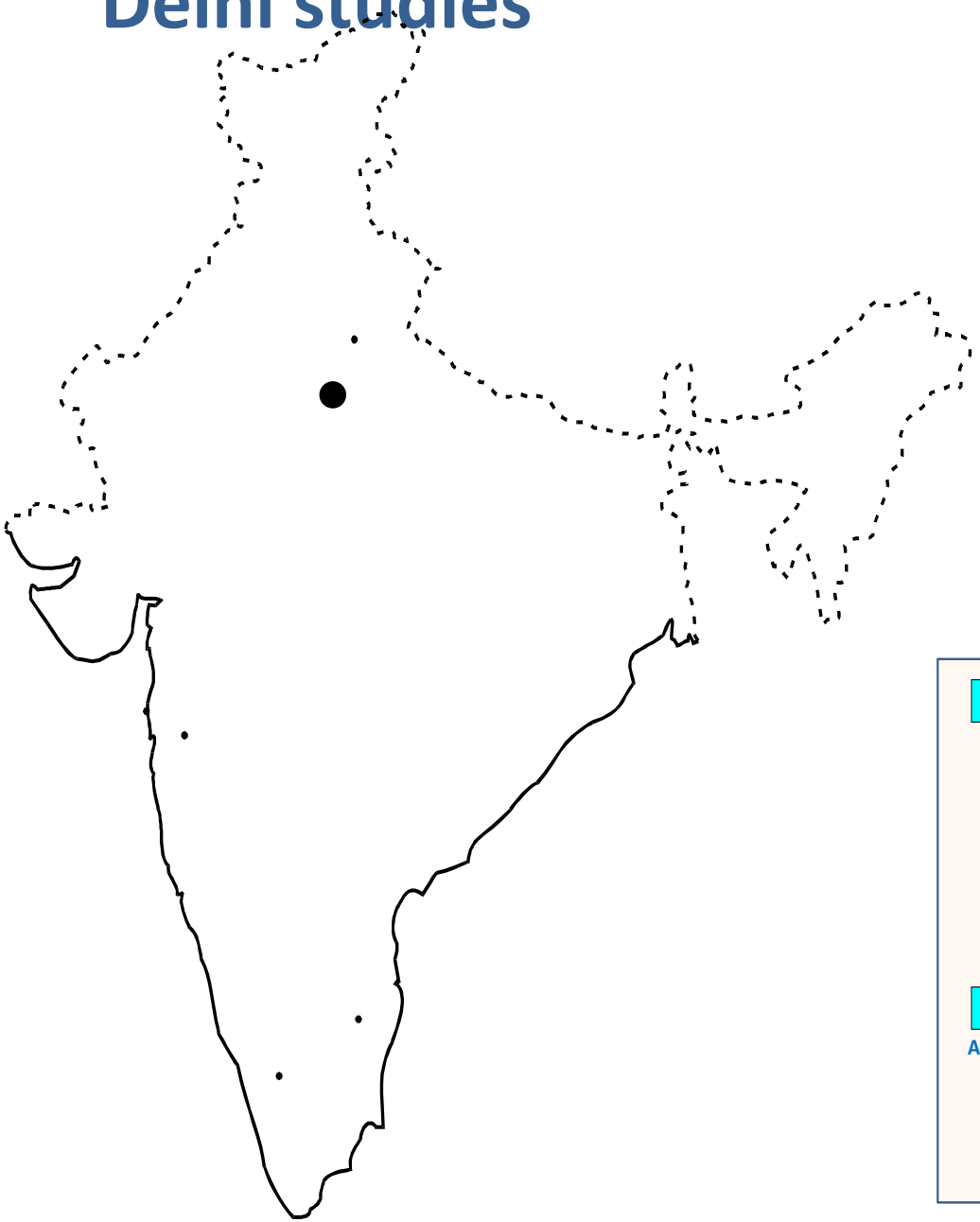
Pune Children's Study

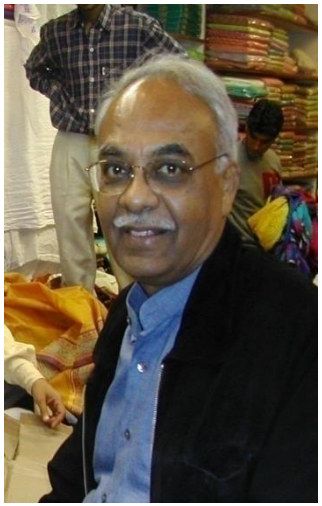


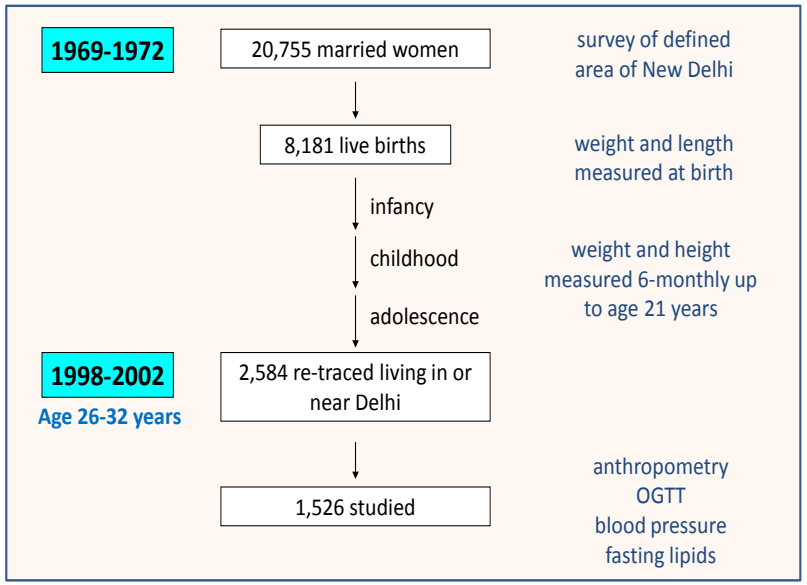


Bavdekar et al, Diabetes, 1999

