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15 years

Advancing Your Career in Diabetes Education

Getting to the Gut – Meet your Microbiome

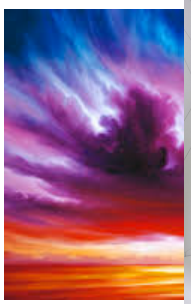
Beverly Thomassian, RN, MPH, CDE, BC-ADM
DiabetesedEd.net

Meet Your Gut Bacteria

- Discuss the role of gut bacteria in relation to health.
- State strategies to improve intestinal health.
- Describe the integration of diabetes prevention and optimizing gut microbiome.
- Enjoy the state of wonder

In the Beginning

- Earth
- Human
- Spirit



Obesity - other factors?

- Not only humans are gaining weight globally
- Animals are getting heavier too (and not just the domestic kind).
- Factors – sleep deprivation, AC, light exposure?
  - Marmosets to macaques



Newsweek, Fat Canaries in a Coal Mine, Dec 10, 2010.. Begley

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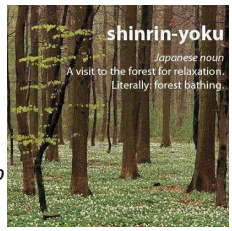
Humans and Nature

- Quiet: think tank of soul
- Trips to forest, enhance bodies immune system by increasing the number and activity of lymphocytes –
  2008 Nippon Med School Tokyo
- Tranquility lowers BP, reduces muscle tension, decreases stress related illness and improves sleep.



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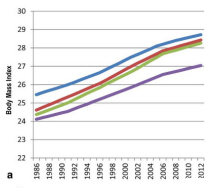
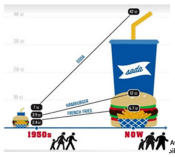
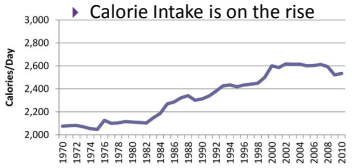
U.S. Weight - 68% overweight or obese



- 34% BMI 25-29
- 34% BMI 30 +
- 1/3 of all overwt people don't get diabetes
- We burn 100 cals less a day at work
- Overall, food costs ~ 10-15% of income
- Calorie Intake is on the rise





Average Daily Per Capita Calories Adjusted for Waste. Source: Economic Research Service of the United States Department
ability (Per Capita) Data System.

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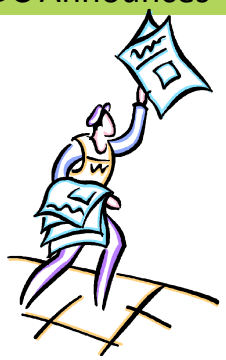
CDC Announces

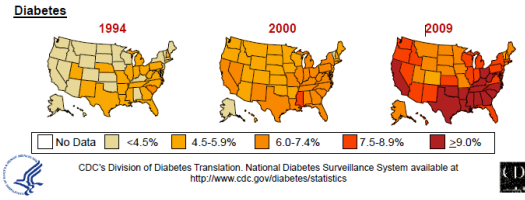


35% of Americans will have Diabetes by 2050

Boyle, Thompson, Barker, Williamson
2010, Oct 22:8(1)29
www.pophealthmetrics.com

Diabetes in America 2017

- 30.3 million or > 9.4%
  - 27% don't know they have it
- 37% of US adults have pre diabetes (86 mil)
  - 90% don't know they have it



Quick Question

- What do you think is contributing to increasing prevalence of type 2 diabetes?
  A. Processed foods
  B. Increased sugar intake
  C. Lack of exercise
  D. Changes in gut bacteria
  E. Environment
  F. All of the above

Standard American Diet is SAD

- 70% of food consumed is processed
- Low fiber, high sugar
- Intake of fruit and veggies decreasing
- We are starving our good bacteria

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United States: The Revis family of North Carolina. Food expenditure for one week: $341.98. Favorite foods: spaghetti, potatoes, sesame chicken.
Peter Menzel, from the book, "Hungry Planet: What the World Eats."

