Programming nutrizionale delle malattie dell'anziano

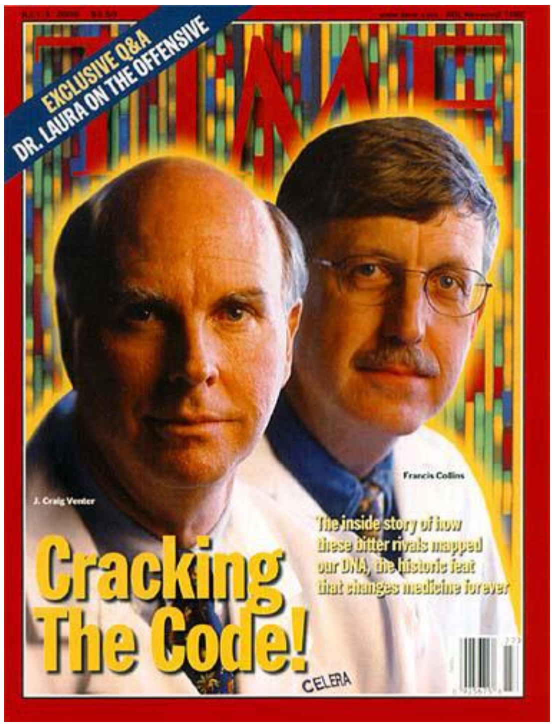
Riccardo Calvani, PhD

Dipartimento di Geriatria, Ortopedia e Neuroscienze

Università Cattolica del Sacro Cuore

Outline

- **The Dutch Hunger Winter and the developmental origins of health and disease (DOHaD)**
- **Mechanisms of nutritional programming of adult diseases**
- **The "First 1000 days" paradigm**
- **From Waddington "epigenetic landscape" to "Pachinko model"**



"Without understanding the environment in which cells or species exist, life cannot be understood. An organism's environment is ultimately as unique as its genetic code."

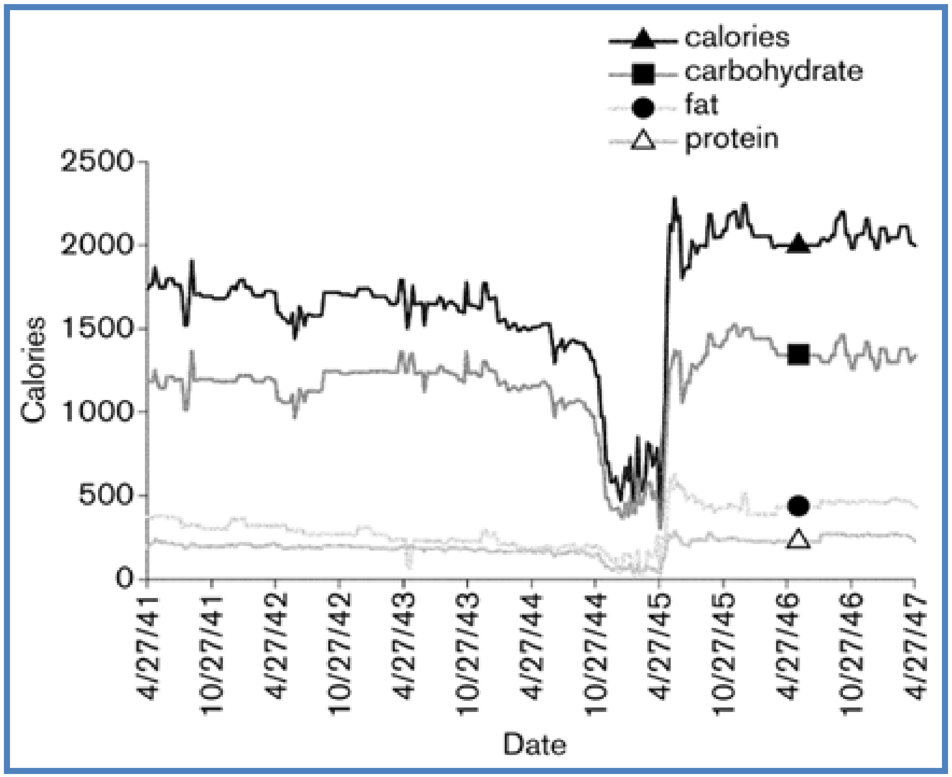
Craig Venter

Venter, J. C. A Life Decoded. 3 (Penguin, Allen Lane, London, 2007).

The Dutch Hunger Winter and the developmental origins of health and disease

Laura C. Schulz[1]
Department of Obstetrics, Gynecology and Women's Health, University of Missouri, Columbia, MO 65211

PNAS | **September 28, 2010** | vol. 107 | no. 39 | **16757–16758**



The Dutch famine and its long-term consequences for adult health

Tessa Roseboom *, Susanne de Rooij, Rebecca Painter

First trimester

- Glucose intolerance
- Cardiovascular disease
- Hypertension
- Dyslipidemia
- Obesity
- Affective disorders

Second trimester

- Glucose intolerance
- Pulmonary disease
- Renal disease

Third trimester

- Glucose intolerance

Early Human Development (2006) **82**, 485–491

CONGRESSO NAZIONALE 60° NAPOLI 25-28 Novembre 2015

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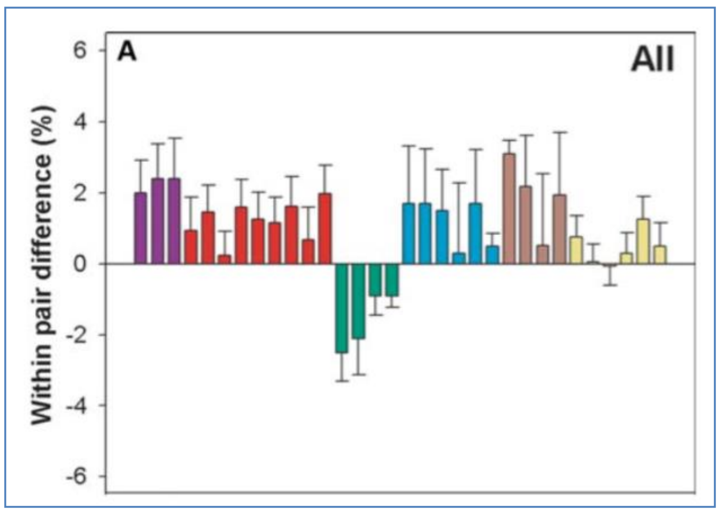
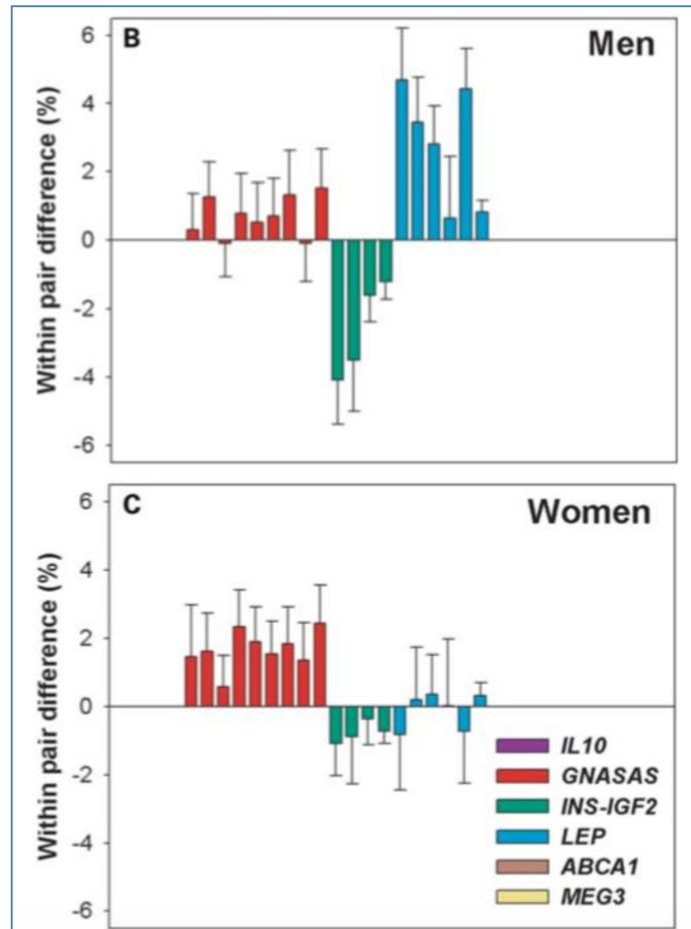
OXFORD JOURNALS Human Molecular Genetics

DNA methylation differences after exposure to prenatal famine are common and timing- and sex-specific

Elmar W. Tobi[1], L.H. Lumey[3,5], Rudolf P. Talens[1], Dennis Kremer[1], Hein Putter[2], Aryeh D. Stein[4], P. Eline Slagboom[1] and Bastiaan T. Heijmans[1,*]





Human Molecular Genetics, 2009, Vol. 18, No. 21
doi:10.1093/hmg/ddp353

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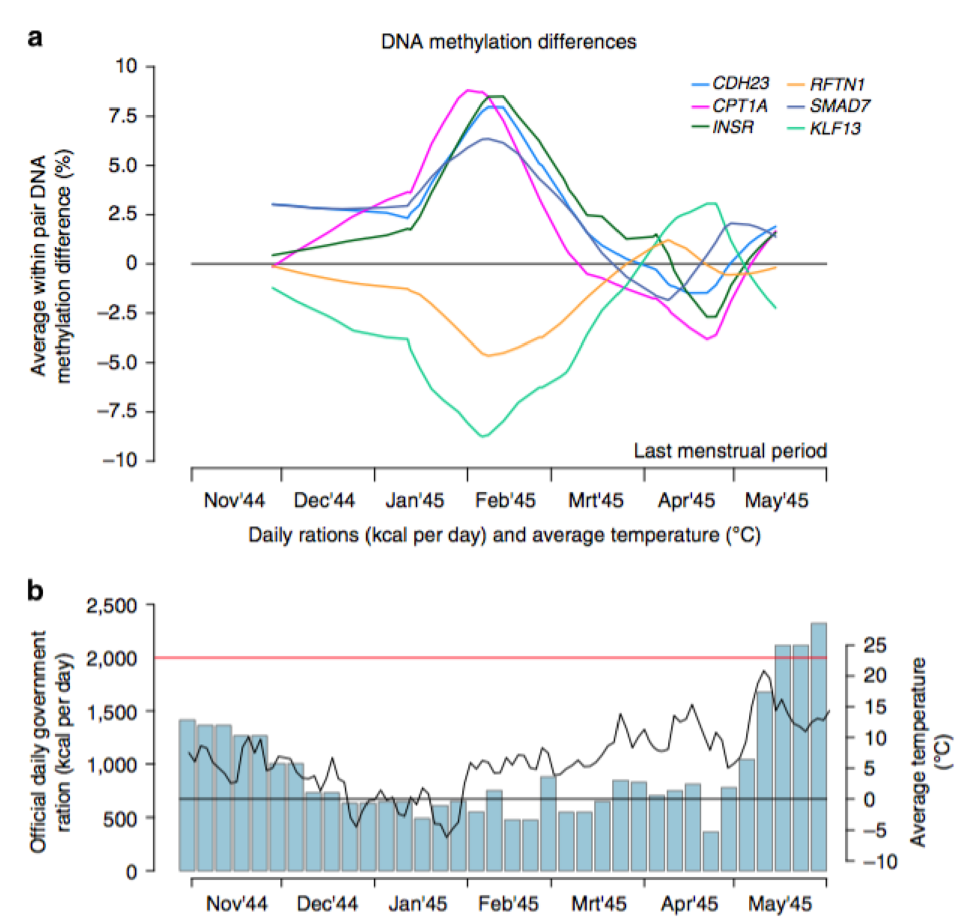
DNA methylation signatures link prenatal famine exposure to growth and metabolism

Elmar W. Tobi[1], Jelle J. Goeman[2,†], Ramin Monajemi[2], Hongcang Gu[3], Hein Putter[2], Yanju Zhang[1], Roderick C. Slieker[1], Arthur P. Stok[1], Peter E. Thijssen[1,4], Fabian Müller[5], Erik W. van Zwet[2], Christoph Bock[5,6,7], Alexander Meissner[3,8], L.H. Lumey[1,9], P. Eline Slagboom[1] & Bastiaan T. Heijmans[1]

nature COMMUNICATIONS



NATURE COMMUNICATIONS | 5:5592 | DOI: 10.1038/ncomms6592 |

Breast Cancer Risk After Caloric Restriction During the 1944–1945 Dutch Famine

Sjoerd G. Elias, Petra H. M. Peeters, Diederick E. Grobbee, Paulus A. H. van Noord

JNCI Journal of the National Cancer Institute

Journal of the National Cancer Institute, Vol. 96, No. 7, April 7, 2004

Risk Factor	Relative Risk	95% Confidence Interval (CI)*
Conjugated equine estrogen	0.77	0.59–1.01
Birth weight	1.09†	2.00–17.00
Fish intake	1.14	1.03–1.26
Premarin/Progestin	1.24	1.01–1.54
Premarin/Progestin	1.26	1.00–1.59
French fries (1 additional serving per week)	1.27	1.12–1.44
Grapefruit	1.3	1.06–1.58
Night shift work	1.51	1.36–1.68
Flight attendant (Finnish)	1.87	1.15–2.23
Dutch famine‡	2.01	0.92–4.41
Antibiotic use§	2.07	1.48–2.89
Flight attendant (Icelandic)	4.1	1.70–8.50
Electric blanket use¶	4.9	1.50–15.6
Tobacco smoking and lung cancer	26.07	6.58–103.3

Cancer J 2009;15: 93–104

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PNAS Celebrating 100 Years 1915-2015

Prenatal undernutrition and cognitive function in late adulthood

Susanne R. de Rooij[a,1], Hans Wouters[a], Julie E. Yonker[b], Rebecca C. Painter[c], and Tessa J. Roseboom[a]

Table 3. Mean actual cognition test scores according to timing of prenatal exposure to the Dutch famine

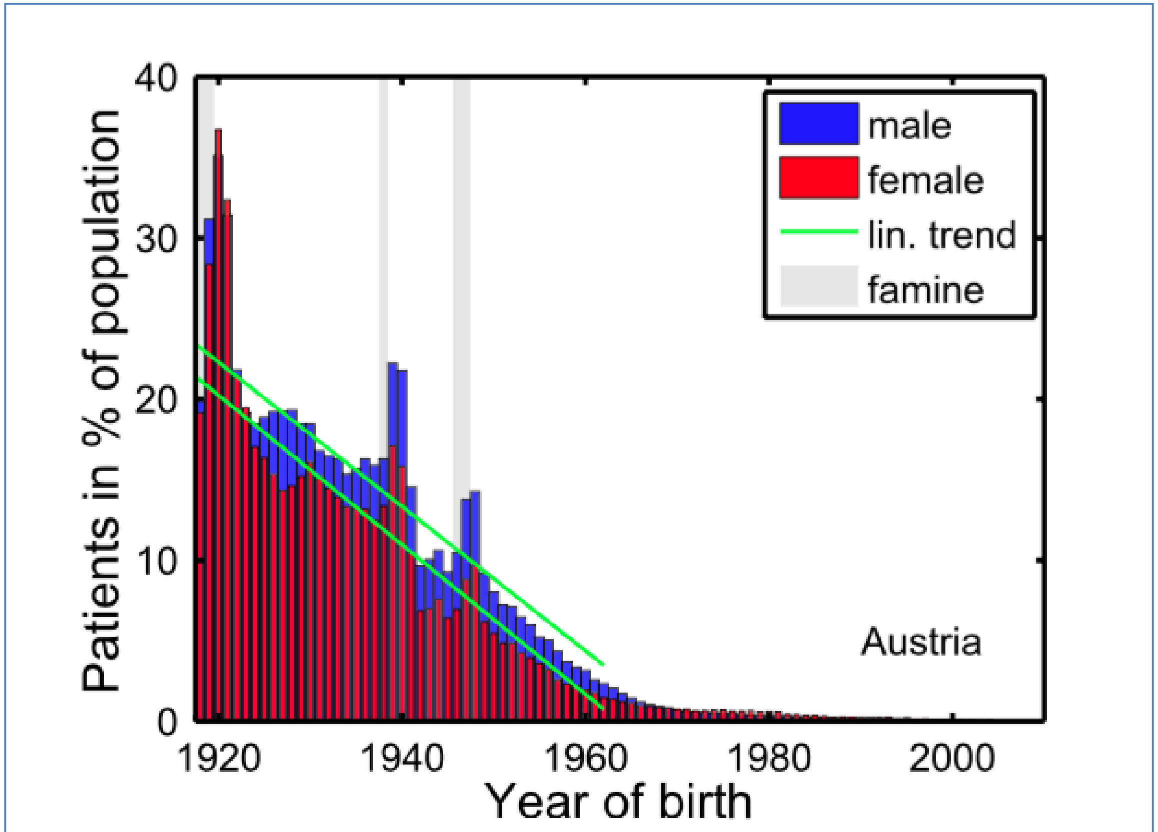
	N	Born before	Exposure to famine: In late gestation	In mid gestation	In early gestation	Conceived after	Total
N		231	126	107	64	209	737
AH4 test							
Response time (s)*	727	22.6	21.4	22.5	23.4	23.2	22.6 (10.2)
Score (%)*	727	70.9	72.4	71.8	76.0	73.3	72.4 (19.0)
Memory task							
Immediate recall (items)	613	22.1	20.7	22.2	20.0	21.3	21.4 (6.9)
Retrieval (%)	583	81.8	78.5	83.2	79.7	79.6	80.7 (19.9)
Mirror task							
Rounds*	717	3	3	3	3	3	3 (2)
Errors*	717	55	49	37	55	41	49 (79)
Errors per round*	643	13	12	10	14	10	12 (30)
Stroop task							
Response time (s)	678	3.5	3.5	3.5	3.6	3.4	3.5 (0.6)
Score (%)*	714	42.3	36.5	40.0	27.5†	43.9	38.5 (55.7)
Possibly inattentive (%)	699	11.3	11.3	15.5	24.6	13.9	13.7

Data are given as means (SD) or *medians (IQR). Shaded areas indicate the groups exposed to famine during gestation compared with the control groups unexposed to famine during gestation.