Delhi studies





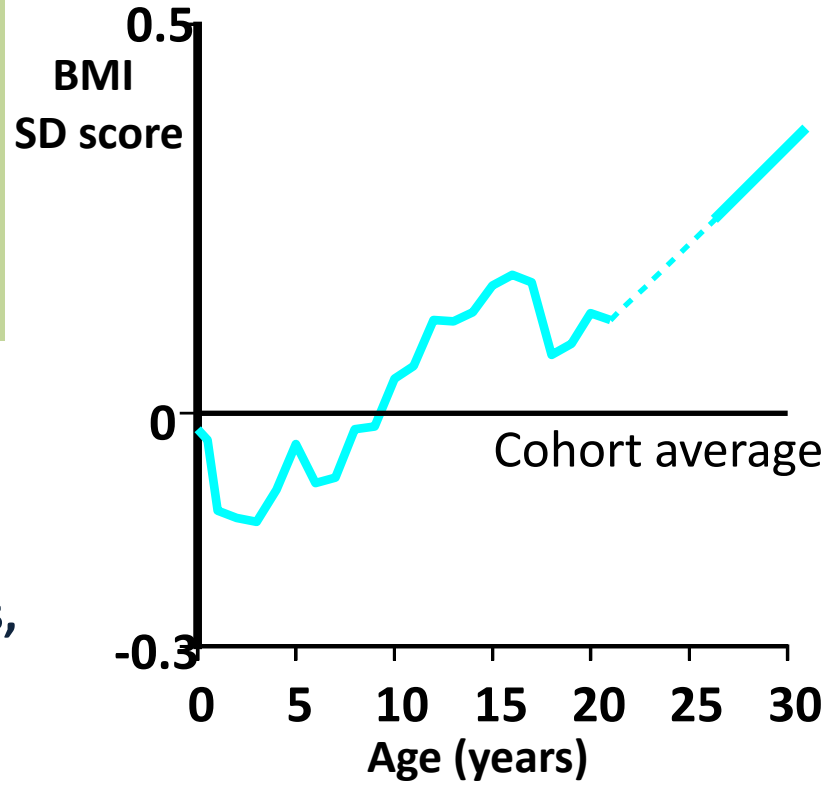


New Delhi Birth Cohort

- In childhood:
- Less than 1% were obese (IOTF ≥30 kg/m^2)
  Mean BMI ranged from –0.4 to –1.0 SD (CDC)