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Guatemala: The Mendozas of Todos Santos - Food expenditure for one week: 573 Quetzales or $75.70. Family Recipe: Turkey... VIEW MORE
Peter Menzel, from the book, "Hungry Planet: What the World

19 of 27

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Quick Question

- Which of the following is considered an added sugar?

a. Lactose
b. Aspartame
c. Non-nutritive sweeteners
d. Sucrose

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Question of the Week
Standards of Care
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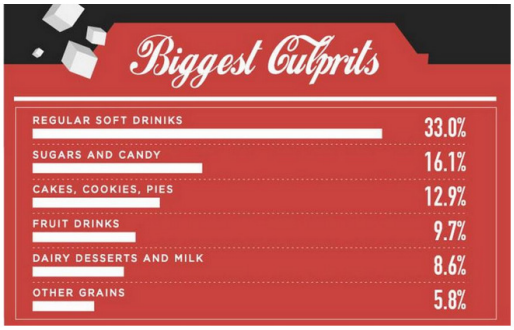
Quick Question

- How many teaspoons of added sugar are Americans eating a day

a. 3 Tablespoons
b. 30 Teaspoons
c. 3 servings
d. 75 gms (5 serving)

Sugar, Sugar, everywhere



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Quick Question

- How many grams of sugar in one teaspoon of sugar?

a. 2 gms
b. 4 gms
c. 5 gms
d. 15 gms (one serving)

30 teaspoons x 4 gms = 120 gms
4 cals per gm sugar – 4 x 120 = 480 Cals per day
from white sugar ~ 25% of our daily cals

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How Many Teaspoons of Sugar?

at this container of Chobani Yogurt.

For one serving, the label states there are 16 gms of sugar. Does that mean there are 4 teaspoons of added sugar in this yogurt? Not necessarily.

Serving Size 5.3oz (150g) Servings per Container 1	
Amount per Serving	%DV*
Calories 120	Calories from Fat 0
Total Fat 0g	0%
Saturated Fat 0g	0%
Trans Fat 0g	-
Cholesterol 5mg	2%
Potassium 200mg	6%
Sodium 55mg	2%
Total Carbs 16g	6%
Dietary Fiber <1g	3%
Sugars 16g	-
Protein 12g	24%
Vitamin A 0% · Vitamin C 0%	
Calcium 15% · Iron 0%	

The Fooducate Sugar Rush App allows you to see how much sugar has been added to foods!
Just scan the barcode of any product and instantly see a breakdown of naturally occurring and added sugars.

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New Labels – ADDED Sugar revealed

Nutrition Facts
Serving Size 2/3 cup (55g)
Servings Per Container About 8

Amount Per Serving		
Calories 230	Calories from Fat 72	
		% Daily Value*
Total Fat 8g		12%
Saturated Fat 1g		5%
Trans Fat 0g		
Cholesterol 0mg		0%
Sodium 160mg		7%
Total Carbohydrate 37g		12%
Dietary Fiber 4g		16%
Sugars 1g		
Protein 3g		
Vitamin A		10%
Vitamin C		8%
Calcium		20%
Iron		45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Nutrition Facts
8 servings per container
Serving size 2/3 cup (55g)

Amount per serving	
Calories	**230**
	% Daily Value*
Total Fat 8g	10%
Saturated Fat 1g	5%
Trans Fat 0g	
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 37g	13%
Dietary Fiber 4g	14%
Total Sugars 12g	
Includes 10g Added Sugars	20%
Protein 3g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 8mg	45%
Potassium 235mg	6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

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Dietary Sugar Affects Gut Colonies?

