




Annual Meeting of the NASPGHAN

Chicago, ILL
October 10-13, 2013

Keynote Lecture:
“Nutrients in the Perinatal Environment: Lessons Learned”

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Boston, MA

Disclosure Statement

Dr. Allan Walker has disclosed the information listed below. Any real or apparent conflict of interest related to the content of the presentation has been resolved

<u>Organization Name</u>	<u>Affiliation/financial interest</u>
Dannon/Yakult International	Scientific Advisory Board
Mead Johnson Nutritionals	Research Grant & Scientific Advisory Board
NUTEK Inc.	Scientific Advisory Board

Perinatal Nutrition

Lecture outline:

- New “hygiene hypothesis”
- Diet and disease “burden”
- Diet and microbiota
- Microbiota and disease
- Preconception and intrauterine nutrition
- Neonatal nutrition
- Clinical consequences
- Summary and conclusions

Perinatal Nutrition

Lecture outline:

- New “hygiene hypothesis”

The “Hygiene Hypothesis” has Evolved Into A New Paradigm

“**Western Society Nutrition** and the effects it has on **gut colonization** and **immune responses** are an increasingly likely explanation for the greater incidence of inflammatory diseases such as **asthma** and **type-1 diabetes** in developed countries”

Nature Immunology 12:5-9, 2011

Perinatal nutritional programming: A convergence of the “hygiene” and “fetal programming” hypotheses

“Accumulating evidence suggests that **nutrition** during pregnancy and early postnatal life is one of the most important environmental cues that programs microbiological, metabolic and immunologic development which in turn influences long-term health”

from Utrecht, Netherlands Symposium “*Bringing Science to Early Life Nutrition*”

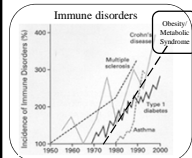
Am J Clin Nutr. 2013; 98(suppl):586S-593S

Perinatal Nutrition

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- New “hygiene hypothesis”
- Diet and disease “burden”

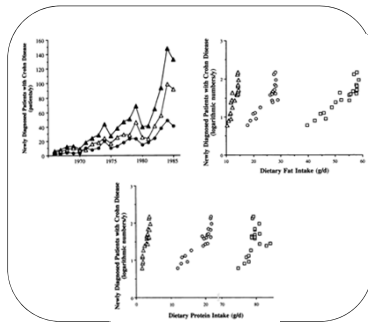
Does Diet Affect “Disease Burden”?



New Engl J Med 2002;347:911-920

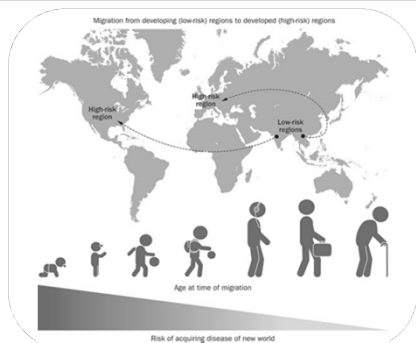


Science September 2012



Am J Clin Nutr. 1996;63:741-5

Acquired “Western Lifestyle” (Nutrition) Affects Disease Expression In Immigrants



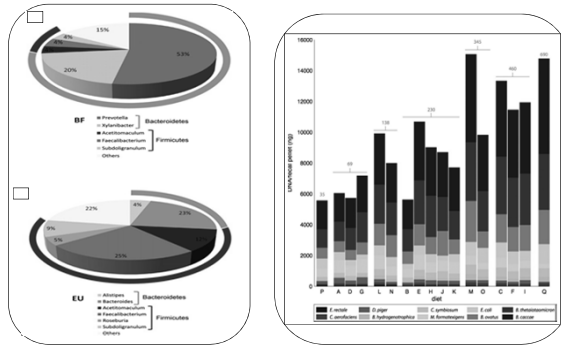
Nat Rev Gastroenterol Hepatol. 2012;9:609-14

Perinatal Nutrition

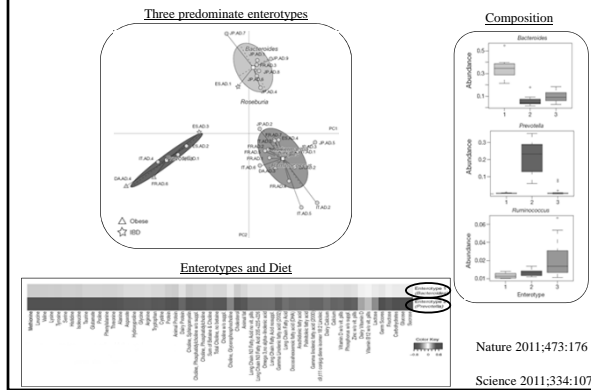
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Diet And Its Effects On Gut Microbiota