†Statistically significant difference compared with participants unexposed to famine during gestation (based on linear regression analysis, $P < 0.05$, adjusted for sex).

Quantification of excess risk for diabetes for those born in times of hunger, in an entire population of a nation, across a century

Stefan Thurner[a,b,c,1], Peter Klimek[a], Michael Szell[a,d], Georg Duftschmid[e], Gottfried Endel[f], Alexandra Kautzky-Willer[g], and David C. Kasper[h]



PNAS | March 19, 2013 | vol. 110 | no. 12 | 4703–4707

THE LANCET, MAY 10, 1986

Epidemiology

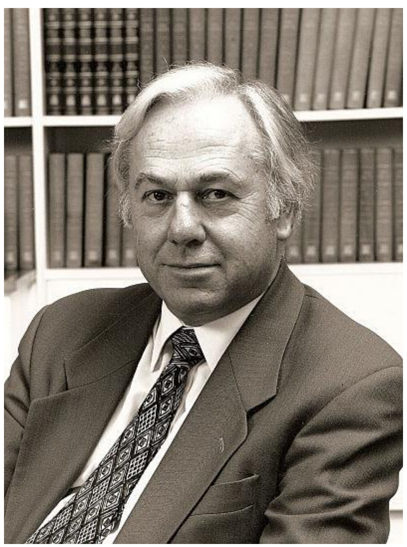
INFANT MORTALITY, CHILDHOOD NUTRITION, AND ISCHAEMIC HEART DISEASE IN ENGLAND AND WALES

D. J. P. BARKER C. OSMOND
MRC Environmental Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton SO9 4XY

The Lancet · Saturday 9 September 1989

WEIGHT IN INFANCY AND DEATH FROM ISCHAEMIC HEART DISEASE

D. J. P. BARKER P. D. WINTER
C. OSMOND B. MARGETTS
S. J. SIMMONDS
MRC Environmental Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton SO9 4XY



David Barker

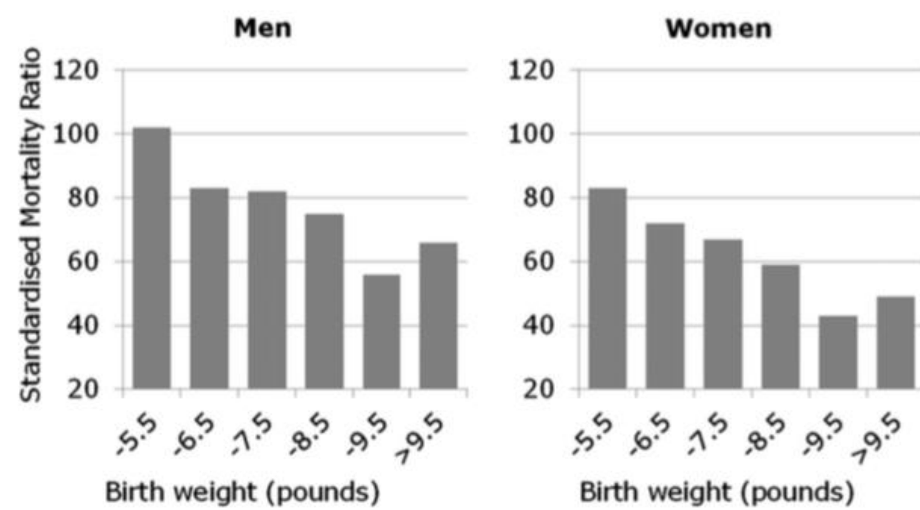
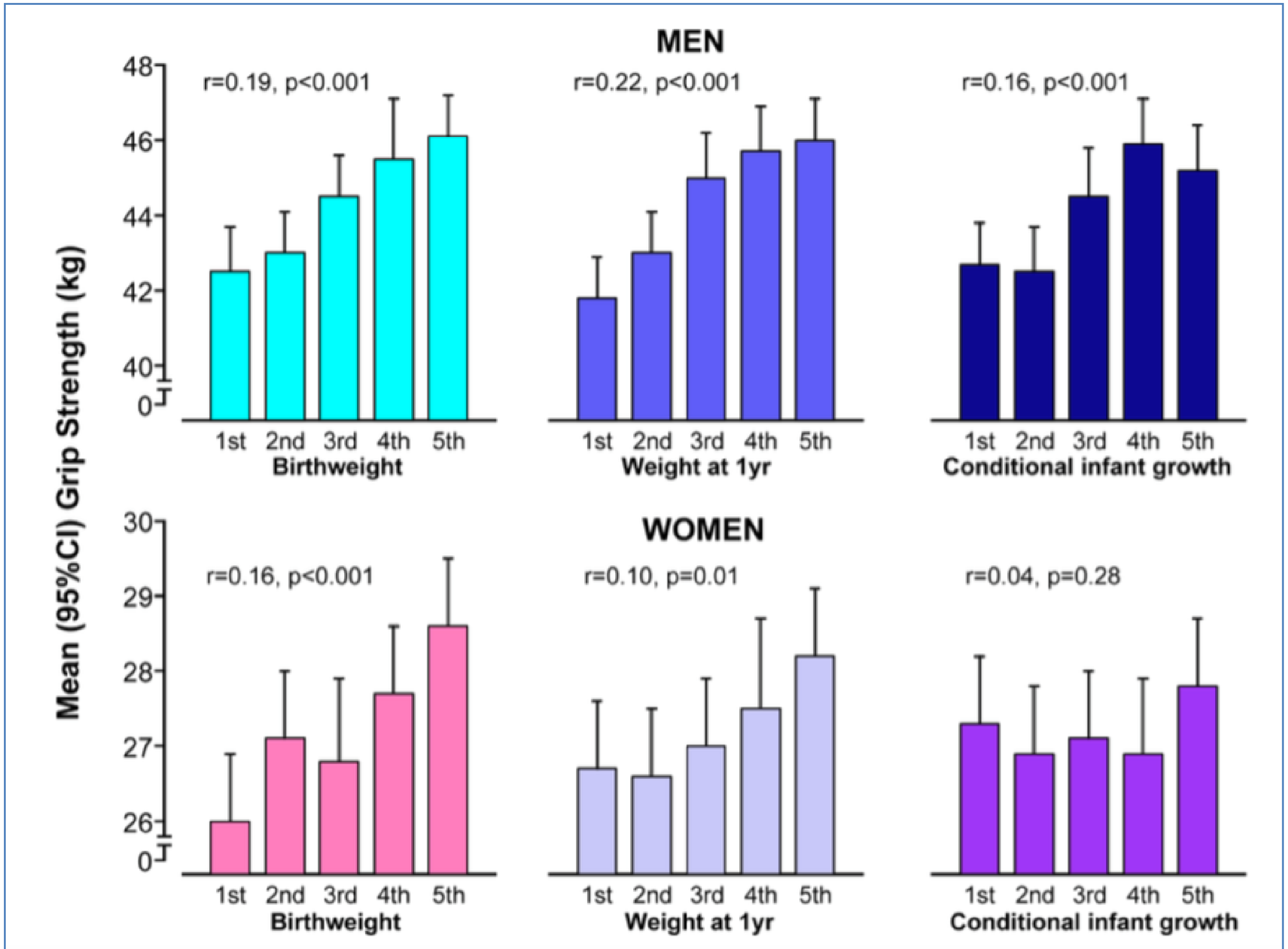


Fig. 1 – Mortality from coronary heart disease in 15,726 men and women in Hertfordshire.

The developmental origins of sarcopenia

Avan Aihie Sayer, **Holly Syddall**, **Helen Martin**, **Harnish Patel**, **Daniel Baylis**, and **Cyrus Cooper**
MRC Epidemiology Resource Centre, University of Southampton, Southampton, UK



J Nutr Health Aging. 2008 ; 12(7): 427–432.

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Physiological Reviews

EARLY DEVELOPMENTAL CONDITIONING OF LATER HEALTH AND DISEASE: PHYSIOLOGY OR PATHOPHYSIOLOGY?

M. A. Hanson and P. D. Gluckman

A secure developmental environment

- **Investment for longevity**
  - Commitment to repair
  - Commitment to tissue reserve:
    - neuronal number
    - nephron number
    - cardiomyocyte number
    - other stem cells
- **Investment for large adult size**
  - Bone mass
  - Muscle mass

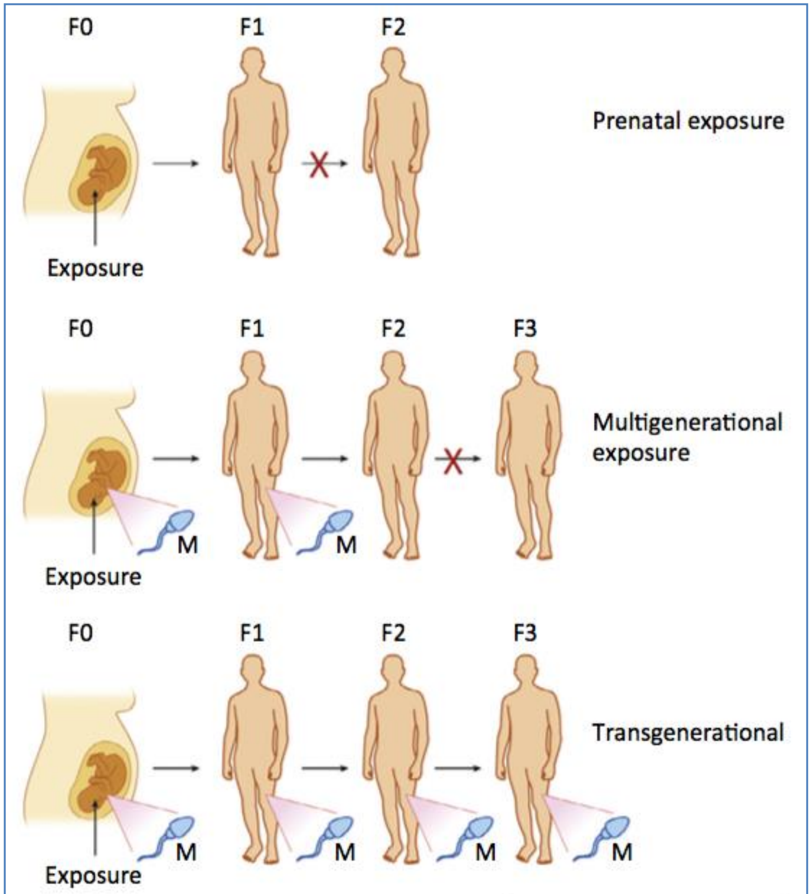
A threatening developmental environment

- **Immediate trade-offs to survive**
  - Smaller birth size
  - Prematurity
  - Sarcopenia
  - More fat
  - Fewer nephrons, cardiomyocytes, neurons
- **Reproductive strategy**
  - early puberty
- **Investment to resist environmental challenges**
  - Altered HPA and stress response
  - Altered behavior
  - Appetite & food preference

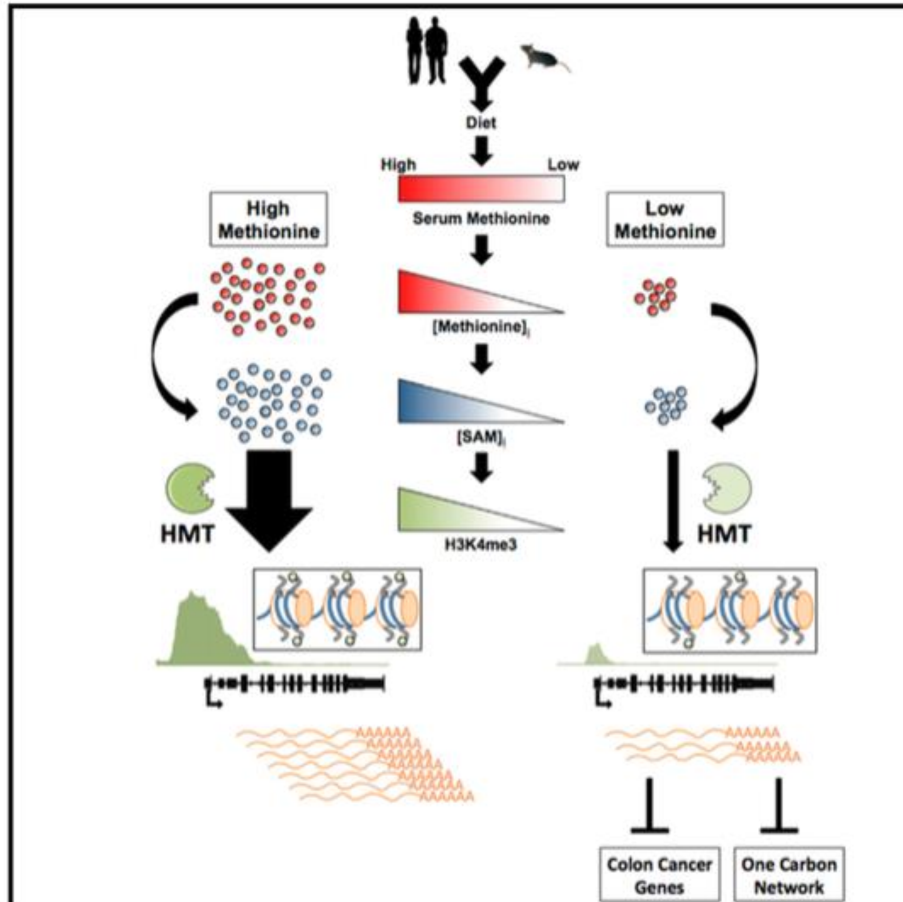
Nutritional epigenetics with a focus on amino acids: implications for the development and treatment of metabolic syndrome

Yun Ji[a], Zhenlong Wu[a,*], Zhaolai Dai[a], Kaiji Sun[a], Junjun Wang[a], Guoyao Wu[a,b]

Journal of Nutritional Biochemistry xx (2015) xxx–xxx



Trends in Molecular Medicine, February 2015, Vol. 21, No. 2



Mentch et al., 2015, Cell Metabolism 22, 1–13
November 3, 2015 ©2015 Elsevier Inc.

