

Malnutrition early in life: Consequences for future health.

BS Bentsen

Dept of Paediatric Gastroenterology
Ullevål University Hospital

- **”This early window of time programming future outcome”.**

– Alan Lucas 1990.

Programming.

- **”the process whereby a stimulus or input during a sensitiv period of development has permanent effects on the structure, physiology and metabolism of the organ.”**

– Alan Lucas 1991.

Protein/calory malnutrition.

- **”Its origin is poverty and the exploitation of man by the more powerful”. (Viteri 1990)**

Early programming of later health.

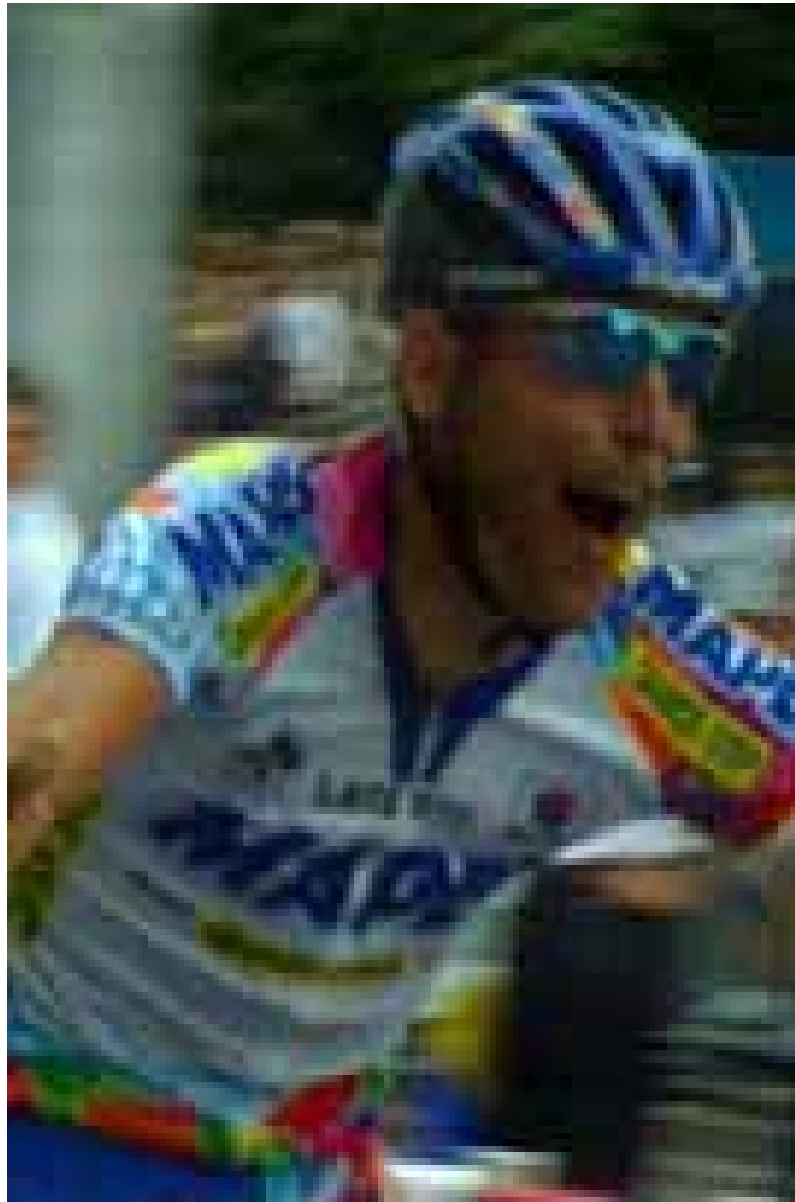
- **1974 G. Dorner**
 - **Proposed interactions between genetics and environment during early development to determine later function in adult life, confirmed only recently by experimental data.**
 - **Described programming effects of perinatal metabolic/endocrine factors on later risk of diabetes, obesity and CVD.**

Nutrition in fetal life and infancy most important because of:

- **High growth rate.**
- **High nutrient requirements/kg body weight.**
- **Limited body stores.**
- **Immature body functions (GI, metabolic, renal).**
- **Rapid tissue and organ development.**

Prenatal programming.