- Daily sugary beverage increases type 2 risk by 18%.
- After accounting for weight, type 2 diabetes risk 13%
- Diet Soda alters gut bacteria?
- Dietary sugar affecting "healthy" gut microbial colonies

Dr. Steven Smith, Mayo Clinic in Rochester, MN.
Online issue of BMJ, July 2015

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Two diet drinks a day could double the risk of diabetes, study finds

By Laura Donnelly, HEALTH EDITOR
21 OCTOBER 2016 - 6:01AM

Two fizzy drinks a day could double the risk of diabetes - even if they are diet versions - a Swedish study has found.

- Artificial sweeteners:
  - stimulate and distort appetite
  - alter gut bacteria
  - Increase glucose intolerance
- Sugar sodas:
  - Increase risk of LADA
  - Increase insulin resistance
- Associated w/ less healthy lifestyle

European Journal of Endo, 10-2016

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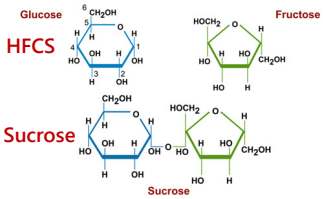
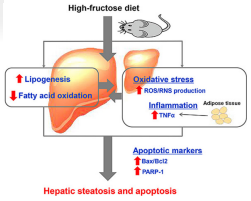
Quick Question

- Which of the following is true about sucrose digestion?
  - a. Sucrose metabolism increases fructose in the liver
  - b. Honey raises blood glucose more than sucrose
  - c. Sucrose is broken down into glucose only
  - d. Sucrose is broken down into dextrose and maltose

Sucrose and High Fructose Corn Syrup (HFCS) undermine health

HFCS is 42%-55% Fructose; Sucrose Is 50% Fructose





Sucrose – monosaccharide
HFCS - disaccharide

Fructose

- Make first pass through liver
- Does not stimulate insulin or satiety hormone
- Is stored as fat, increasing risk of fatty liver disease
- 70% of obese patients with diabetes have fatty liver disease
- Excess fructose intake associated with inflammation, oxidative stress, metabolic syndrome, hyperglycemia

Quick Question

What is the daily added sugar goal as stated by the World Health Organization and the American Heart Association?

a. Limit added sugar intake to less than 50 gms a day

b. Limit added sugar intake to about 6 teaspoons a day

c. Limit added sugar intake to less than 300 calories a day

d. Avoid all added sugar and high fructose corn syrup.

Where to Start - Soda Tax?

- Mexico – down 12% (esp in lower SES groups)
- Berkeley had 21% drop in a year
  - Both resulted in increase in water and milk consumption
- Sugary drinks a primary driver of obesity
- Let your vote and voice be heard

Lots of Resources at DiabetesEd.Net


Type 2
look BEYOND the obvious
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Bacterial Cells Outnumber Human Cells 10 to 1
The Human Microbiome Project
10 trillion human cells
Host 100 trillion bacterial and fungal cells
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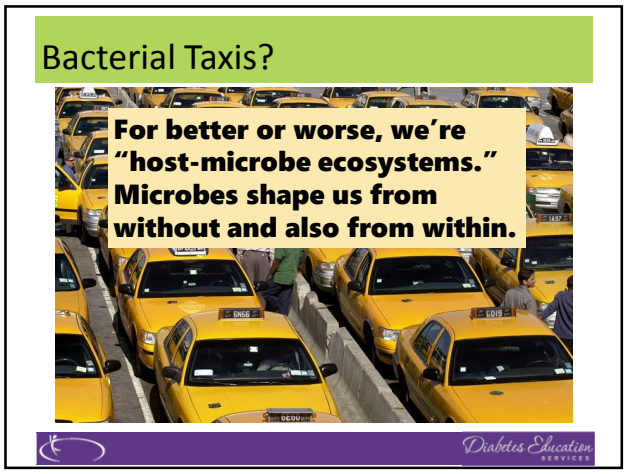
Bacterial Taxis?
For better or worse, we're "host-microbe ecosystems." Microbes shape us from without and also from within.
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Bacteria and Romance

Microbes, a Love Story

Are you attracted to her, or to the teeming community of microorganisms living in her gut?