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Nutrition and the developing brain: nutrient priorities and measurement[1–3]

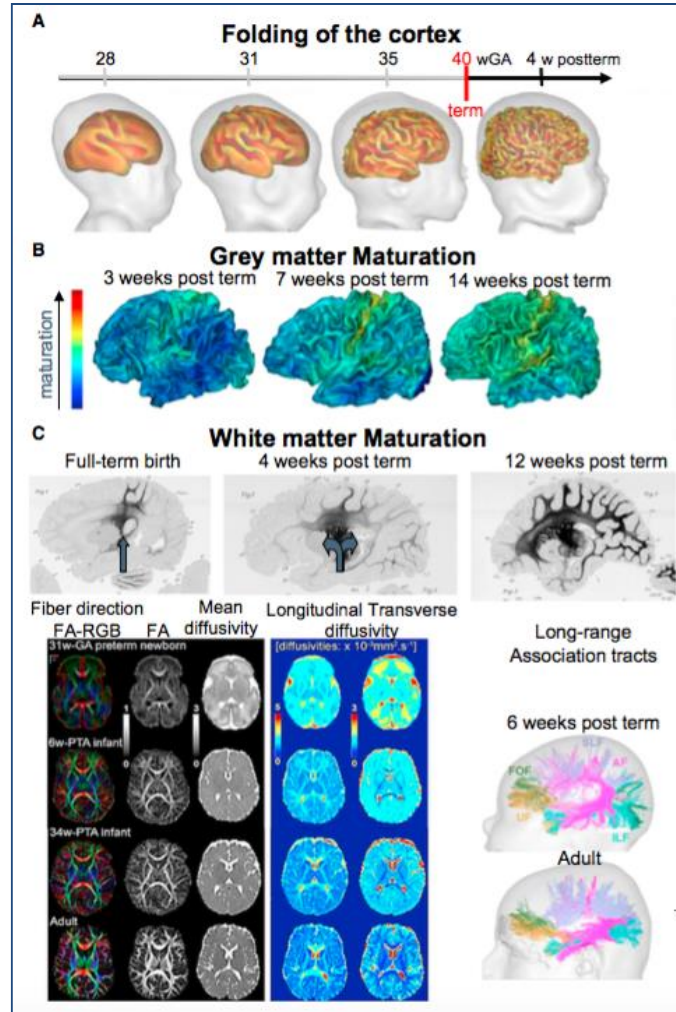
Michael K Georgieff

Am J Clin Nutr 2007;85(suppl):614S–20S.

TABLE 1
Important nutrients during late fetal and neonatal brain development[1]

Nutrient	Brain requirement for the nutrient	Predominant brain circuitry or process affected by deficiency
Protein-energy	Cell proliferation, cell differentiation	Global
	Synaptogenesis	Cortex
	Growth factor synthesis	Hippocampus
Iron	Myelin	White matter
	Monoamine synthesis	Striatal-frontal
	Neuronal and glial energy metabolism	Hippocampal-frontal
Zinc	DNA synthesis	Autonomic nervous system
	Neurotransmitter release	Hippocampus, cerebellum
Copper	Neurotransmitter synthesis, neuronal and glial energy metabolism, antioxidant activity	Cerebellum
LC-PUFAs	Synaptogenesis	Eye
	Myelin	Cortex
Choline	Neurotransmitter synthesis	Global
	DNA methylation	Hippocampus
	Myelin synthesis	White matter

[1] LC-PUFAs, long-chain polyunsaturated fatty acids.

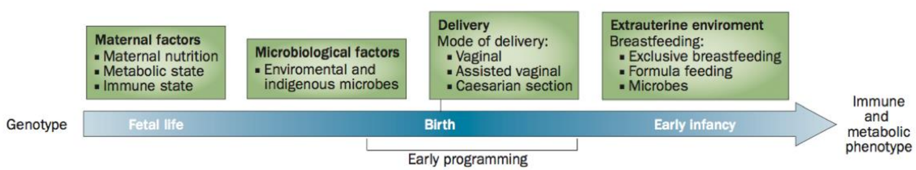


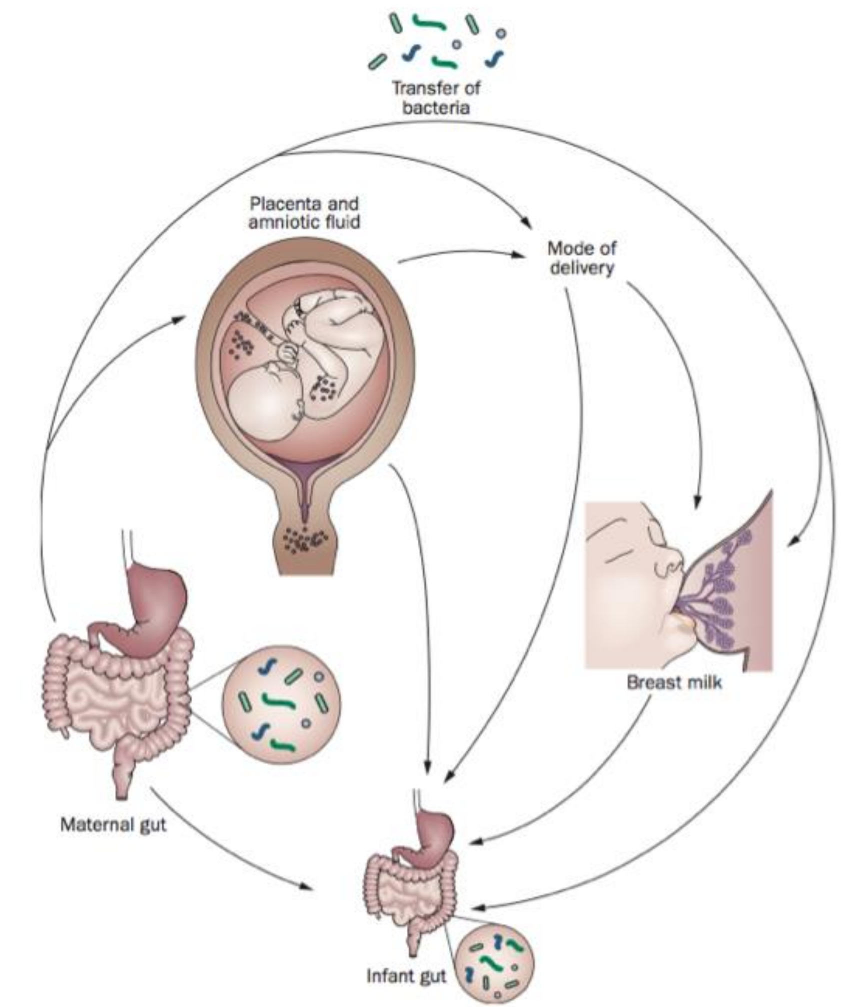
Neuron 88, October 7, 2015

nature REVIEWS GASTROENTEROLOGY & HEPATOLOGY

Microbial contact during pregnancy, intestinal colonization and human disease

Samuli Rautava, Raakel Luoto, Seppo Salminen and Erika Isolauri





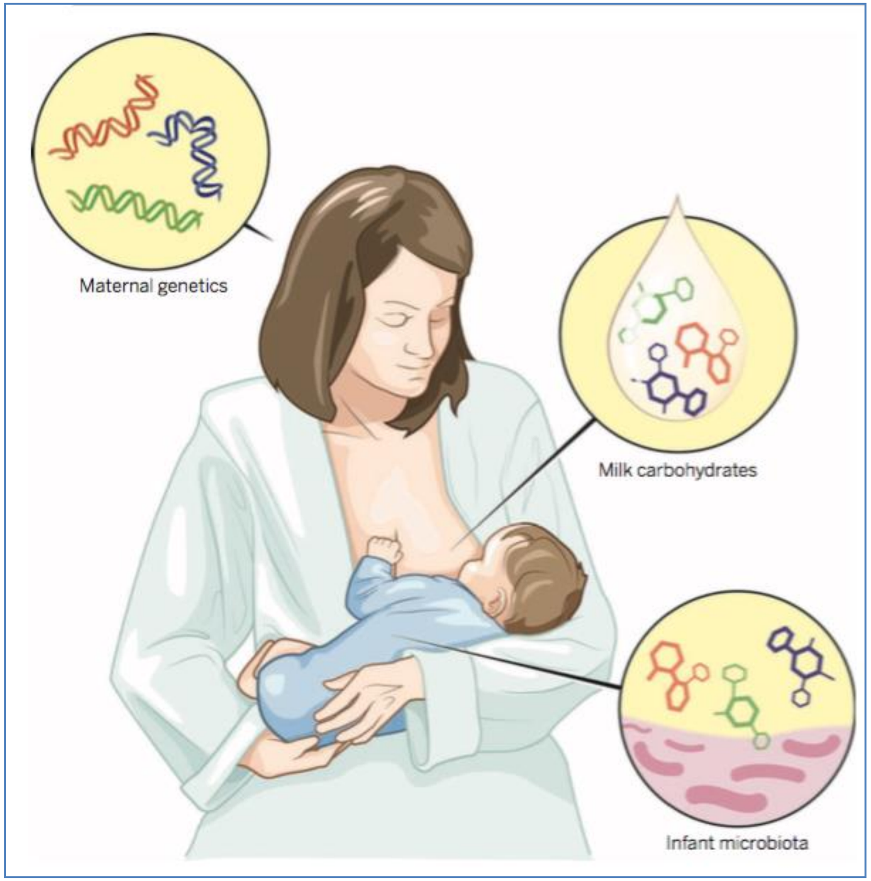
Rautava, S. *et al. Nat. Rev. Gastroenterol. Hepatol.* advance online publication 14 August 2012

MICROBIOTA

Mother's littlest helpers

Breastmilk nourishes the microbes colonizing the neonatal intestinal tract

Science AAAS



"...our microbiota are ecologically engineered by mothers and breastmilk."

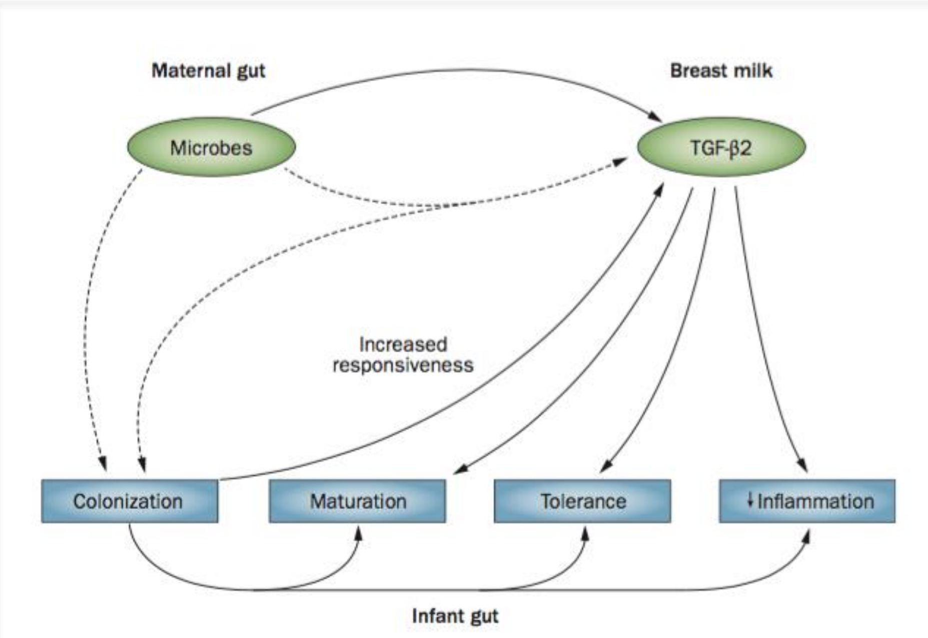
Katie Hinde and Zachery T. Lewis
Science **348**, 1427 (2015);

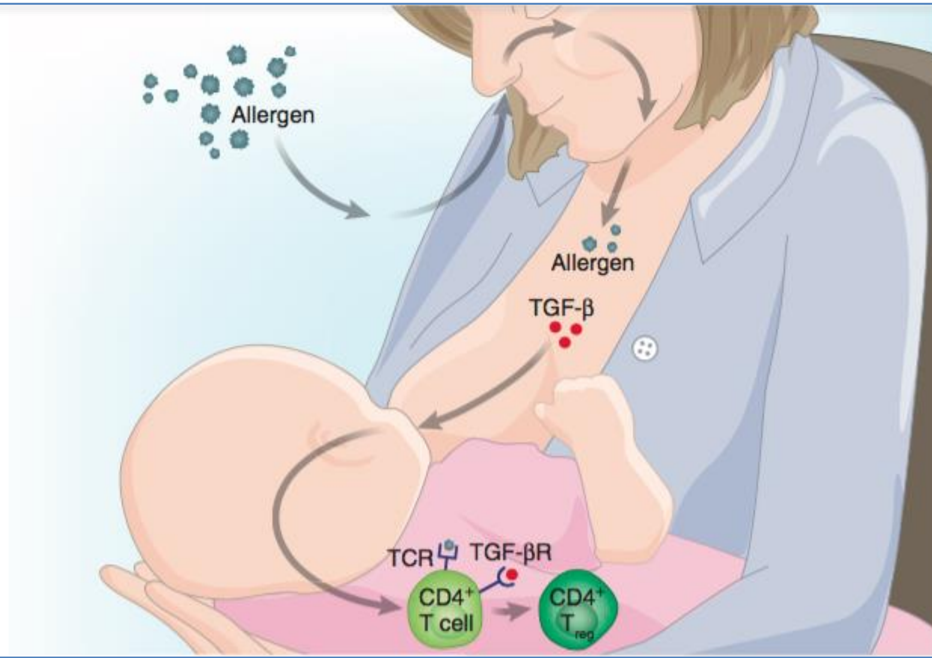
Microbial contact during pregnancy, intestinal colonization and human disease

Samuli Rautava, Raakel Luoto, Seppo Salminen and Erika Isolauri

Breathing easier with breast milk

Lynn Puddington & Adam Matson





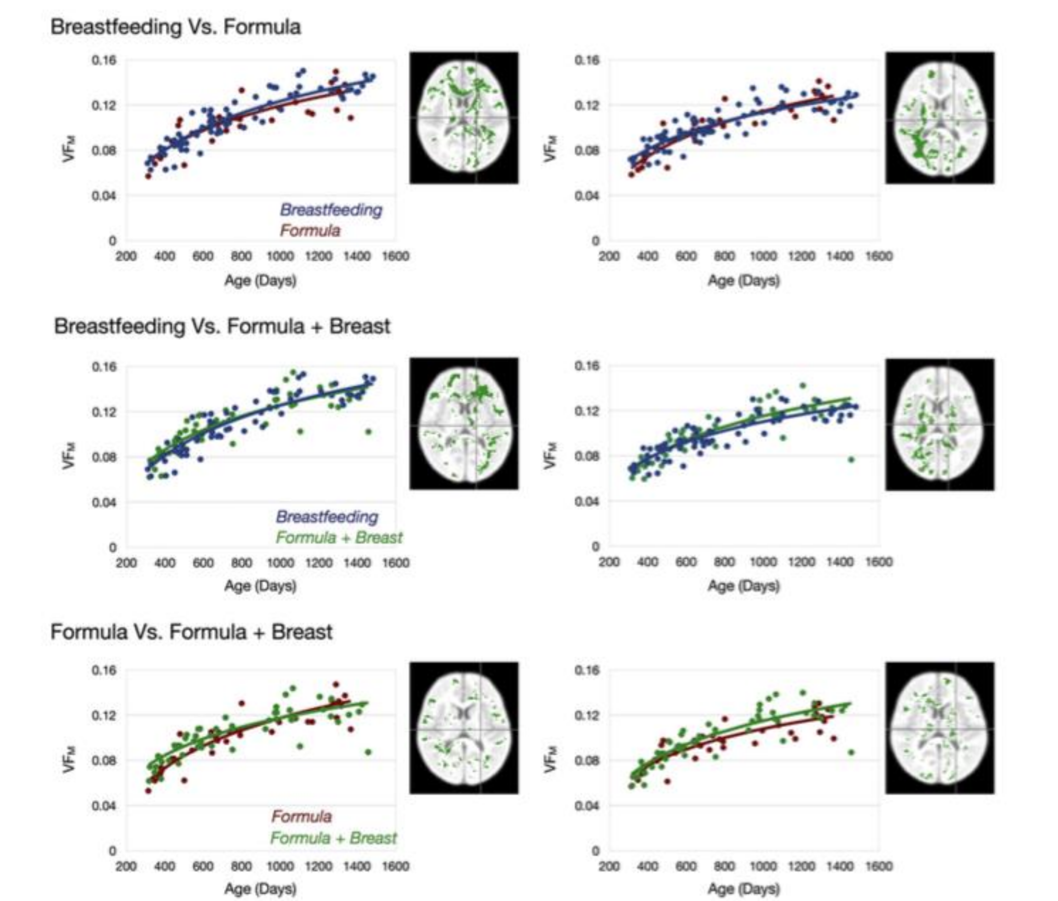
Rautava, S. *et al. Nat. Rev. Gastroenterol. Hepatol.* 9, 565–576 (2012)

VOLUME 14 | NUMBER 2 | FEBRUARY 2008 NATURE MEDICINE

Breastfeeding and early white matter development: A cross-sectional study

Sean C.L. Deoni [a,*], Douglas C. Dean III [a], Irene Piryatinsky [a,b], Jonathan O'Muircheartaigh [a,c], Nicole Waskiewicz [a], Katie Lehman [a], Michelle Han [a], Holly Dirks [a]

NeuroImage



Comparison of behavioral test scores for breast-fed children divided into short and long feeding durations. Bold values indicate statistically different scores corrected for type 1 error using Holm–Bonferroni correction.