Diet And Its Effects On Gut Microbiota



Perinatal Nutrition

Lecture outline:

- New “hygiene hypothesis”
- Diet and disease “burden”
- Diet and microbiota
- Microbiota and disease

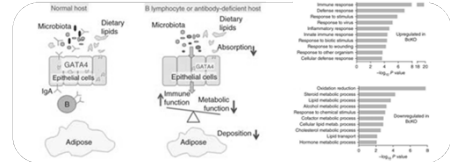
Triologue Between Commensals, Gut Associated Immune Tissue And Intestinal Epithelium



Nat Rev Gastroenterol Hepatol. 2012;9:609-14

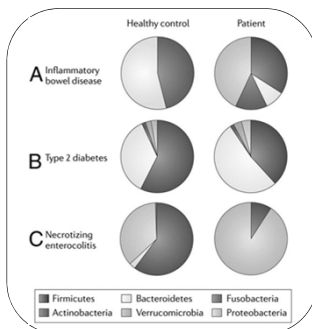
Science. 2010;328:228-31

Immunological Effect



Nat Med. 2011;17:1585-93

Dybiosis in Clinical Disease

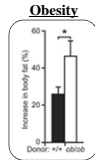


Pediatrics. 2012;129:950-60

Microbiota As An "Intermediate" In Disease Expression

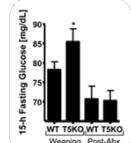


Nat Rev Gastroenterol Hepatol. 2012;9:609-14



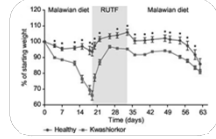
Nature. 2006;444:1027-31

Metabolic Syndrome



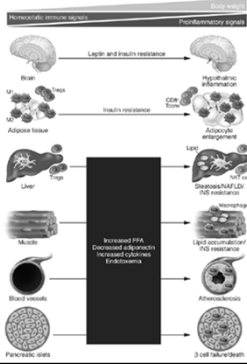
Science. 2010;328:228-31

Kwashiorkor



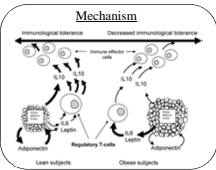
Science. 2013;339:548-54

Inflammatory Links Between Obesity And Metabolic Disease

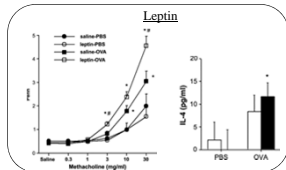


J Clin Invest. 2011;121:2111-7

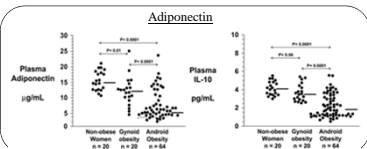
Relationship Between Obesity And Allergic Disease



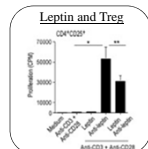
Allergy. 2007;62:1205-13.



J Allergy Clin Immunol. 2005;115:103-9



J Clin Endocrinol Metab. 2005;90:5876-9



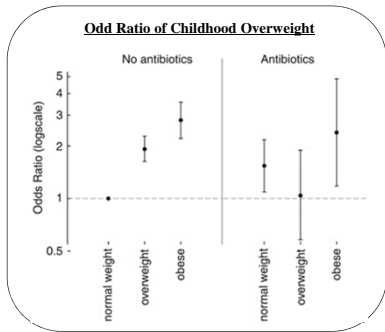
Immunity. 2007;26:241-55

Perinatal Nutrition

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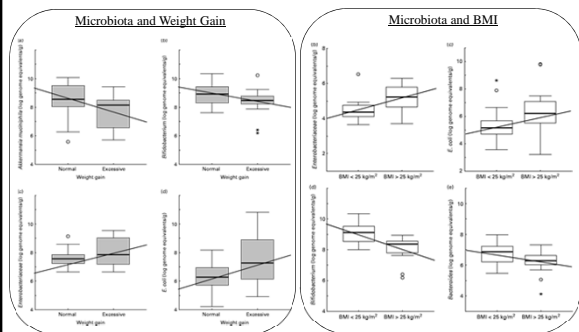
- New “hygiene hypothesis”
- Diet and disease “burden”
- Diet and microbiota
- Microbiota and disease
- Preconception and intrauterine nutrition

What Is The Impact Of Maternal Pre-conception BMI On Childhood Obesity?