The microbiome often acts as an invisible puppet master.
We are attracted to partners by the scent of their microbiome.
Partners are often attracted to others because they have different pathogen recognition genes

Sonia Shah

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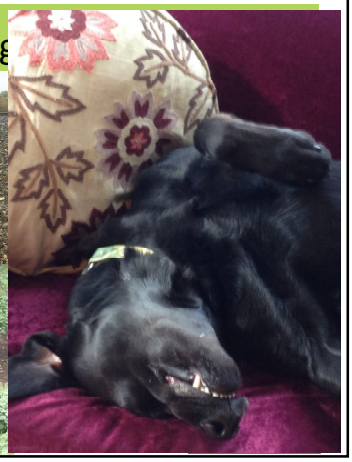
A Day in my Dog



SCIENCE

HUMANS SHARE MICROBIOMES WITH THEIR DOGS, STUDY FINDS

YOU HAVE A LOT MORE IN COMMON WITH FIDO THAN YOU THINK.

By Francie Diep April 18, 2013

- Bring bacteria into house from soil and who knows what else?
- Increases human microbiome diversity
- Less allergic and autoimmune diseases

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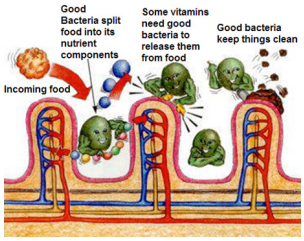
Quick Question

- How much does your gut bacteria weigh?
  A. 24 ounces
  B. 3 pounds
  C. Less than 1 pound
  D. 1.5 pounds
  E . Not sure

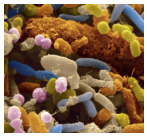
How do our bacteria help us?

- Maintain physiological homeostasis and metabolism.
- Other benefits
  - pathogen displacement
  - immune system development
  - barrier fortification
  - vitamin production
  - nutrient absorption
- Forgotten organ

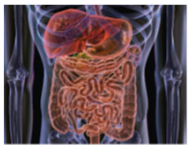


3 lbs of Microbes in our Gut

- Community of bacteria extra 'organ' "microbiome".
- Evolved together with our microbiome over millions of years.
- Ratios of these communities has changed over the past 30 years
- Mirrors global spikes in obesity, diabetes, allergic and inflammatory diseases
- What are we doing to change these bacteria?



Human Intestine Friends



- The majority belong 2 major phyla:
- Firmicutes
  - includes *Clostridium*, *Enterococcus*, *Lactobacillus* and *Ruminococcus*
- Bacteroidetes
  - includes *Bacteroides* and *Prevotella*

in proportions determined in part by birth, breastfeeding, diet

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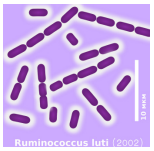
Intestinal Health – A Balancing Act

- Within these, three distinct enterotypes of the human gut microbiome proposed by Arumugam:
  - (1) abundant *Bacteroides* (assoc with carbs and meat intake, Western Diet)
  - (2) few *Bacteroides* but abundant *Prevotella* (higher fiber, vegetarian diets)
  - (3) abundance of Firmicutes *Ruminococcus* – (fat and protein intake).
- Each of these genera may be linked to distinct nutrient-metabolism functions



The Health Advantage of a Vegan Diet: Exploring the Gut Microbiota Connection

Marlan Glick-Bauer and Ming-Chin Yeh *

Nutrition Program, CUNY School of Public Health, Hunter College, City University of New York, 2180 Third Avenue, Room 618, New York, NY 10035, USA; E-Mail: mglickbauer@gmail.com

* Author to whom correspondence should be addressed; E-Mail: myeh@hunter.cuny.edu; Tel.: 11-212-988-7778; Fax: 11-212-988-7818.