	Short breast feeding duration	Long breast feeding duration	p-Value
Participants (n)	22	25	
Age (days)	691 ± 324	807 ± 341	0.24
Breast feeding duration	220 ± 81	600 ± 124	
Gross motor	20.41 ± 4.7	23 ± 5	**0.046**
Fine motor	20.4 ± 5.5	25.3 ± 8.6	**0.028**
Receptive language	19.2 ± 8.9	26.7 ± 11.2	**0.015**
Expressive language	16.9 ± 7.9	25.6 ± 10.7	**0.0036**
Visual reception	20.9 ± 9.2	30 ± 11.1	**0.0042**

Fetal and Early Childhood Undernutrition, Mortality, and Lifelong Health

DISEASE PREVENTION
www.sciencemag.org/special/prevention

Science **337**, 1495 (2012)

Chessa K. Lutter[1]* and Randall Lutter[2]

Outcomes	Measure of breast-feeding	Effect size	Notes
Ovarian cancer	Length of breast-feeding	Reduced risk of ovarian cancer by 28% for each year of breast-feeding (odds ratio: 0.72; 95% CI: 0.54 to 0.97)	Meta-analysis of nine studies with 4387 cancer ovarian cancer cases and 10,574 controls (*32*)
Breast cancer	Length of breast-feeding	Reduced risk of breast cancer by 4.3% for each year of breast-feeding in first analysis; reduced risk of breast cancer by 28% for each year or more of breast-feeding in second analysis	First meta-analysis included 45 studies conducted through 2001; second meta-analysis included 23 studied published between 1980 and 1998 (*32*)
Type 2 diabetes	Length of breast-feeding	Reduced diabetes risk by 4%; 95% CI: 1 to 9% per year of breast-feeding in first cohort and 12%; CI: 6 to 18% in second cohort	Two cohorts from a high-quality longitudinal study of 150,000 parous women in the U.S. (*32*)
Hypertension	Never breast-fed versus exclusively breast-fed first child for ≥6 months	Increased risk of hypertension by 29% (hazard ratio: 1.29; 95% CI: 1.20 to 1.40)	55,636 parous women in the U.S., reported 8861 cases during 660,880 person-years of observations (*30*)

Conclusions

The prenatal period and the first 24 months of life provide a 1000-day window in which sound nutrition, especially adherence to recommended breastfeeding and complementary feeding practices, can improve not only the health of vulnerable infants and young children, but also the trajectory of aspects of their well-being and the health of their mothers.

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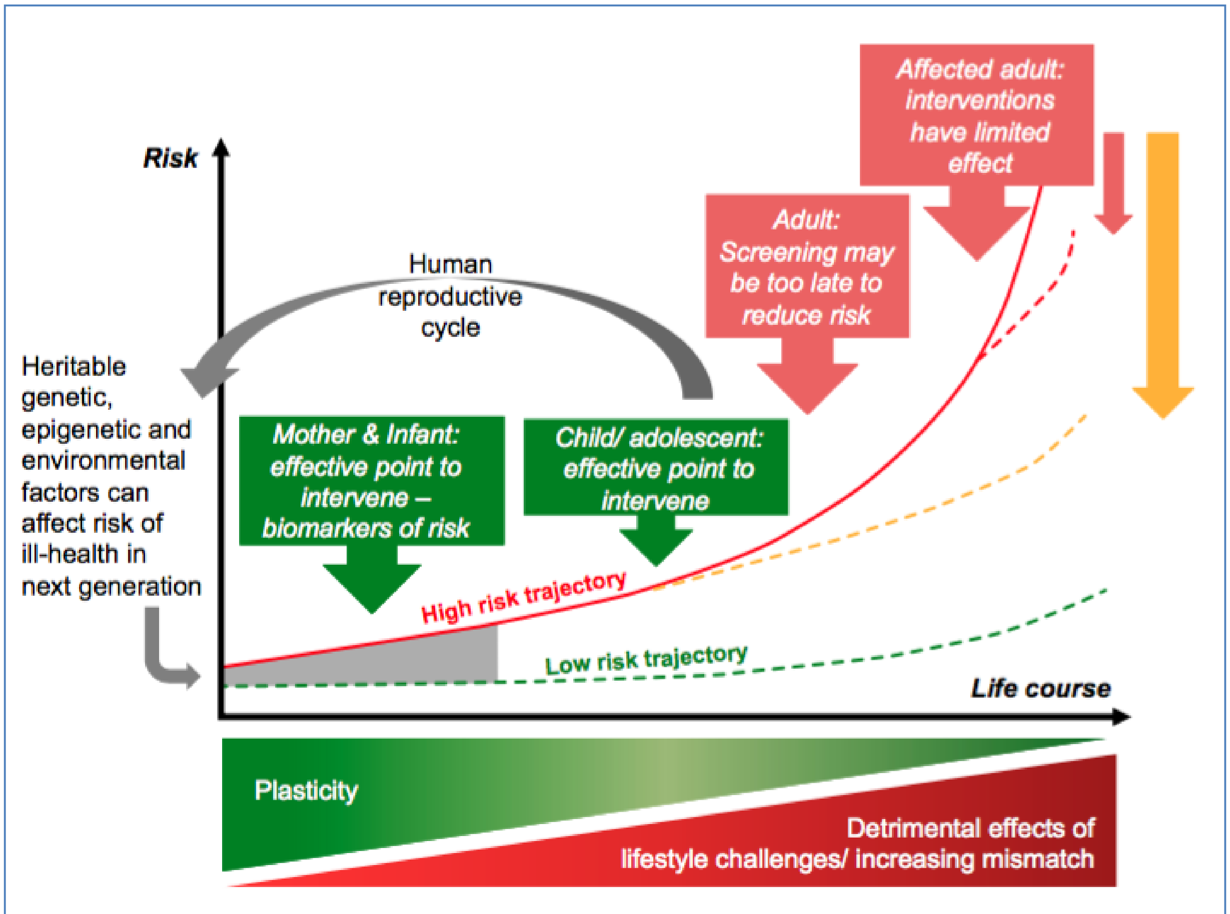

Physiol Rev 94: 1027–1076, 2014

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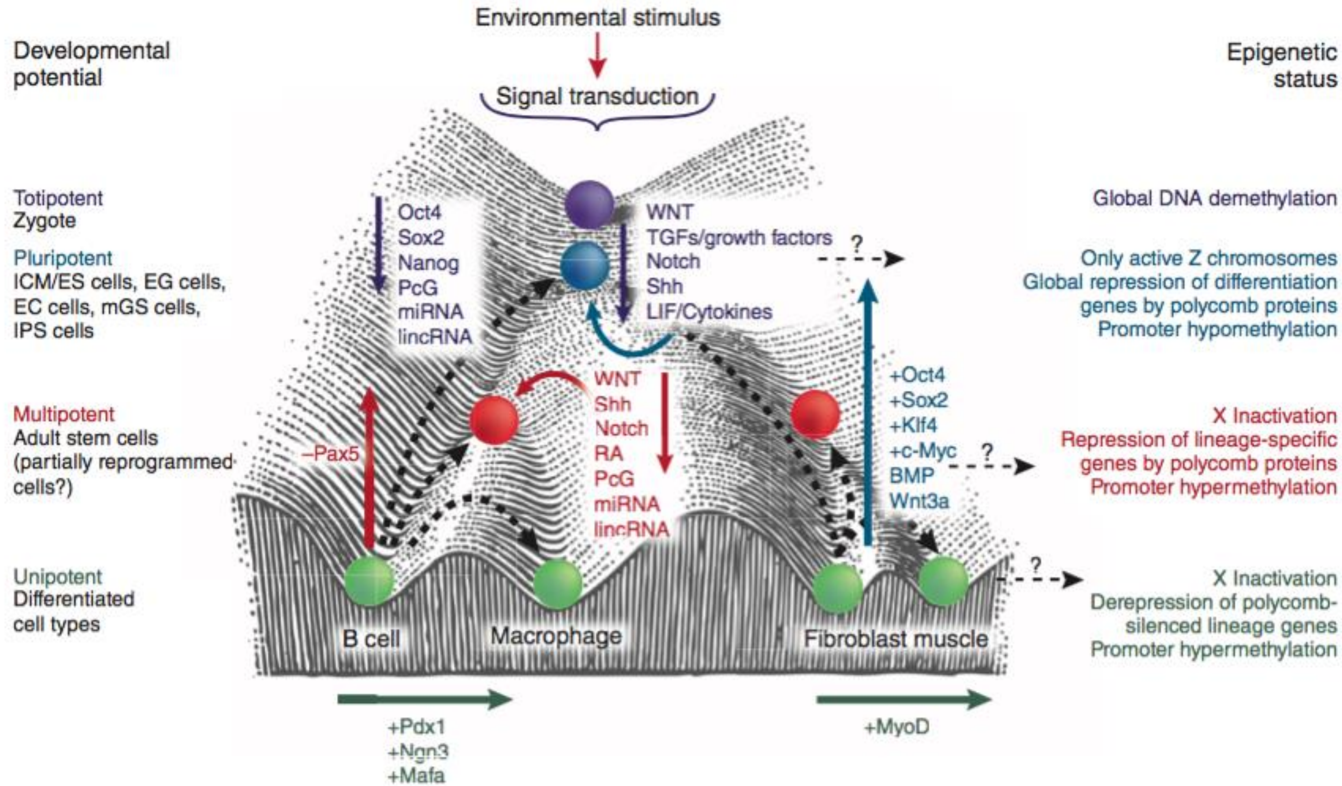
Linking cell signaling and the epigenetic machinery

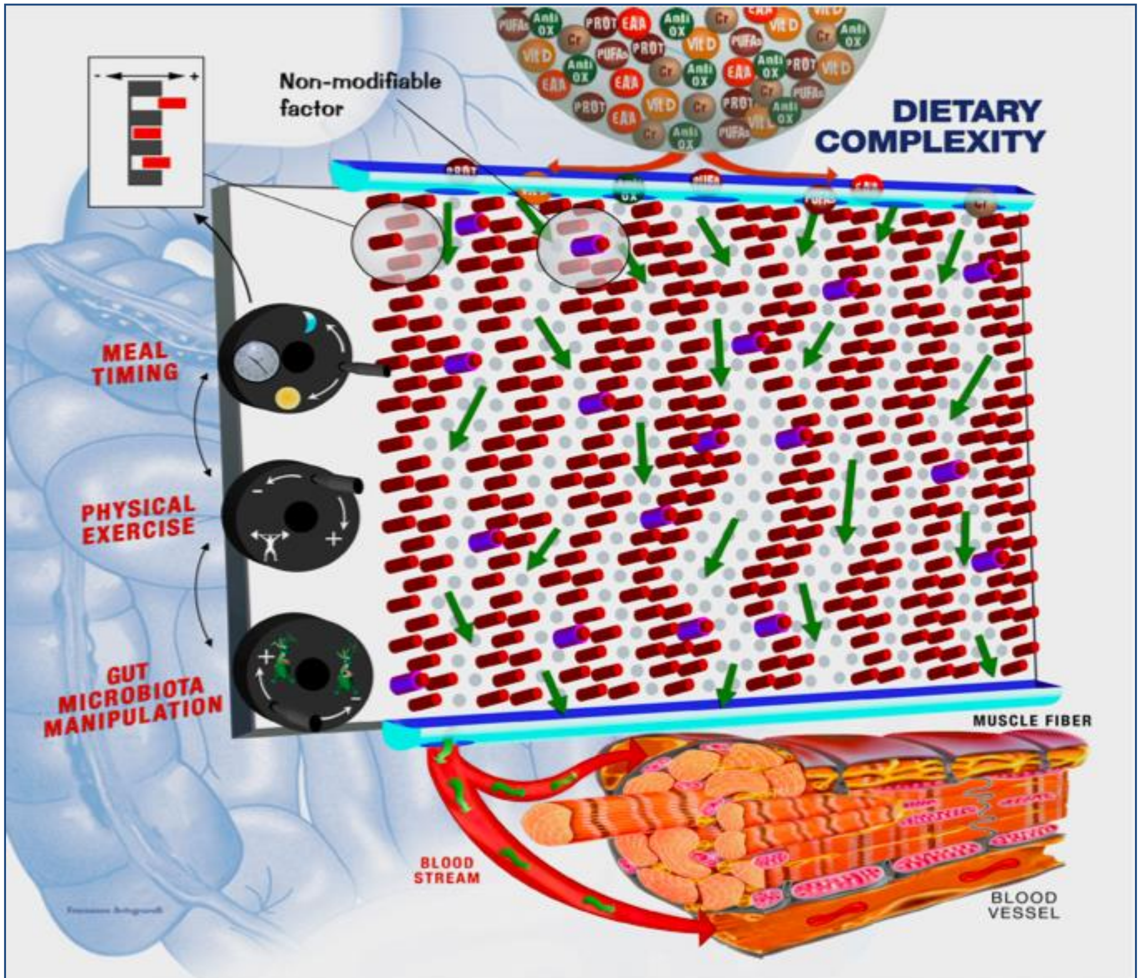
Helai P Mohammad & Stephen B Baylin

nature biotechnology



CURRENT NUTRITIONAL RECOMMENDATIONS AND NOVEL DIETARY STRATEGIES TO MANAGE SARCOPENIA

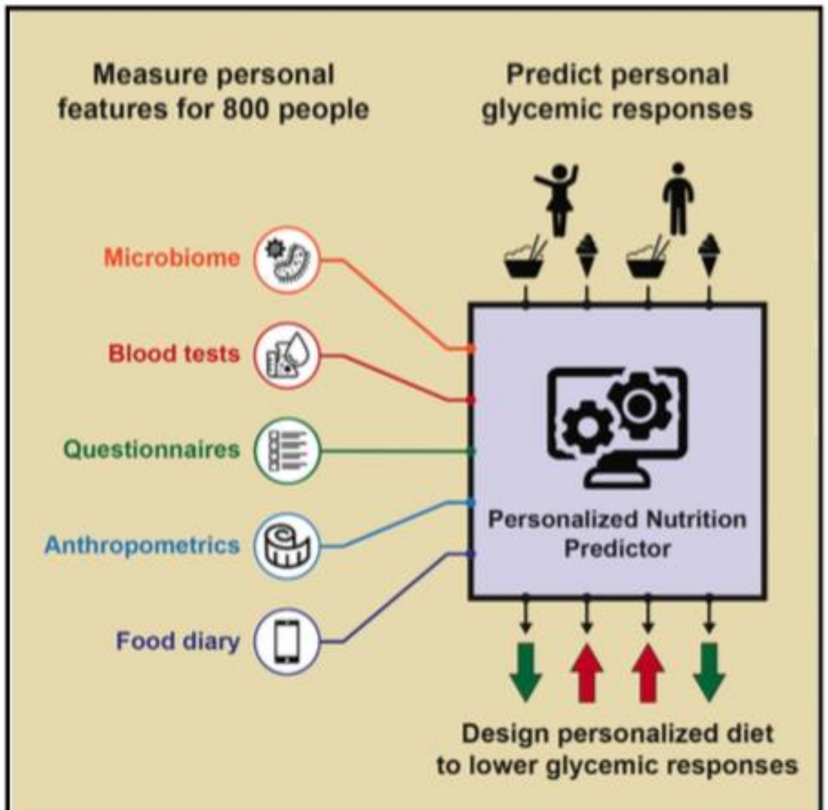
R. CALVANI[1], A. MICCHELI[2], F. LANDI[3], M. BOSSOLA[4], M. CESARI[5], C. LEEUWENBURGH[6], C.C. SIEBER[7], R. BERNABEI[3], E. MARZETTI[3]