- At 26-32 years:
- 10% obese (BMI ≥30 kg/m^2)
- 10% impaired glucose tolerance (pre-diabetes)
  4% type 2 diabetes
  25% Metabolic Syndrome

Childhood BMI of men and women who developed diabetes or pre-diabetes,



Bhargava et al, New Eng J Med 2004

Pune Maternal Nutrition Study

1993 | 1994-96 | 2000-03, 2006-08 | 2013

Preconception → **Intrauterine** → **Birth** → **Postnatal** → **6 and12 y** → **18 y**

Maternal
Size
Hemo-globin
2675

Maternal
Size
Nutrition
Metabolism
Paternal size
Metabolic variables
Fetal growth (USG)
814

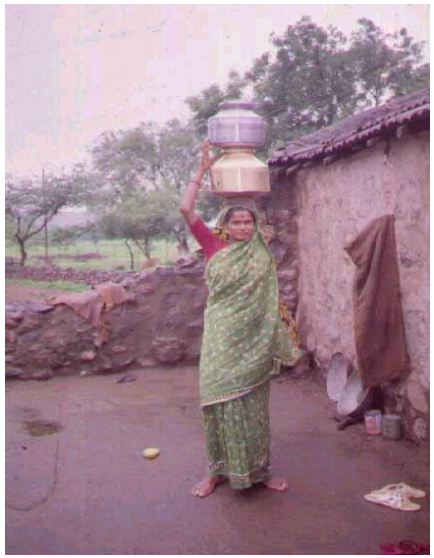
Size
Phenotype
770

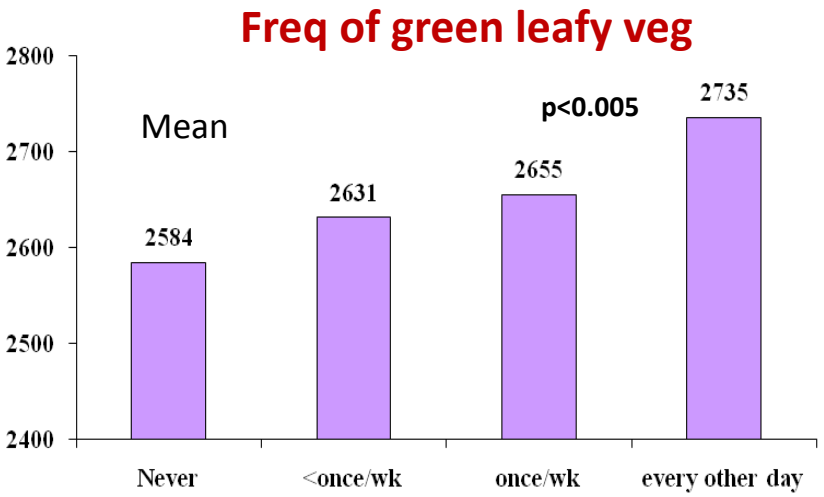
Growth
every
6 months
743

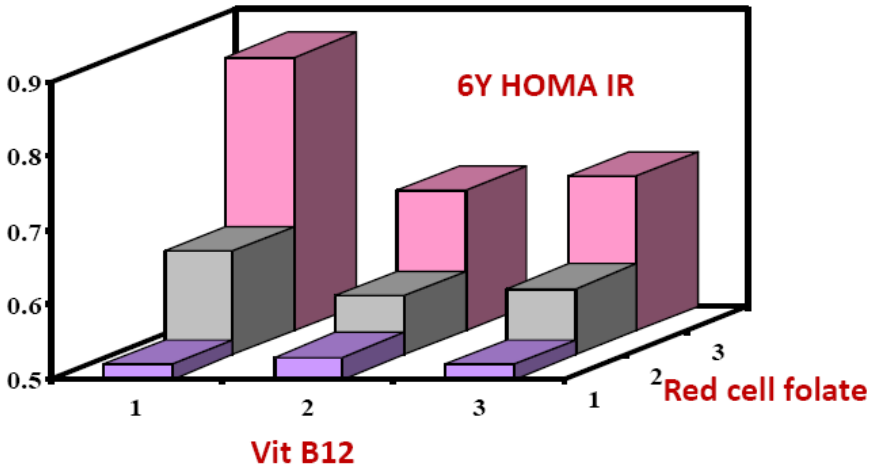
Children & parents
Size, body composition
IR
CVD risk markers
Cognition
698