Received: 13 August 2014; in revised form: 16 October 2014 / Accepted: 31 October 2014 / Published: 31 October 2014

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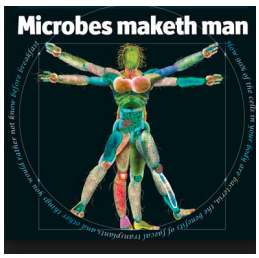
Gut Microbiome

- Part of endocrine axis
- Stabilized by 3 years of age
- Influenced by:
  - Birth method
  - Breast fed
  - Early Antibiotic use
  - Environment
  - Travel
- Help us
  - utilize energy
  - fight off invaders



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C-Section – Consider Gauze in Vagina

- early research by Dr. Maria Gloria Dominguez-Bello, an associate professor in the Human Microbiome Program at the NYU School of Medicine. She is testing a fast and easy work-around called the "gauze-in-the-vagina technique."

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More Breast Milk

PreBiotic

- Sets the stage for healthy bacterial microdiversity to take hold
- Oligosaccharides feed the Bifidobacterium

ProBiotic

- Contains healthy super hero bacteria

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Weight and Gut Bacteria New and Early Research

- Leaner people appear to have more bacterial diversity and a higher proportion of bacteroidetes
- Obese people appear to have higher levels of firmicutes
- Bacteria tend to run in families

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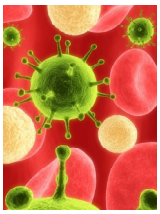
Weight and Gut Bacteria New and Early Research

- Fecal samples in humans have distinct microbial signatures:
  - Obese
  - Type 1
  - Type 2



Pathobionts – at low levels in healthy people but can bloom under certain dietary conditions (bacteria gone rogue)

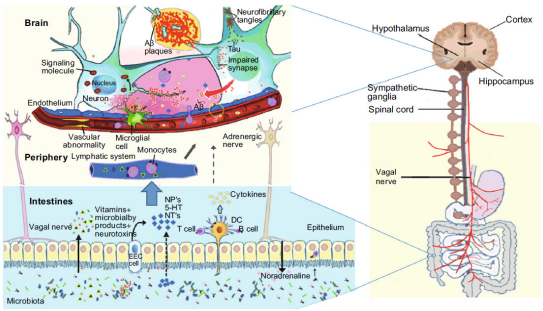
Lipopolysaccharide Endotoxins – stimulated with high fat diets

Endocrine Today 10/2014

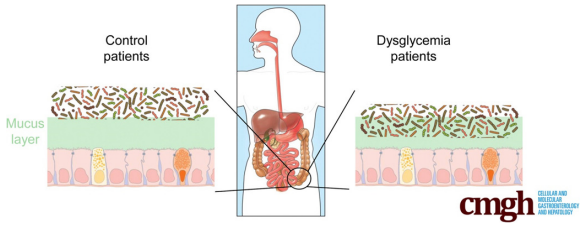
Intestinal bacteria protect against diabetes

- 2 groups with prediabetes (Finnish Diabetes Prevention Study)
- The group who did not get diabetes had:
- A high concentration of indolepropionic acid protects against type 2
  - A metabolite produced by intestinal bacteria
  - Fed by a diet rich in whole grain and dietary fiber
  - This acid is neuroprotective and an antioxidant
  - Potent scavenger of hydroxyl radicals

Link Between Gut and Brain



Colonic Microbiota Encroachment Correlates With Dysglycemia in Humans



Benoit Chassaing, Shreya M. Raja, James D. Lewis, Shanthi Srinivasan, Andrew T. Gewirtz
Cellular and Molecular Gastroenterology and Hepatology (September 2017)

Encroachment of bacteria into mucous layer of intestine causes inflammation

- Findings
  - Bacterial epithelial distance inversely correlated to Dysglycemia
  - Translation
    - Patients with diabetes had a thinner the mucous layer of the intestine
    - Why? Less short chain fatty acids
    - Why? Less healthy bacteria (Akkermansia and Bifidobacteria) to protect mucous membrane and produce fatty acids (byturate)

Source: Happy Oligo

Metformin alters gut metabolism

Especially increases Akkermansia and Bifidobacterium.