Cell

Personalized Nutrition by Prediction of Glycemic Responses

Graphical Abstract



Authors

David Zeevi, Tal Korem, Niv Zmora, ..., Zamir Halpern, Eran Elinav, Eran Segal

Correspondence

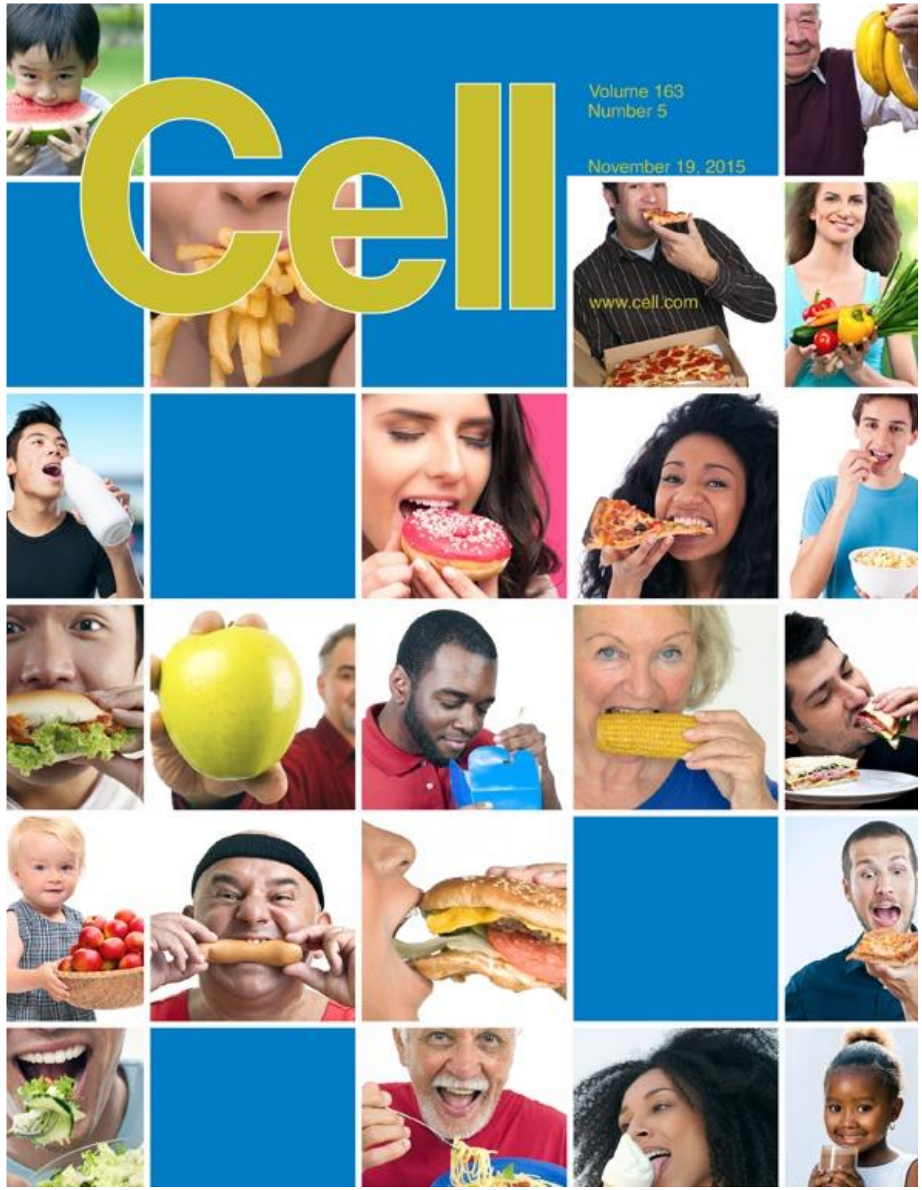
eran.elinav@weizmann.ac.il (E.E.), eran.segal@weizmann.ac.il (E.S.)

In Brief

People eating identical meals present high variability in post-meal blood glucose response. Personalized diets created with the help of an accurate predictor of blood glucose response that integrates parameters such as dietary habits, physical activity, and gut microbiota may successfully lower post-meal blood glucose and its long-term metabolic consequences.

Cell *163*, 1079–1094, November 19, 2015

Take Home Message



"I have had to eat my own words many times, and I have found it a very nourishing diet."

Sir Winston Churchill

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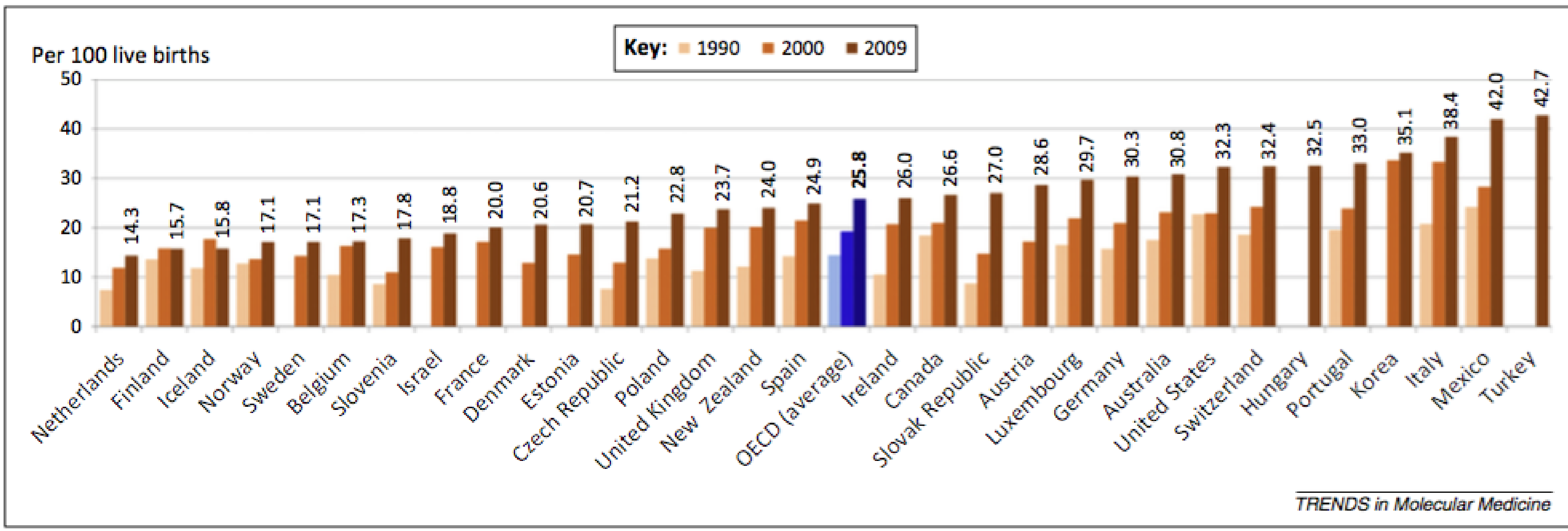
Special Issue: Nurturing the Next Generation

The infant microbiome development: mom matters

Noel T. Mueller[1,2], Elizabeth Bakacs[3], Joan Combellick[4], Zoya Grigoryan[3], and Maria G. Dominguez-Bello[3]

Trends in Molecular Medicine



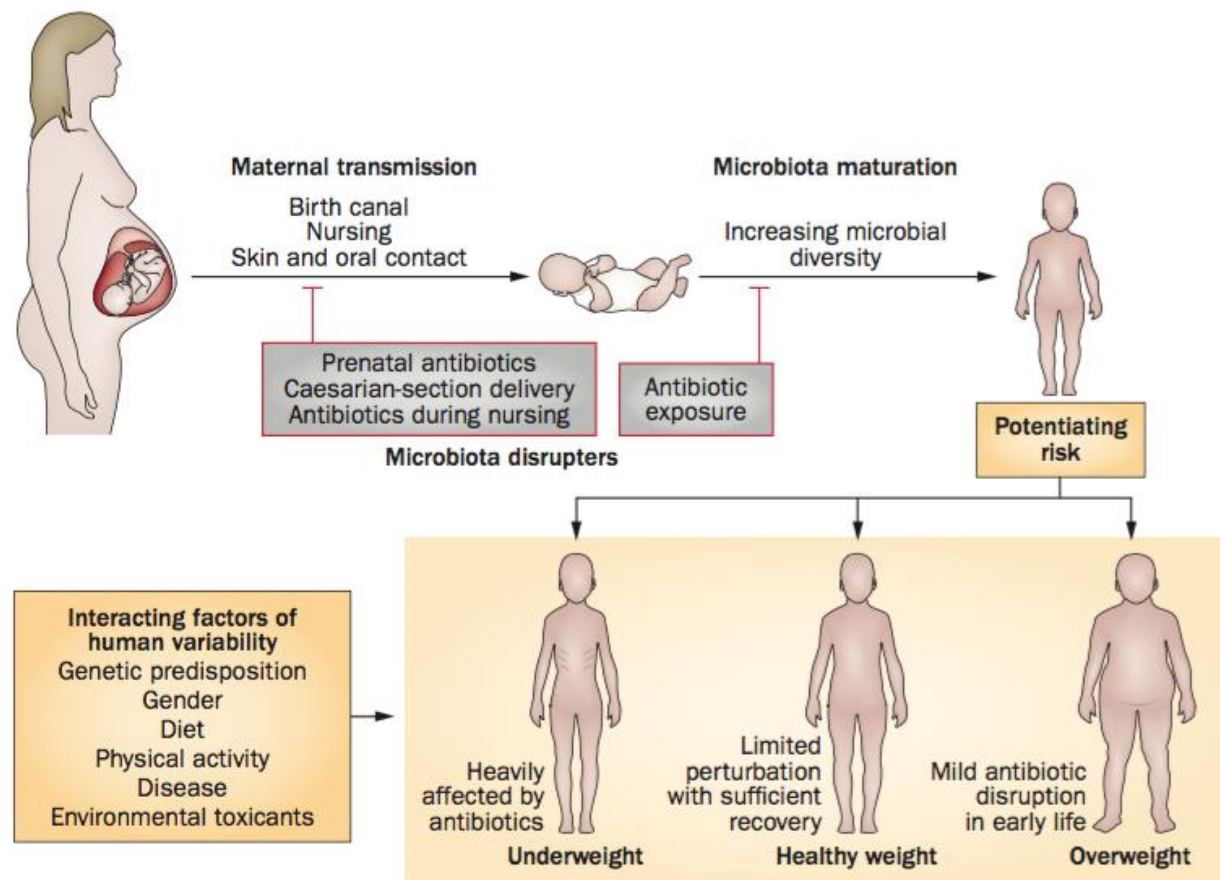
Trends in Molecular Medicine, February 2015, Vol. 21, No. 2

OPINION

Antibiotics in early life and obesity

Laura M. Cox and Martin J. Blaser

nature REVIEWS ENDOCRINOLOGY



Nat. Rev. Endocrinol. advance online publication 9 December 2014;

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Special Issue: Nurturing the Next Generation

The infant microbiome development: mom matters

Noel T. Mueller[1,2], Elizabeth Bakacs[3], Joan Combellick[4], Zoya Grigoryan[3], and Maria G. Dominguez-Bello[3]

Trends in Molecular Medicine

Perturbation to microbiome assembly	Prevention strategies	Restoration approaches
C-section delivery	Support efforts to increase use of midwives Champion evidence-based labor management Optimize managing labor (reduce pain, increase maternal comfort) Educate women about the potential consequences of C-section delivery Change policies around physician incentives and malpractice insurance	Inoculation of neonate with maternal vaginal flora immediately following C-section delivery Breastfeeding Pre- and probiotic supplementation of neonate
Gestational, perinatal, or postnatal antibiotics	Implement robust antimicrobial stewardship programs (http://www.whitehouse.gov/the-press-office/2014/09/18/executive-order-combating-antibiotic-resistant-bacteria) Develop safe strategies that limit use of antibiotics in women in labor (e.g., rapid PCR testing for group B *Streptococcus* at the time of admission to the delivery unit) During C-section delivery, give antibiotics after cord clamping to eliminate fetal exposure to antibiotics Use more prudency in antibiotic administration during pregnancy	Breastfeeding Pre- and probiotic supplementation of mother during pregnancy and neonate after birth
Formula feeding	Adopt WHO/UNICEF Baby Friendly Hospital Initiative Develop other policies that incentivize breastfeeding Do not offer formula to newborns without request or medical indication Promote use of donor breast milk rather than formula when maternal milk is not an option	Reintroduce breastfeeding Pre- and probiotic supplementation