Children & parents
Size, body composition
IR
CVD risk markers
Genetics and Epigenetics
663

Maternal Nutrition & offspring size, metabolism



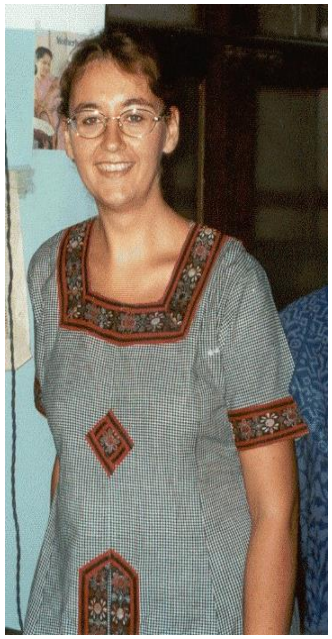




Adjusted for sex, age and fat%; maternal adiposity, protein intake, birth size, vitamin B12

Rao et al, J Nutr2001
Yajnik et al, Int J Obes 2003
Yajnik et al, Diabetologia 2008

Mysore Parthenon Study

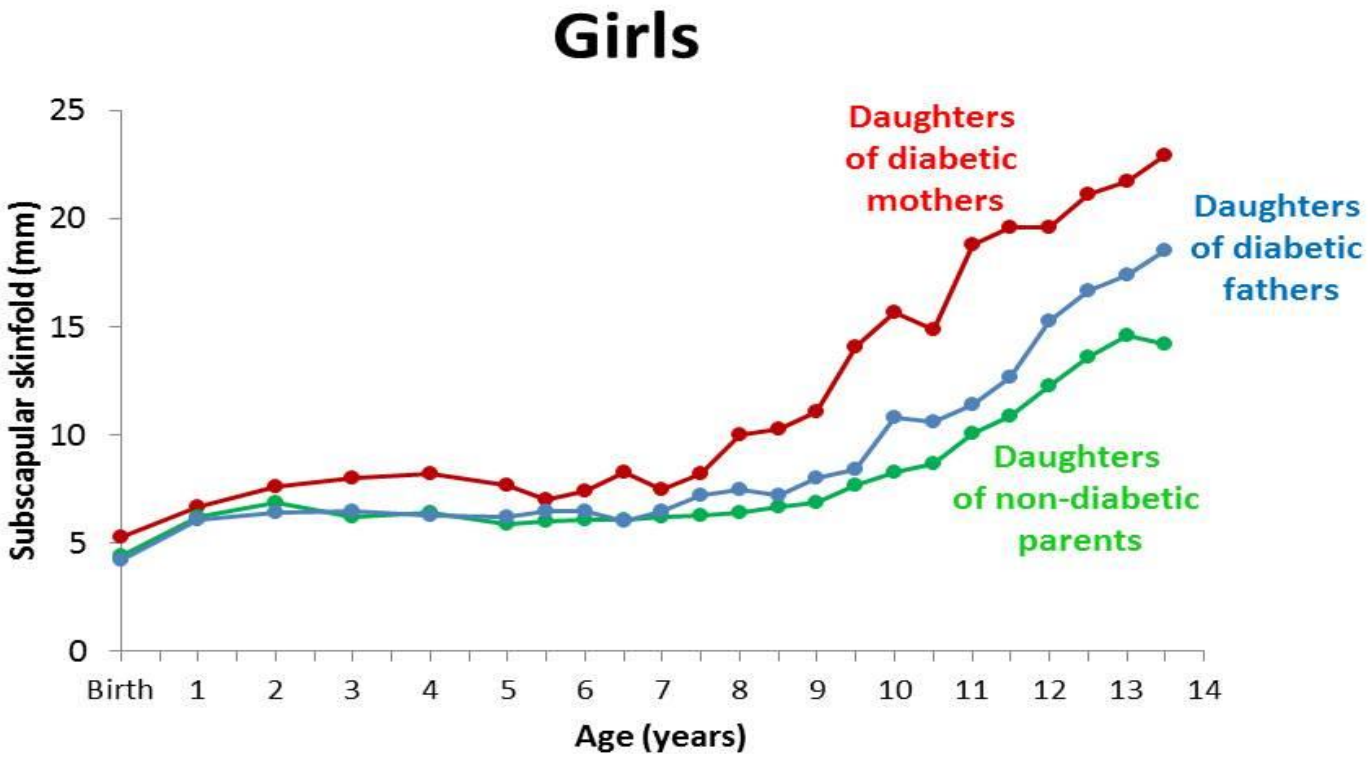



~6% gestational diabetes; mean age 24 yrs; mean BMI 23 kg/m^2

Birth weight: GDM 3.3 kg; non-GDM 2.9 kg; increased adiposity

Hill et al, Acta Obstet Gynecol Scand 2005
Krishnaveni et al, Diabetologia 2009

Effects of Gestational Diabetes on the Children



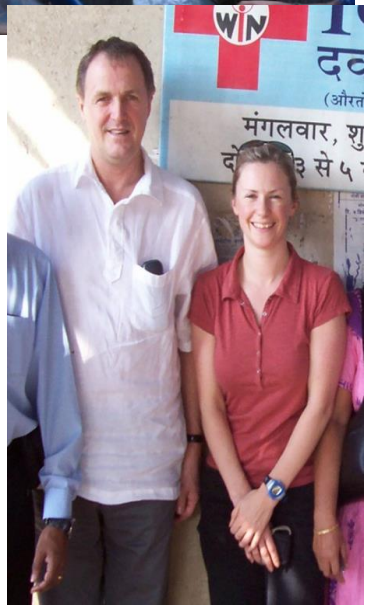
Krishnaveni et al Diabetes Care 2010

Mumbai Maternal Nutrition Project