McDonalds Study

After eating for Fast Food for 10 Days

McDonald's and the Microbiome: What Effect Does Junk Food Have on Gut Bacteria?

Tim Spector, a genetics professor at King's College London – Endo Today 2015

Dramatic Changes

- Gut microbiome diversity devastated
- Firmicutes replaced by Bacteroidetes
- Bifidobacteria decreased by over 50%
- Pt felt bad- took over 2 weeks to get gut back to health

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Obesity associated with

- Higher levels of:
  - Firmicutes
  - *Staphylococcus aureus*
- *Depletion of:*
  - *Bifidobacterium*
  - *Lactobacillus*
- Microbes might strategically generate cravings for food
- High fat diet, lower fiber diet decreases microbial diversity
- Decreases butyrate, gut more alkaline and inflamed

- *Endocrine Today, Oct 2014 Meghan Jardine*

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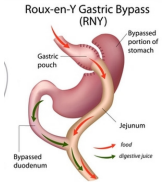
Gastric Bypass effects on Blood Glucose

- Increases gut hormones but…
- Physical manipulation of the gut alters bacterial communities
- Levels of the Firmicute *Roseburia Intestinalis* increase
  - *Roseburia Intestinalis are lacking in people with type 2 (butyrate producing)*
  - Maybe this increase lowers BG levels?



Endocrine Today – April 2015

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Research on Type 1

- Primary Prevention – what triggers type 1?
  - Viruses
  - Lack of breastfeeding
  - Early exposure to foods?
  - Hygiene (too much?)

- Intervention – Secondary and Tertiary
- Cure

The Hygiene Hypothesis

- In studies, mouse raised in clean environment is higher risk for DM than one raised in dirty one
- "Clean living" may increase risk for autoimmune diseases
- DM risk is higher in urban than rural settings
- Daycare, other early exposures, lower risk for DM
- Children exposed to dirt, farm animals, and other kids have less reactive immune systems

Type 1 Diabetes and Gut Bacteria DiabImmune Study Group

- Exciting research Type 1
  - 8 children with same risk of getting type 1 diabetes based on family history and HLA Q phenotype
  - In the 4 children with ATB conversion, w/in 6 months before, the levels of firmicutes decreased and bacteroidetes increased.
  - The bio diversity also decreased
  - Hope that can id kids early on and halt progression to type 1.

Resource

The Dynamics of the Human Infant Gut Microbiome in Development and in Progression toward Type 1 Diabetes

Aleksandar D. Kostic[1, 2, 3], Dirk Gevers[1], Heli Siitjander[4, 5], Tommi Vatanen[1, 6], Tuulia Hyötyläinen[7, 11], Anu-Maaria Hämäläinen[8], Aleksandr Peet[10], Vallo Tillmann[10], Päivi Pöhö[5, 11], Ismo Mattila[7, 11], Harri Lähdesmäki[9], Eric A. Franzosa[3], Outi Vaarala[5], Marcus de Goffau[12], Hermie Harmsen[12], Jorma Ilonen[13, 14], Suvi M. Virtanen[15, 16, 17], Clary B. Clish[1], Mateq Orešič[7, 11], Curtis Huttenhower[1, 3], Mikael Knip[4, 5, 18, 19, 20], on behalf of the DIABIMMUNE Study Group. [22]

Early TEDDY Finding

- **Infants at Risk of Type 1 Diabetes Benefit from Early Probiotics**
- Exposure to probiotics during the first month of life is associated with a 60% decrease in the risk of pancreatic beta-cell islet autoimmunity among children with type 1 diabetes–associated *HLA* genotype DR3/4, but not among those with other genotypes.