Trends in Molecular Medicine, February 2015, Vol. 21, No. 2

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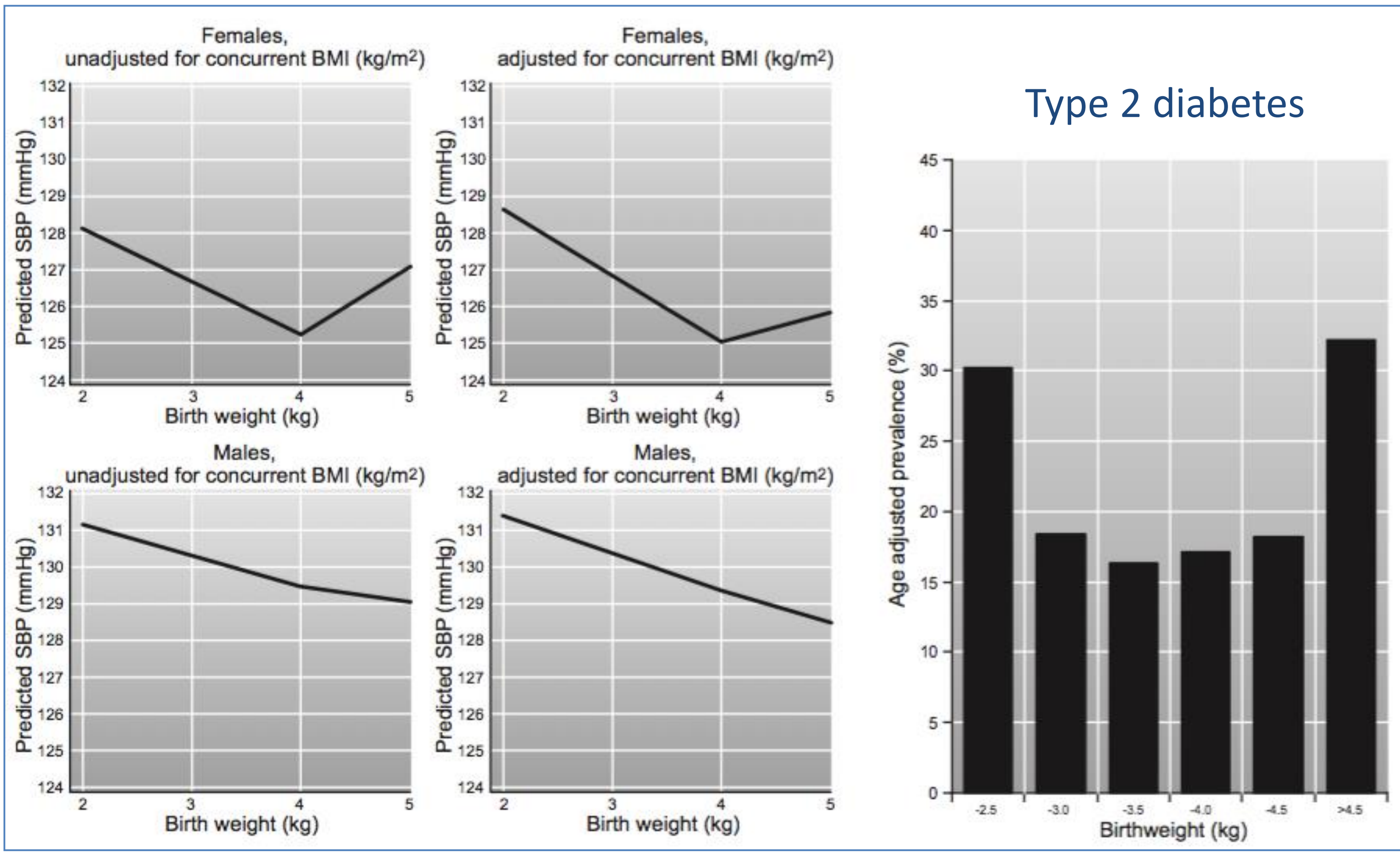
M. A. Hanson and P. D. Gluckman

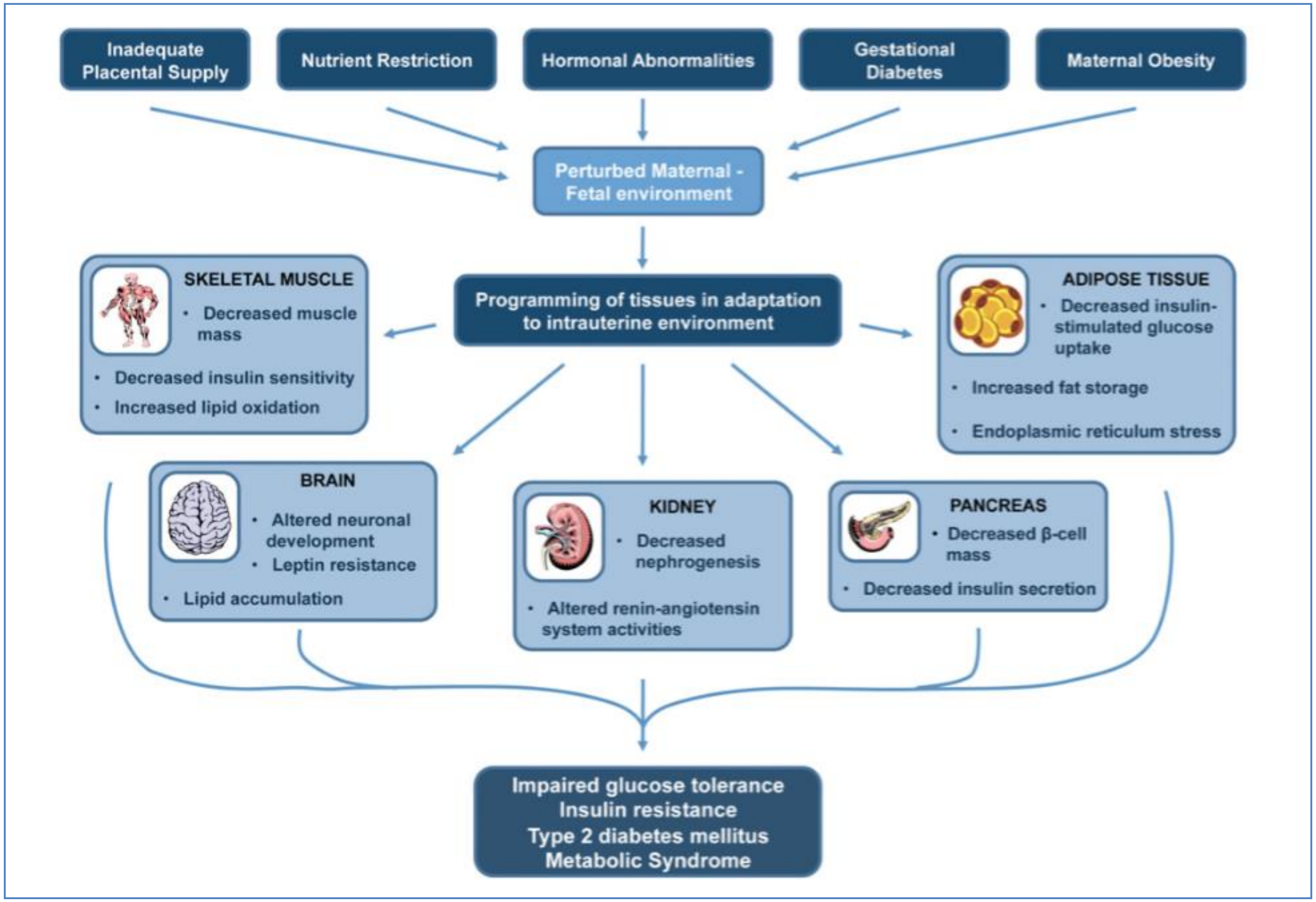


Biochem. J. (2010) 427, 333–347 (Printed in Great Britain) doi:10.1042/BJ20091861

REVIEW ARTICLE

Mechanisms involved in the developmental programming of adulthood disease

Matthew J. WARNER and Susan E. OZANNE[1]



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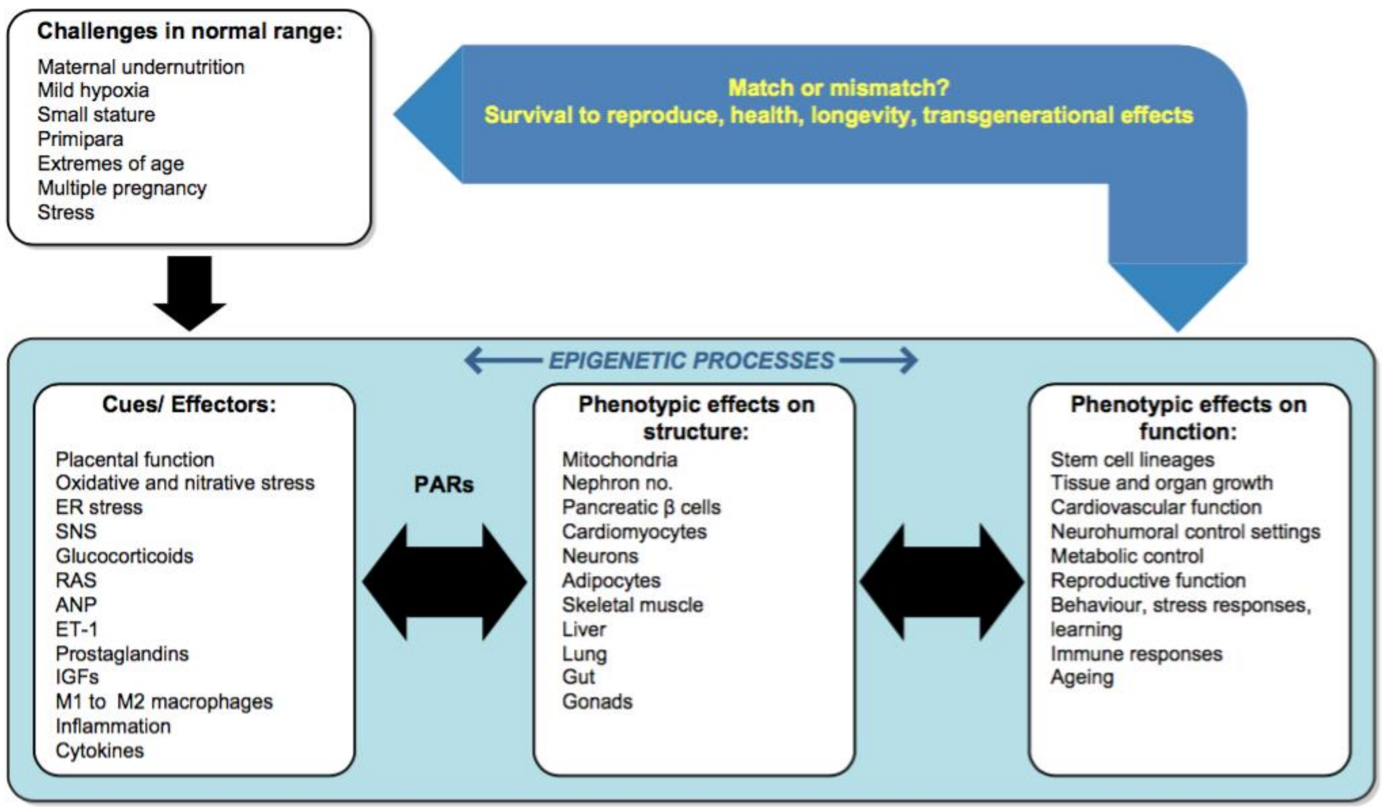
EARLY DEVELOPMENTAL CONDITIONING OF LATER HEALTH AND DISEASE: PHYSIOLOGY OR PATHOPHYSIOLOGY?

M. A. Hanson and P. D. Gluckman

PHYSIOLOGICAL ADAPTIVE PROCESSES IN DEVELOPMENTAL CONDITIONING



nature International weekly journal of science

Don’t blame the mothers

Careless discussion of epigenetic research on how early life affects health across generations could harm women, warn **Sarah S. Richardson** and colleagues.

14 AUGUST 2014 | VOL 512 | NATURE | 131

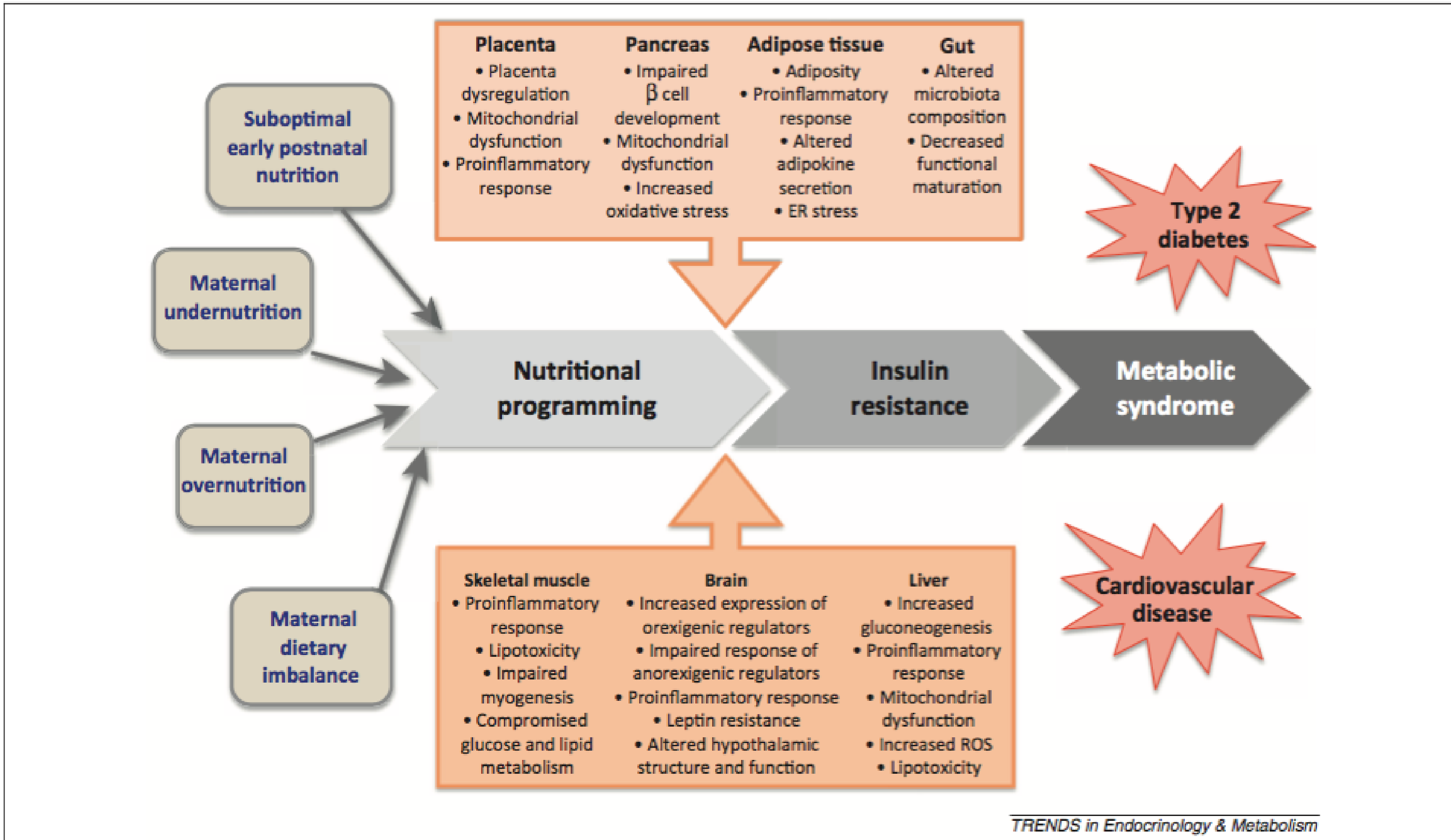
Congresso Nazionale 60° — Napoli 25-28 Novembre 2015

Università Cattolica del Sacro Cuore

Nutritional programming of insulin resistance: causes and consequences

Daniella E. Duque-Guimarães and Susan E. Ozanne

Trends in Endocrinology & Metabolism

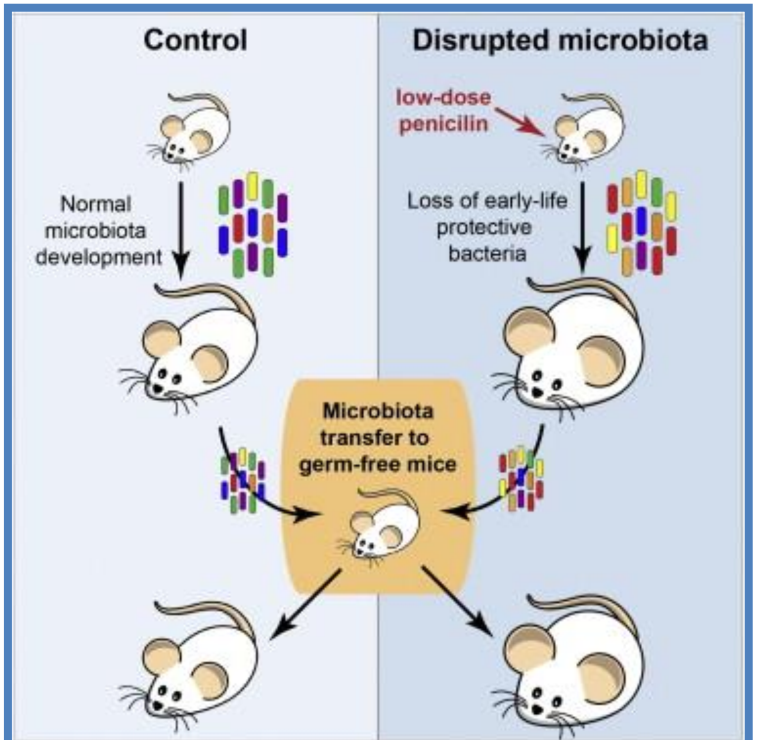


CONGRESSO NAZIONALE 60
NAPOLI 25-28 Novembre 2015

UNIVERSITÀ CATTOLICA del Sacro Cuore

Altering the Intestinal Microbiota during a Critical Developmental Window Has Lasting Metabolic Consequences