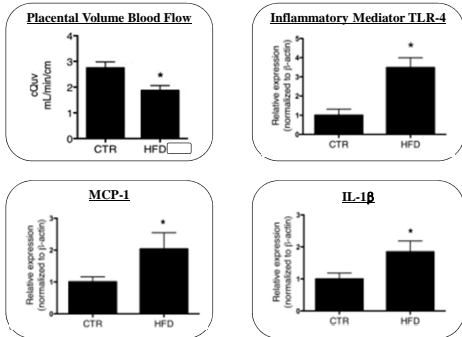
Int J Obes (Lond). 2011;35:522-9

Gut Microbiota In Pregnant Women: Role Of Weight Gain and BMI



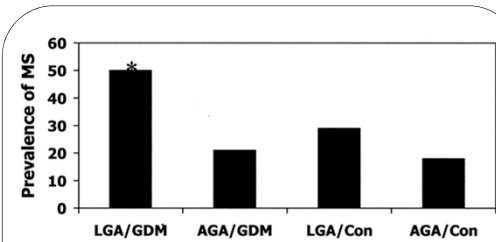
Br J Nutr. 2010;104:83-92

Role Of High Fat Obesogenic Diet On Placental Hemodynamics And Stillbirth



Endocrinology. 2011;152:2456-64

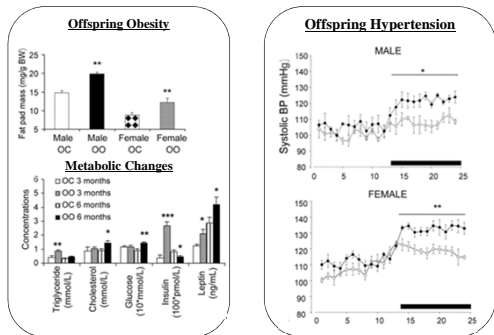
Metabolic Syndrome In Childhood: Role of Birth Weight and Gestational Diabetes



LGA – Large For Gestational Age
MS – Metabolic Syndrome
AGA – Appropriate For Gestational Age
GDM – Gestational Diabetes Mellitus

Pediatrics. 2005;115:e290-6

Diet-Induced Obesity During Pregnancy Results In Offspring Obesity And Hypertension

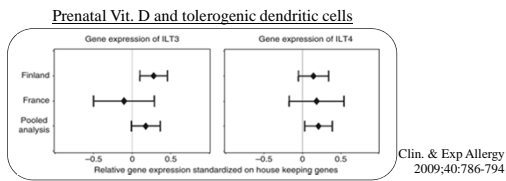
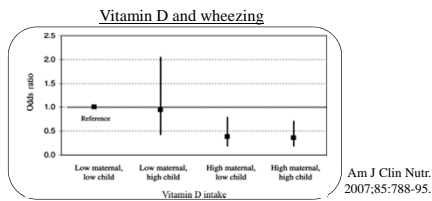


Hypertension. 2008;51:383-92

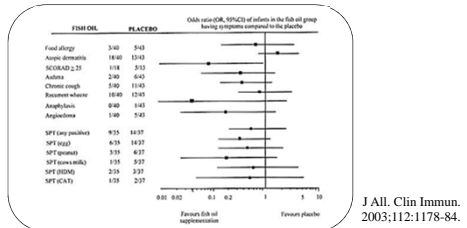
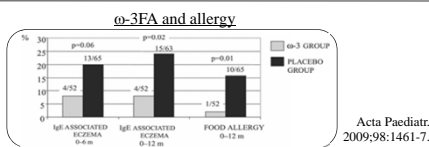
Intrauterine Nutrition: Immunoprogammung effect

- Vitamin D
- Omega 3 FA
- Probiotics
- Farm animal exposure and unpasteurized cow's milk ingestion

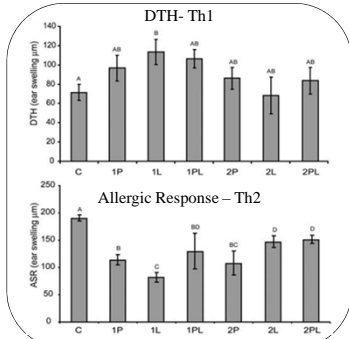
Intrauterine Nutrition : Immunoprogammung