JAMA Pediatrics

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Original Investigation | November 08, 2016

Association of Early Exposure of Probiotics and Islet Autoimmunity in the TEDDY Study FREE

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Protect against Type 1 Diabetes

A happy gut may help protect against Type 1 Diabetes - a diet rich in high-fiber foods encourage production of beneficial short-chain fatty acids that may help protect against the onset of Type 1 diabetes.

Including fruits, legumes in your diet may help check the onset of diabetes - The Economic Times

A diet rich in high-fiber foods can protect against Type 1 diabetes.

The diet is rich in a specific type of fibre that comes from a plant product called high amylose corn starch. The fibre is resistant to digestion in the upper intestine, and instead is fermented into acetate and butyrate by bacteria in the large intestine, or colon.

Sydney, Nature Immunology March 2017

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Take Home Messages

- What can we pass on to our patients and communities to promote healthy microbiomes?

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Reunite with "Old Friends"

But while your inherited genes are more or less fixed, it may be possible to reshape, even cultivate, your "second genome"

shots - health news

Staying Healthy May Mean Learning To Love Our Microbiomes

July 22, 2013 • Scientists are investigating the microscopic world that lives in and on our bodies. It's becoming clear that these tiny companions play a much more complex and important role in human health than thought. But we don't yet know enough about the microbiome to use it to prevent and treat disease.

Listen 8:59

Playlist Download Embed

Centre For Infections/Science Photo Library/Corbis

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Getting to Better Gut Bacterial Health

Eat more PREbiotics

- Foods with indigestible fibers that nourish the good bacteria:
  - High fiber foods like, whole grains, fruits, veggies, nuts
  - High in prebiotic fibers include: Jerusalem artichokes, onions, kale, Brussels sprouts, bananas, dandelion greens & more

PRObiotics

- These foods contain healthy bacteria like *Bifidobacterium* and *lactobacillus.*
  - Yogurt, Kefir – look for "live or active cultures"
  - Fermented foods like: Sauerkraut, Kimchi, Miso soup, kombucha

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Kefir – Fermented Milk

From the Turkish word *keyif*, which means "feeling good" after eating

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GET Lots of Diverse Fiber Foods
Goal is 25 – 30 gms day

American Food Project

Full Plate Diet

- Helps increase fiber in usual meals

Fiber is suddenly hip. Grandma, it turns out, was just ahead of her time.

—*Health & Nutrition Letter*
Tufts University
February 2009

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12 Super Foods to Enjoy

- Beans
- Dark Green Leafy Vegs
- Citrus Fruit
- Sweet Potatoes
- Berries
- Garlic

- Tomatoes
- Onions
- Fish High in Omega-3 Fatty Acids
- Whole Grains
- Nuts
- Fat-Free Milk and Yogurt

100 Trillion Friends to Call Your Own

From the way back when, to current time
man and bacteria have been intertwined.

Start with your head, it's a happening place,
there's staphylococcus all over your face.

Next up is gums, teeth and mouth,
You'll find streptococcus inside and out!

Now to your stomach, to keep the pH,
H. pylori is on the case!

Inside the intestines, 30 feet of tube,
3 pounds of bacteria digesting your food.

From Bacteroidetes to keep you lean,
to Firmicutes, a junk food digesting machine!

Prevotella another bug on the scene,
breaks down fiber, veggies and beans!

Lactobacillus is a newborn's friend,
lining birth canal from tip to end.

Down to your feet, in-between the toes,
that's where lots of pseudomonas grows!

Short chain fatty acids, you wanna keep them around
Protects gut mucous lining from breakin' down

So here's my message, always nourish your gut
With fresh fruit, grains, veggies, beans and nuts

More kefir, miso, sauerkraut, kimchi
Less sugar and fast foods to keep away disease

Breast feed, get dirty, limit antibiotic use
Let newborns come out through the natural shoot

Be reassured that you're never alone
You've got 100 trillion friends to call your own!

100 Trillion Friends to Call Your Own by Beverly Thomassian, RN, MPH, CDE, BC-ADM to the tune "Yeah" in the style of Usher.

Thank You

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