Laura M. Cox,[1,2] Shingo Yamanishi,[2] Jiho Sohn,[2] Alexander V. Alekseyenko,[2,3] Jacqueline M. Leung,[1] Ilseung Cho,[2] Sungheon G. Kim,[4] Huilin Li,[5] Zhan Gao,[2] Douglas Mahana,[1] Jorge G. Zárate Rodriguez,[7] Arlin B. Rogers,[6] Nicolas Robine,[8] P'ng Loke,[1] and Martin J. Blaser[1,2,9,*]

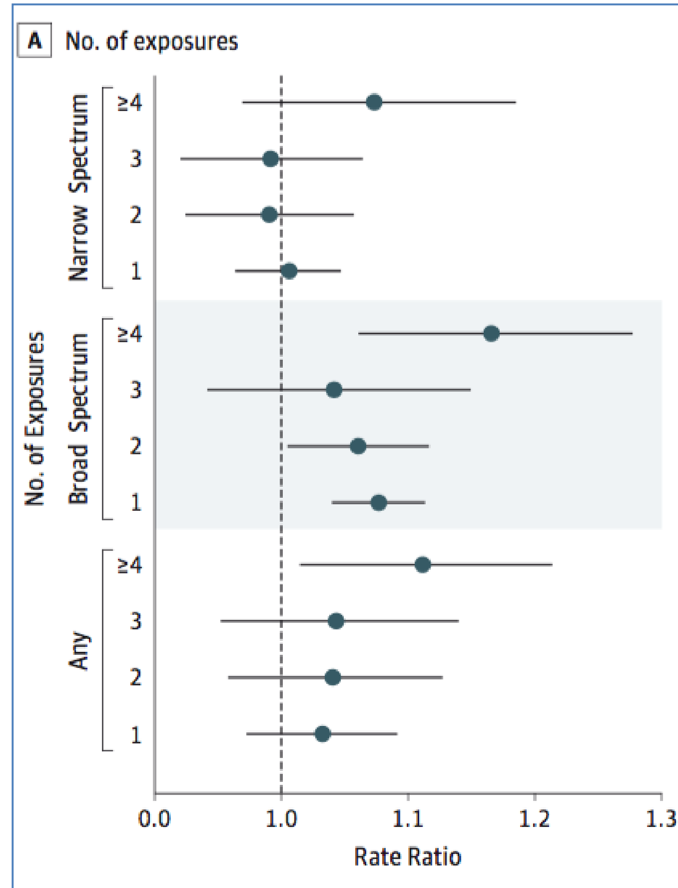


Cell 158, 705–721, August 14, 2014

Original Investigation

Association of Antibiotics in Infancy With Early Childhood Obesity

L. Charles Bailey, MD, PhD; Christopher B. Forrest, MD, PhD; Peixin Zhang, PhD; Thomas M. Richards, MS; Alice Livshits, BS; Patricia A. DeRusso, MD, MS



JAMA Pediatr. doi:10.1001/jamapediatrics.2014.1539
Published online September 29, 2014.

CONGRESSO NAZIONALE 60

NAPOLI 25-28 Novembre 2015

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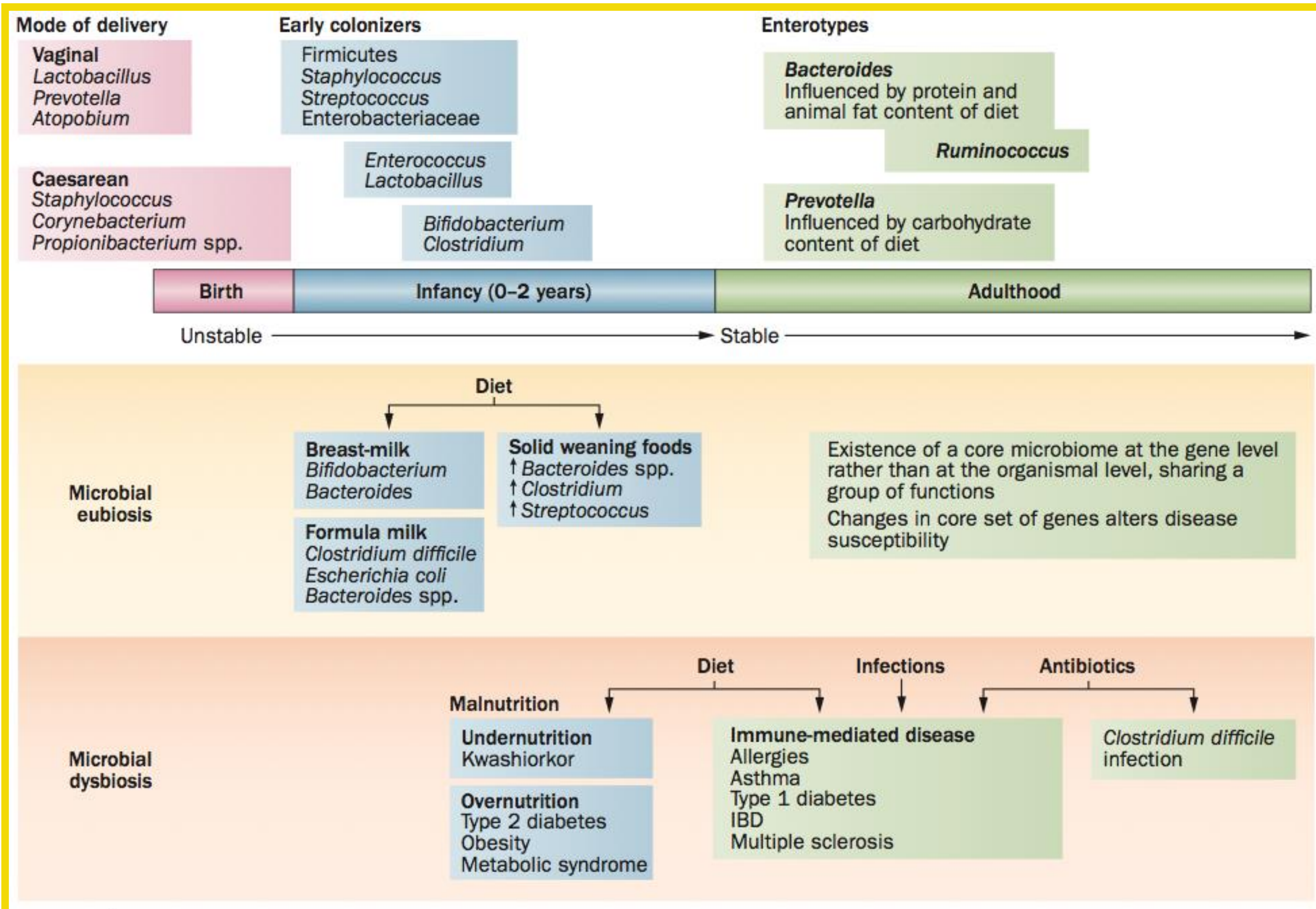
Diet and host–microbial crosstalk in postnatal intestinal immune homeostasis

Nitya Jain and W. Allan Walker

nature REVIEWS GASTROENTEROLOGY & HEPATOLOGY

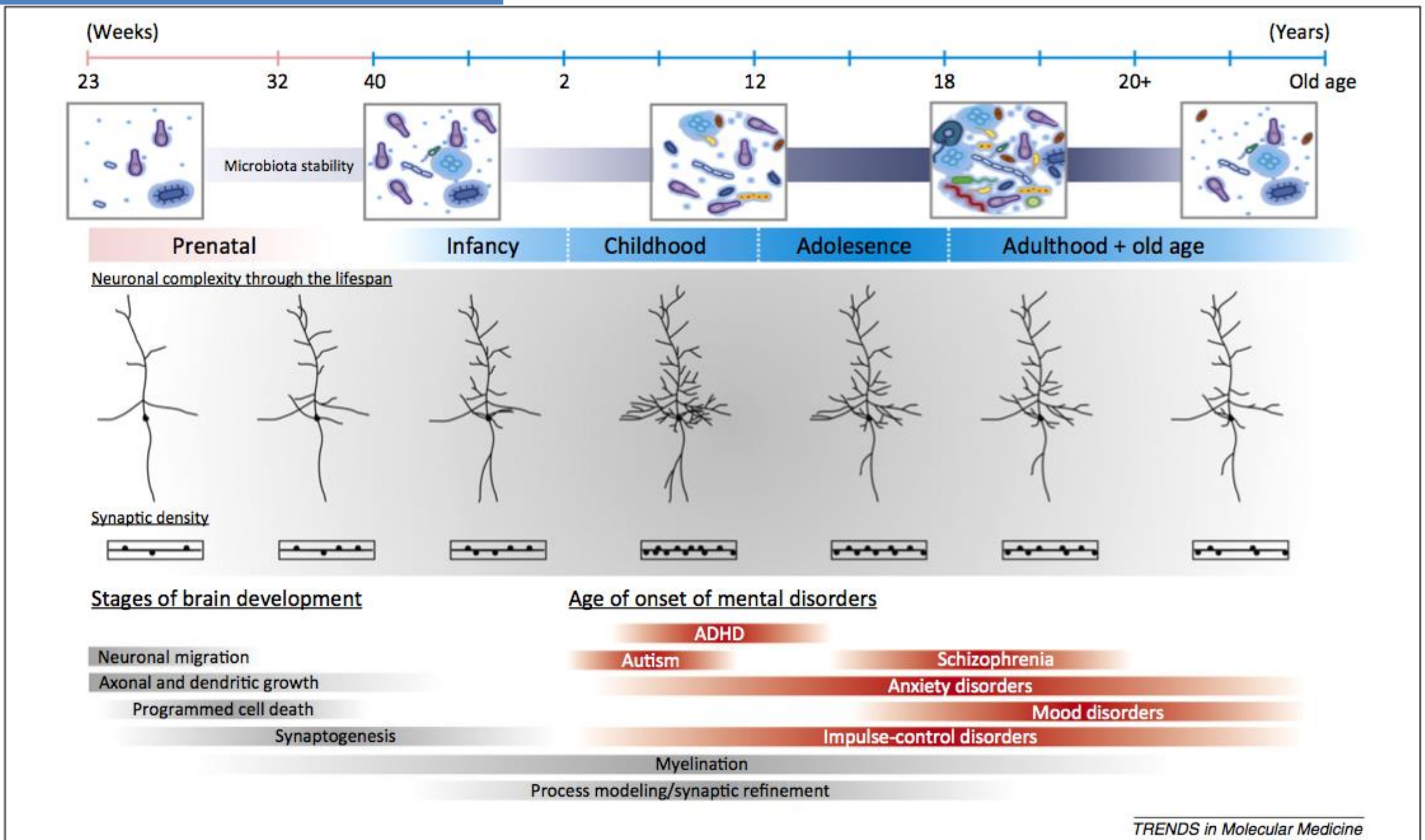


Nat. Rev. Gastroenterol. Hepatol. 12, 14–25 (2015);

Microbiota and neurodevelopmental windows: implications for brain disorders

Yuliya E. Borre[1], Gerard W. O'Keeffe[2,3], Gerard Clarke[1,4], Catherine Stanton[4,5], Timothy G. Dinan[1,4], and John F. Cryan[1,2]

Trends in Molecular Medicine



Trends in Molecular Medicine, September 2014, Vol. 20, No. 9

Special Issue: Systems Approach to Metabolic Disease

Review

Linking Microbiota to Human Diseases: A Systems Biology Perspective

Hao Wu,[1,‡] Valentina Tremaroli,[1,‡] and Fredrik Bäckhed[1,2,*]

Outstanding Questions

What is a healthy microbiome? What are the roles of trans-kingdom interactions between bacteria, viruses, and fungi for immune and metabolic homeostasis? Longitudinal studies are required to characterize the dynamic changes of the normal gut microbiota.

How can we correct an aberrant gut microbiota to promote health and prevent disease?

What are the mechanistic links between an altered gut microbiota and a specific human disease? Systems biology (omics) approaches need to be integrated to expand current knowledge.

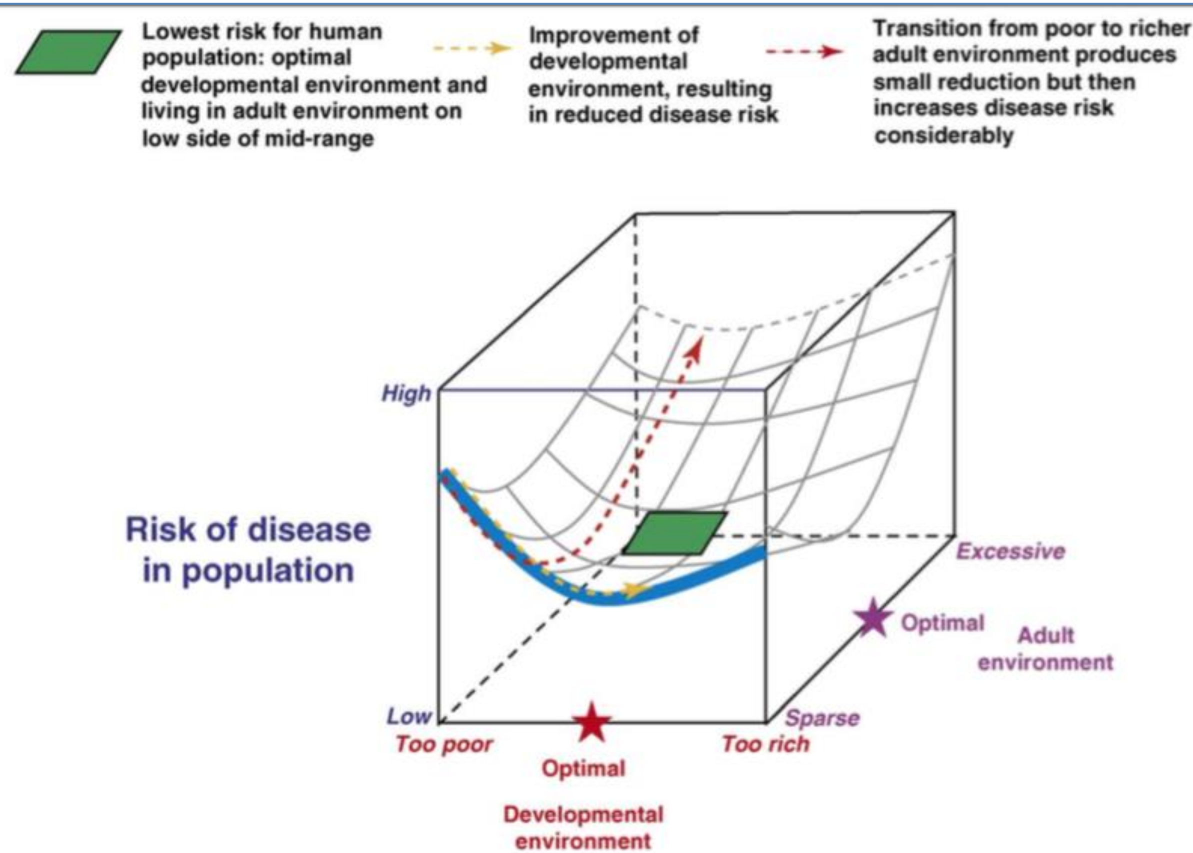
What is the composition of the microbiome in defined microniches within the human intestine? Do site-specific communities play a role in human–microbe interactions in health and disease?