Intrauterine nutrition : immunoprogammung

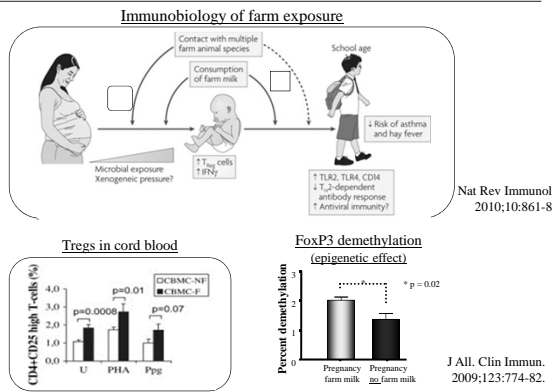


Polyunsaturated Fatty Acid (W6/W3 Ratio) Effect During Pregnancy And Lactation On Immune Responses

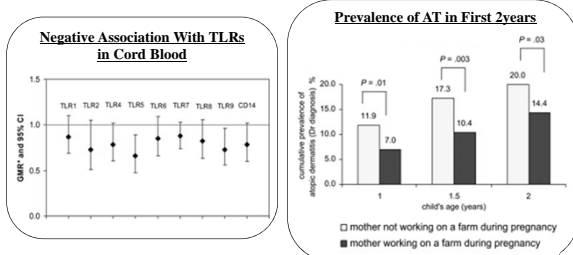


J. Dev. Origins of Health and Diseases 2011;2:112-123

Intrauterine Nutrition : immunoprogammung



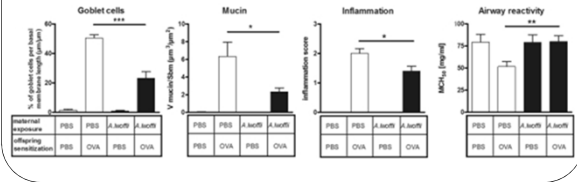
Prenatal Animal Contact And Non-pasteurized Cow Milk Ingestion On Innate Immune Function And Atopic Dermatitis (AT)



J Allergy Clin Immunol. 2011;127:179-85

Convergence Of The Hygiene And Fetal Programming Hypothesis

Asthma Expression in Animal Model After Intrauterine Probiotic Exposure



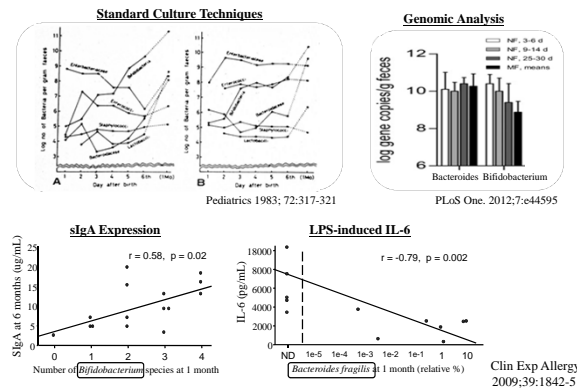
J Exp Med. 2009;206:2869-77

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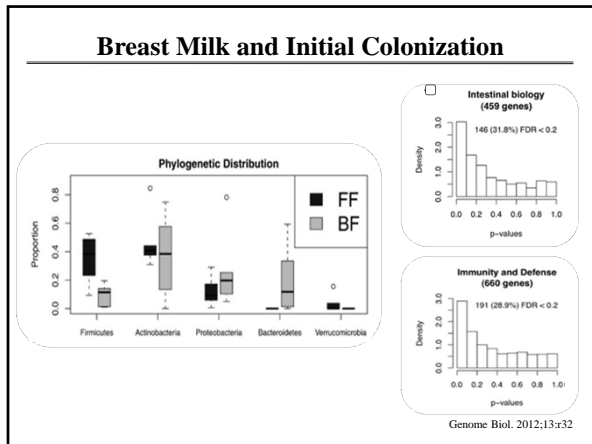
Breast Milk and Initial Colonization