- **Considerable evidence.**
 - **Epidemiological and experimental studies.**
- **Physiological basis.**
 - **Very rapid growth/differentiation depends on substrate availability.**
- **Preventive potential.**
 - **Difficult to modify fetal substrate supply & growth.**





Postnatal programming.

- **Considerable evidence.**
 - Mostly epidemiological and experimental studies.
- **Physiological basis.**
 - Rapid growth/differentiation depends on substrate availability.
- **Preventive potential.**
 - More easy to modify substrate supply to and growth of infants.

Infant feeding programmes longterm health: available evidence.

- **Immune function, infection and allergy risk.**
- **Autoimmune diseases (Type I diabetes, IBD, celiac disease).**
- **Cardiovascular risk.**
- **Bone health.**
- **Neural and brain function.**
- **Obesity.**

Season of birth predicts mortality in Rural Gambia.

Moore SE, Cole TJ, Poskitt EME, Sonko BJ, Sonko BJ, Whitebread RG, McGregor IA, Prentice A.

- **Nature VOL 388 31 July 1997.**

Birth in "hungry-season".

- **Higher mortality in adults.**
- **Gambia 1949-94.**
- **From age 15, more severe infections, 3.65fold risk for premature death.**

– Moore et al. Nature 1997.

The Dutch Famine.

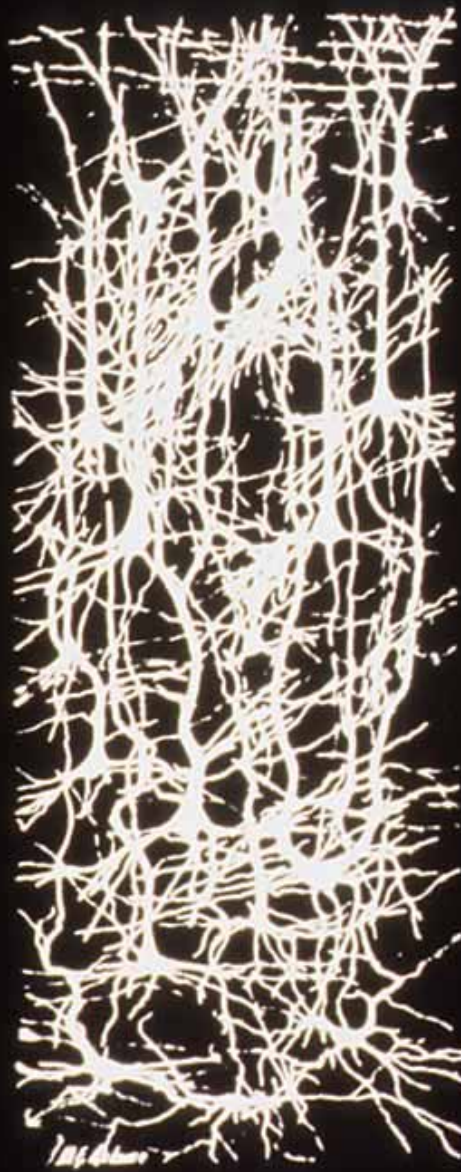
The Dutch Famine.

- **N=2414**
- **Any stage of gestation: Glucose intolerance.**
- **Early gestation: More CHD, atherogenic lipid profile, disturbed coagulation, increased stress responsiveness, increased risk of breast cancer and obesity.**
- **Mid gestation: Microalbuminuria, obstructive airway disease.**