Trends in Endocrinology & Metabolism

Trends in Endocrinology & Metabolism

Developmental origins of metabolic disease: life course and intergenerational perspectives

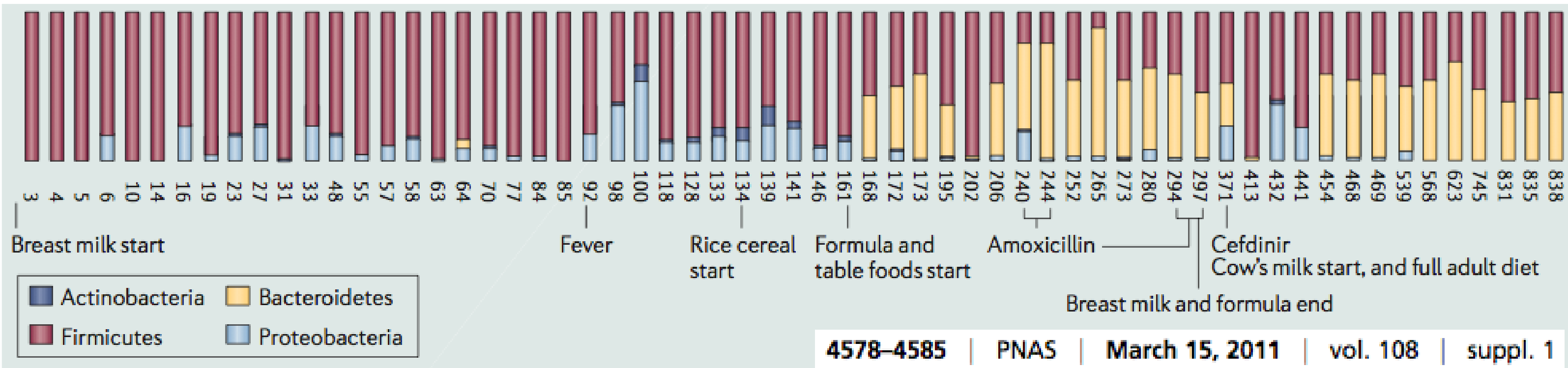
Keith M. Godfrey[1,2,3], Peter D. Gluckman[4,5] and Mark A. Hanson[1,2]

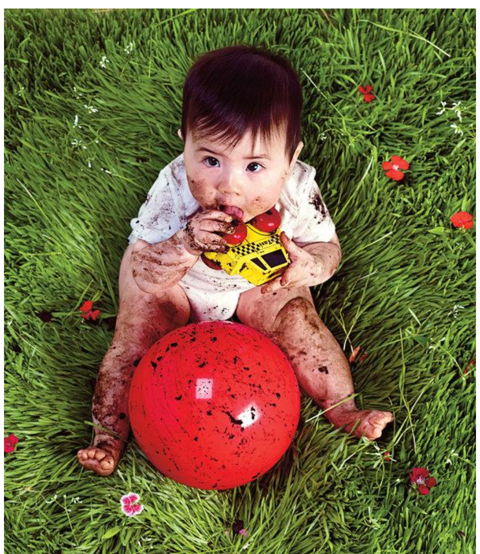


Trends in Endocrinology and Metabolism Vol.21 No.4

Succession of microbial consortia in the developing infant gut microbiome

Jeremy E. Koenig[a], Aymé Spor[a], Nicholas Scalfone[a], Ashwana D. Fricker[a], Jesse Stombaugh[b], Rob Knight[b,c], Largus T. Angenent[d], and Ruth E. Ley[a,1]





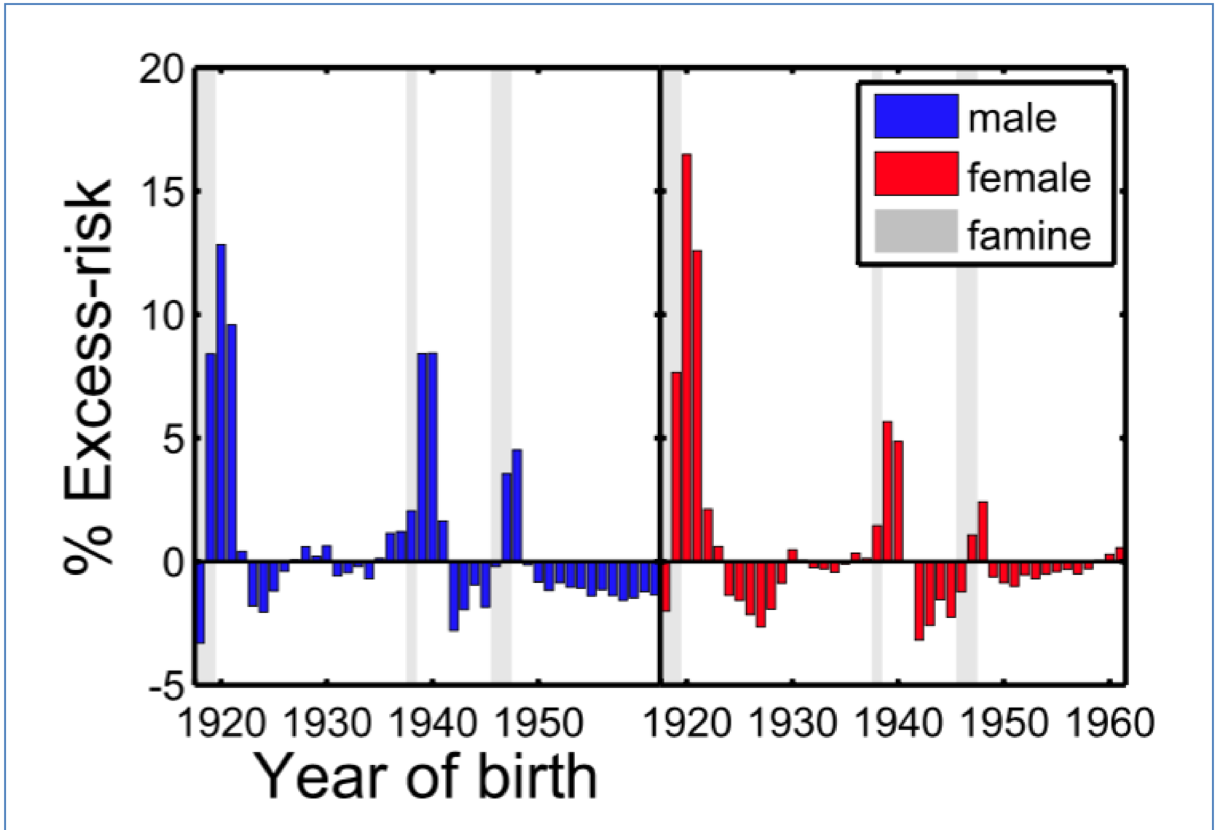
Genetically dictated change in host mucus carbohydrate landscape exerts a diet-dependent effect on the gut microbiota

Purna C. Kashyap[a,b], Angela Marcobal[a], Luke K. Ursell[c], Samuel A. Smits[a], Erica D. Sonnenburg[a], Elizabeth K. Costello[a], Steven K. Higginbottom[a], Steven E. Domino[d], Susan P. Holmes[e], David A. Relman[a,f,g], Rob Knight[c], Jeffrey I. Gordon[h], and Justin L. Sonnenburg[a,1]

www.pnas.org/cgi/doi/10.1073/pnas.1306070110

Quantification of excess risk for diabetes for those born in times of hunger, in an entire population of a nation, across a century

Stefan Thurner[a,b,c,1], Peter Klimek[a], Michael Szell[a,d], Georg Duftschmid[e], Gottfried Endel[f], Alexandra Kautzky-Willer[g], and David C. Kasper[h]



PNAS | March 19, 2013 | vol. 110 | no. 12 | 4703–4707

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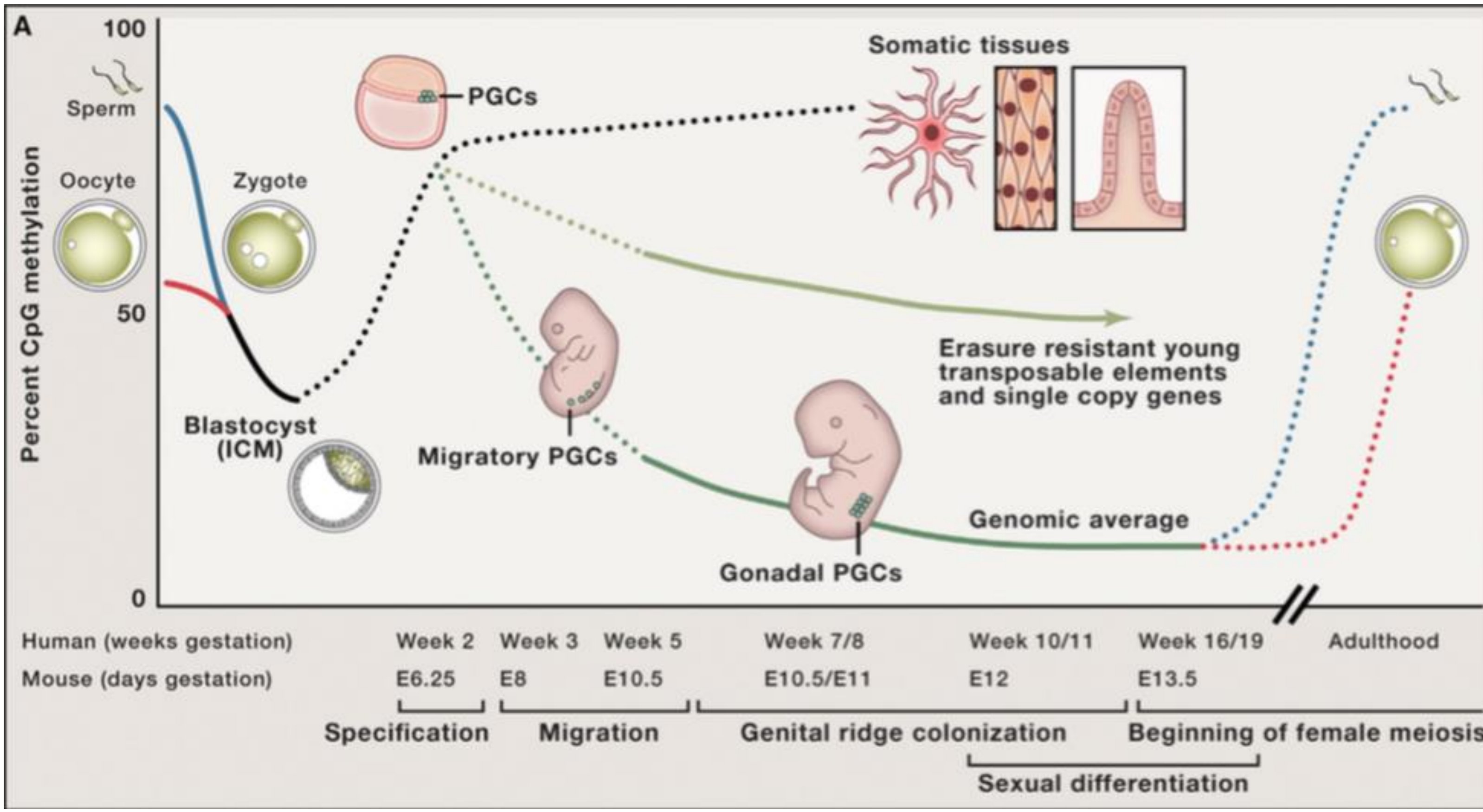
Forget the Parents: Epigenetic Reprogramming in Human Germ Cells

Ferdinand von Meyenn[1,*] and Wolf Reik[1,2,3,*]

Cell

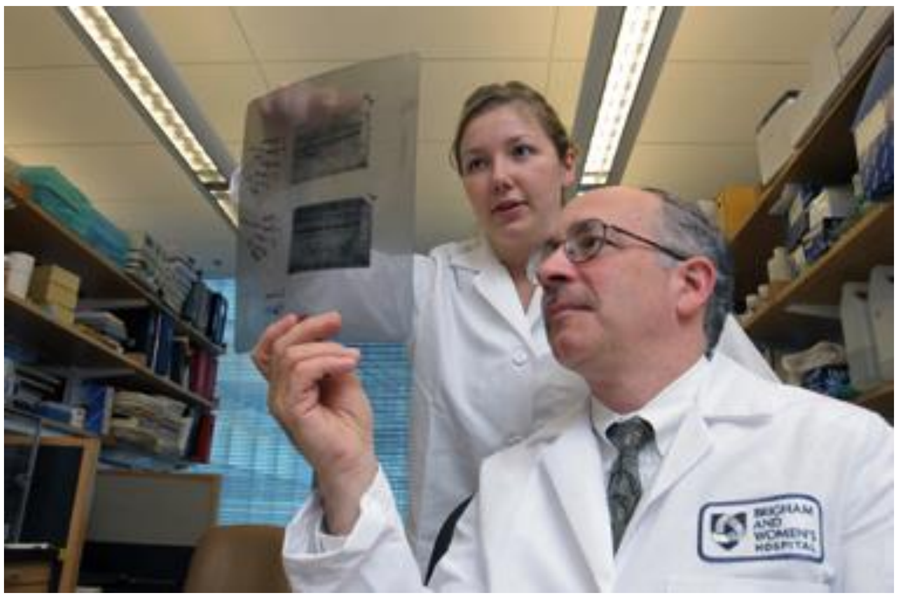


Cell *161*, June 4, 2015


Environment Special:
The oceans—why 70% of our planet is in danger
The Facebook Movie:
The secret history of social networking
TIME
How the first nine months shape the rest of your life
The new science of fetal origins

Gut Microbiota, the Genome, and Diet in Atherogenesis

Joseph Loscalzo, M.D., Ph.D.



"… Genes and environmental factors interact in myriad ways to modulate and modify the biology of all living organisms, challenging the notion that these two principal determinants of phenotype can ever truly act independently of each other…"

N ENGL J MED 368;17 NEJM.ORG APRIL 25, 2013

The Journal of Nutrition, Health & Aging©
Volume 16, Number 7, 2012

BIRTH WEIGHT AND MUSCLE STRENGTH: A SYSTEMATIC REVIEW AND META-ANALYSIS

R. DODDS[1,2,3], H.J. DENISON[3], G. NTANI[3], R. COOPER[4], C. COOPER[3], A.A. SAYER[2,3], J. BAIRD[3]

JNHA The Journal of Nutrition, Health & Aging

Stratification	No. of data points*	Increase in grip strength (kg) per 1 kg increase in birth weight (95% CI)	I^2 (%)	P value**
None	14	0.86 (0.58 to 1.15)	56.2	0.005
Gender				
Female	12	0.81 (0.59 to 1.02)	3.0	0.415
Male	12	0.96 (0.49 to 1.44)	58.8	0.005
Mean age (years)				
< 21	4	0.48 (0.05 to 0.92)	57.1	0.072
21 – 40	6	1.16 (0.85 to 1.46)	0.0	0.436
> 40	4	1.09 (0.67 to 1.51)	36.7	0.192
Study setting				
Developing	3	0.41 (0.05 to 0.77)	0.0	0.788
Developed	11	0.96 (0.66 to 1.26)	54.4	0.016
Risk of bias				
Low	8	0.86 (0.49 to 1.24)	72.6	<0.001
Medium	6	0.92 (0.52 to 1.31)	0.0	0.553

*Note there are 14 data points in gender-adjusted models as for one study (Ortega et al) we only had separate results for males and females. ** From Q-statistic

EPIGENETICS

The epigenome–a family affair

Epigenome disruptions can be transmitted as altered histone modification patterns in sperm