Randomised controlled trial of pre-conceptional micronutrient supplementation

stronger mothers stronger babies

THE MUMBAI MATERNAL NUTRITION PROJECT



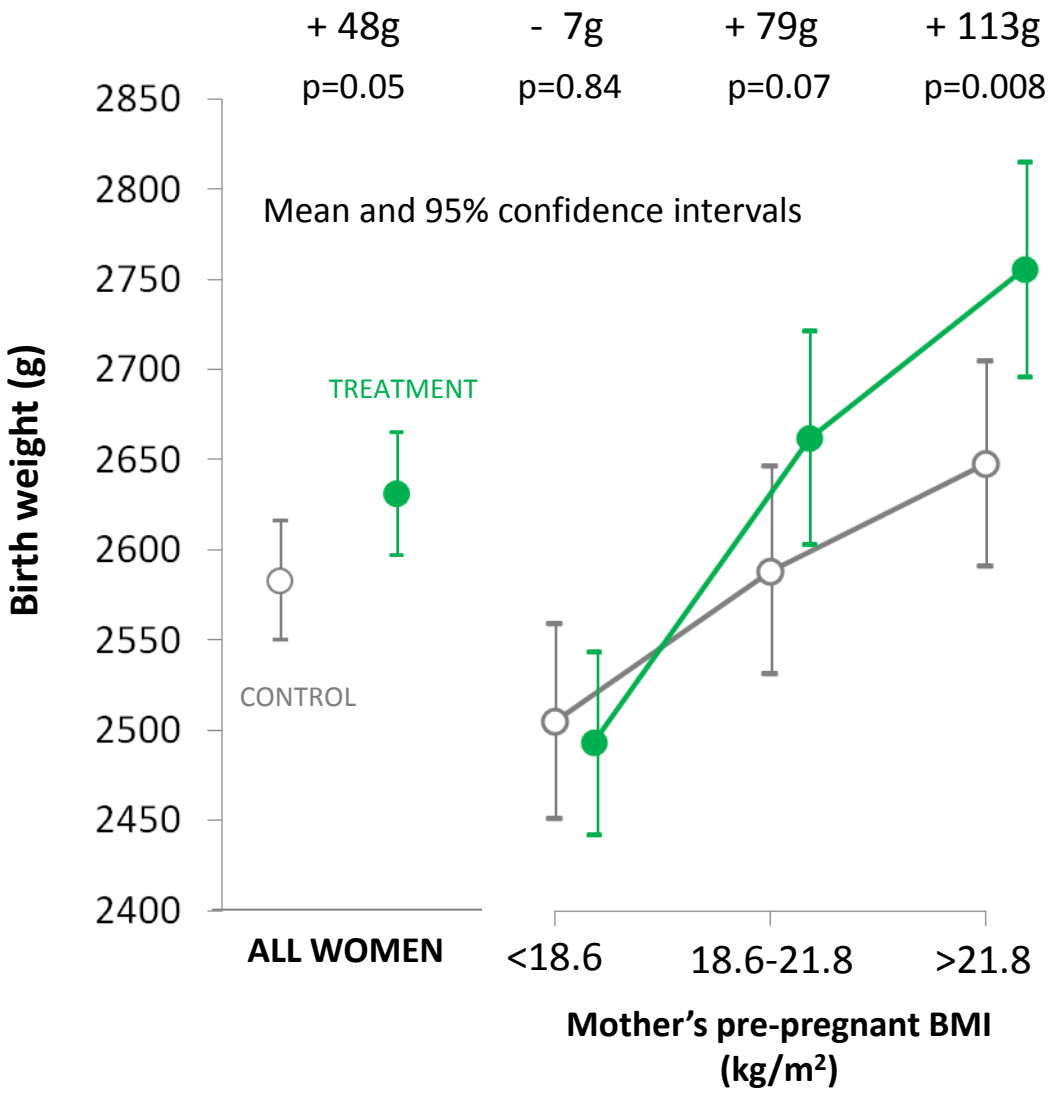
Mumbai Trial

Randomised 6513; pregnancies 2291; singleton livebirths 1962

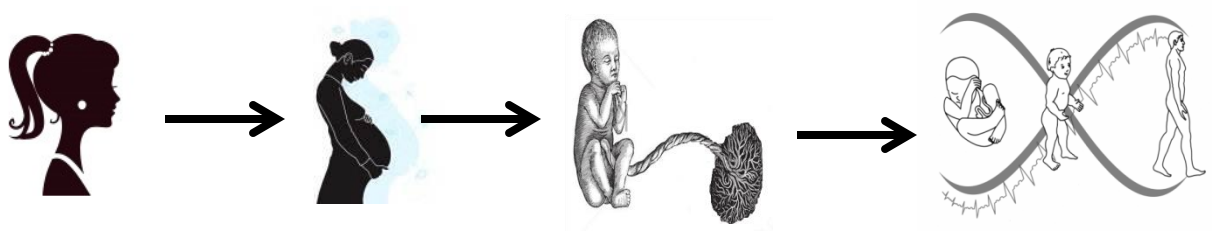
Birth size effect
+48g overall, more in heavier mothers

Low birth weight reduced (34 v 41%)

GDM reduced in mothers (7 v 13%)



Pune Intervention Study
ICMR-MRC



Pre-intervention screening (n=690)
•Exclusion (n=133)

→ Individual Randomisation (n=557)

→ Intervention

1) B12 (2mcg)
2) MMN + B12 + milk
3) Placebo*

→ Newborn
•Cord blood B12, DNA
•Anthro
• Follow up

- Adolescent girls and boys
- Physiological doses
- 3y/till first delivery

*Iron and folate tablets as per Government of India guidelines to all

HISTORIC COHORTS

Birth weight
Child/adult BMI

PROSPECTIVE COHORTS

Maternal size, diet, micronutrient status, fuels

Maternal pre-eclampsia
Child growth

INSULIN RESISTANCE
DIABETES
CVD RISK FACTORS
CVD
COGNITION

Intermediate outcomes:
Fetal development

TRIALS
Pre-conceptional:
Food-based micronutrients (Mumbai)
Vitamin B12 +/- MMN and protein (Pune)

PILOT WORK
Acceptability
Absorption
Dose-response

Other pre- and post-natal interventions

PUBLIC HEALTH IMPACT

MECHANISMS
Epigenetics, metabolomics, cellular/molecular, MR studies

Indian multiple birth cohort Biobank

Team of collaborators: India and UK

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Participants

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