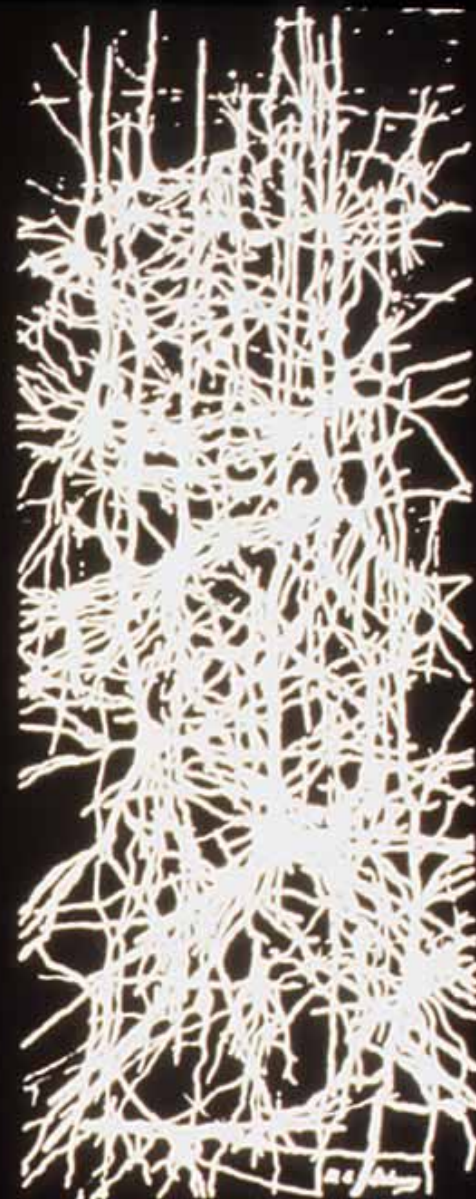
– Roseboom et al, Early Human Dev 2006;82(8)



BIRTH



15 MONTHS



2 YEARS

Programming and the Brain.

- **Preterm infants given enriched formula vs standard formula gave a 13 IQ points deficit for boys given standard formula.**
 - Lucas et al BMJ 1998;317:1481-87.
- **Standard formula gave 38% incidence of mental/motor impairment vs 15% in "enriched group" at 7-8 years of age.**

Studies in developing countries.

- **Randomized trials of early supplementation demonstrating long term cognitive effects.**

– **Lucas A et al. Nutr Rev 2001;59:S24-S33.**

Breast milk to preterms.

- **Lower serum cholesterol at 13-16 years**
 - **Compared to formula fed.**
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- **Singhal et al 2004**

Serum cholesterol and breast feeding.

- **Meta-analysis. 9 studies. 1532 individuals >16 years.**
- **0.07 mmol/ml lower in breast-fed than formula-fed.**

– Owen et al Pediatrics 2003.

Breast feeding and blood pressure in childhood and adulthood.

- **Meta-analysis: 15 studies, 17503 subjects.**
 - **Systolic -1,4 mmHg**
 - **Diastoloic: -0,5 mmHg**
- **Martin et al 2005**

Breast feeding and intima media thickness.

- Intima media thickness -0,20 mm
 - Bifurcation $p=0.02$

- Odds Ratio for plaques
 - Art. carotis 0.50 $p=0.04$
 - Art. femoralis 0.45 $p=0,05$

– Martin et al 2005

DHA+AA in infant formula reduce blood-pressure at 6 years

- **Systolic - 3.6 mmHg p=0.02.**
- **Mean -3.0 mmHg p=0.018.**

– Forsyth et al, Brit Med J 2003.

Growth pattern of Finnish CHD patients.

- **Highest risk:**
- **Low birthweight, fast weight gain, high adult BMI/body fat mass.**

- **Grow now, pay later!**

– NEJM 2005;353:1902-9

Insulin Resistance Syndrome, Glucose Intolerance and Diabetes.

- **Men 59-70 Years og age.**
 - **Birth weight <2.5 kgs insulin res 30%, 40% glucose intolerance and NIDDM.**
 - **Birth weight 3.41 kgs 17% insulin res, 31 % glucose intolerance and NIDDM.**
- **Hales and Barker, BMJ 1991**

Fish oil and prevention of allergy.

- **N=98 allergic women fish oil or placebo during pregnancy from week 20.**
- **Significant reduction of severity of atopic dermatitis ($p=0.045$).**

– Dunstan et al 2003, J Allergy Clin Immunol

Breast feeding reduces obesity prevalence at school age.

- **Significant lower risk for both overweight and obesity in breast fed vs formula.**
- **Dose response effect.**
 - **BMJ 1999, 319:147-50.**
 - **Arenz et al Int J Obesity 2004 (meta-analysis).**

Conclusions.

- **Fetal and infant nutrition strongly programmes long-term health.**
- **Support optimal feeding of mothers and infants. Breastfeeding/High quality formula and weaning foods.**
- **Fast growth in the malnourished neonate can increase risk of metabolic syndrome and its consequences.**