Getting to the Gut – Meet your Microbiome

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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


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.

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
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
Quick Question

Which of the following is considered an added sugar?

- Lactose
- Aspartame
- Non-nutritive sweeteners
- Sucrose

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Question of the Week

Standards of Care
PocketCards
Other great stuff

Quick Question

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

- 3 Tablespoons
- 30 Teaspoons
- 3 servings
- 75 gms (5 serving)
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
New Labels – ADDED Sugar revealed

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

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

- 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
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

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

Bacterial Cells Outnumber Human Cells 10 to 1

10 trillion human cells
Host 100 trillion bacterial and fungal cells

Bacterial Taxis?
For better or worse, we’re “host-microbe ecosystems.”
Microbes shape us from without and also from within.
Bacteria and Romance

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

A Day in my Dog's Life

Bring bacteria into house from soil and who knows what else?

- Increases human microbiome diversity
- Less allergic and autoimmune diseases
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 to 2 major phyla:
  - Firmicutes
    - Includes *Clostridium*, *Enterococcus*, *Lactobacillus*, and *Ruminococcus*
  - Bacteroidetes
    - Includes *Bacteroides* and *Prevotella*

In proportions determined in part by birth, breastfeeding, diet.

Intestinal Health – A Balancing Act

- Within these, three distinct enterotypes of the human gut microbiome proposed by Arumugam:
  1. Abundant *Bacteroides* (assoc w/ 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.

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
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 workaround called the “gauze-in-the-vagina technique.”

More Breast Milk

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

ProBiotic
- Contains healthy super hero bacteria

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
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**

- **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)

**Metformin alters gut metabolism**

- Benefits of metformin may involve gut bacteria
- Researchers have shown that the type 2 diabetes drug metformin helps boost good gut bacteria, according to a new study. The treatment is commonly used to control people's blood sugar levels and Swedish...
**McDonalds Study**

**After eating for Fast Food for 10 Days**

**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

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

**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

**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
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.
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.

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.

Take Home Messages

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

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

American Food Project  Full Plate Diet

- Helps increase fiber in usual meals

American Food Project Full Plate Diet

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.

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

Breast feed, get dirty, limit antibiotics 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!
Thank You

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