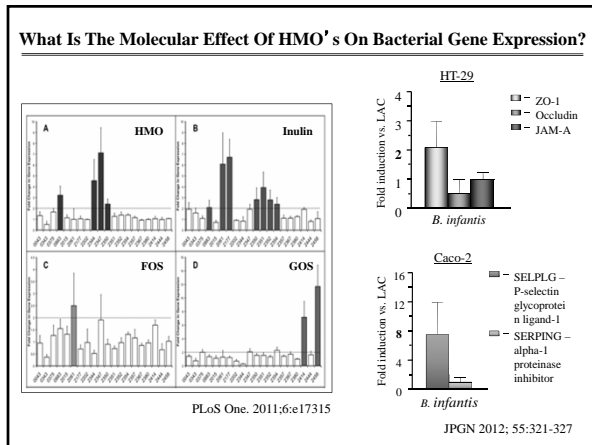


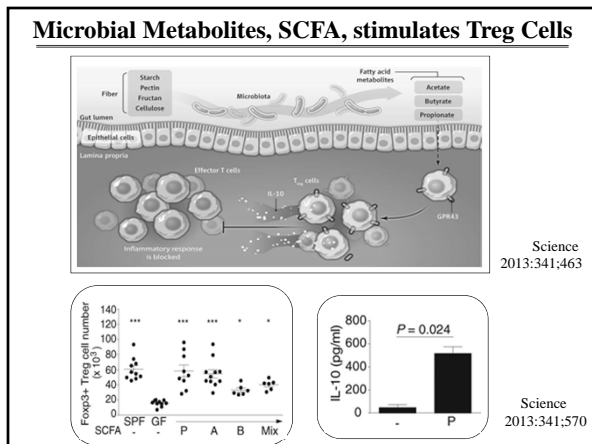
Pediatrics 1983; 72:317-321

PLoS One. 2012;7:e44595

Clin Exp Allergy. 2009;39:1842-51







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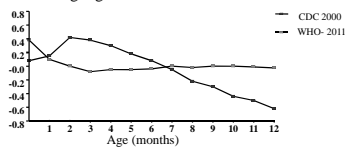
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Clinical Disease Protection (longterm health effects)

- Obesity
- Type II diabetes
- Allergy
- Autoimmune disease
- Cardiovascular health

Breastfeeding and Obesity

1. Initial weight gain



2. Longterm single effect on weight

Table 1. Mean Age-Adjusted Body Mass Index (BMI) and Proportions of Subjects Classified as Overweight at Age 9 to 14 Years, by Category of Infant Feeding in the First 6 Months of Life*

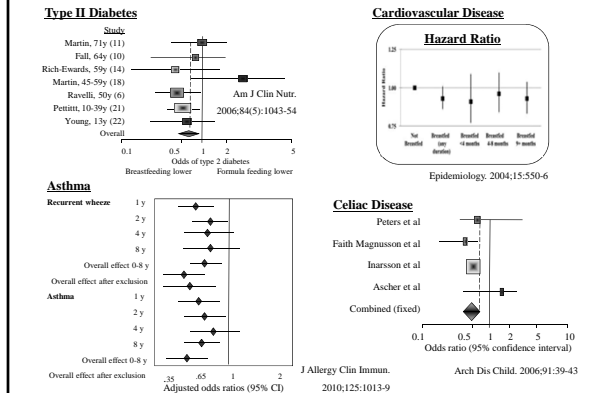
Category	Boys (n = 7189)†			Girls (n = 8189)†		
	No.	Mean BMI, kg/m ²	Overweight, No. (%)	No.	Mean BMI, kg/m ²	Overweight, No. (%)
Breast milk only	2199	18.9	150 (7.1)	2066	18.9	108 (5.1)
Mostly breast milk then infant formula	2311	19.1	162 (7.0)	2517	18.9	110 (4.4)
Both equally	432	19.3	31 (7.2)	559	19.0	25 (4.5)
Mostly infant formula then breast milk	1170	19.5	164 (14.0)	1467	19.1	82 (5.6)
Infant formula only	179	19.3	88 (49.1)	1009	19.3	69 (6.8)

*Proportion of overweight was 84% >95th percentile for age and sex from US data.
 †There were 5 missing values for boys and 0 for girls.

JAMA

2001;285:2461-7

Breast Feeding – longterm health effects



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Summary and Conclusions

- A “new” hygiene hypothesis has evolved implicating perinatal diet in disease states
- Diet affects intestinal colonization which is associated with metabolic and immune-mediated disease
- Inflammation links obesity and metabolic disease
- There is a convergence of the hygiene and fetal programming hypothesis
- A healthy diet during the perinatal period may prevent disease in later life
