Getting to the Gut – Meet your Microbiome

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2019 DiabetesedEd.net
Meet Your Gut Bacteria

- Enjoy the state of wonder
- Discuss the role of gut bacteria in relation to health.
- Describe the integration of diabetes prevention and optimizing gut microbiome.
- State strategies to improve intestinal health.
Diabetes in America 2019

- 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
CDC Announces

35% of Americans will have Diabetes by 2050

Boyle, Thompson, Barker, Williamson
2010, Oct 22:8(1)29
www.pophealthmetrics.com
U.S. Weight - 68% experiencing overweight or BMI >30

- 34% BMI 25-29
- 34% BMI 30 +
- 1/3 of all people with extra weight 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

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
Increasing Weight - 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, exposure to PFAS (polyfluoroalkyl substances) and other endocrine disrupters
  - Marmosets to macaques

Newsweek, Fat Canaries in a Coal Mine, Dec 10, 2010, Begley
Early studies have shown a link between greater PFAS exposure and increased risk for endocrine outcomes like BMI >30, but more research is needed specifically to examine factors like exposure timing,” Abby Fleisch, MD, MPH
PFAS can be found in

- **Food** packaged in PFAS-containing materials, processed with equipment that used PFAS, or grown in PFAS-contaminated soil or water.

- **Commercial household products**, including stain- and water-repellent fabrics, nonstick products (e.g., Teflon), polishes, waxes, paints, cleaning products, and fire-fighting foams (a major source of groundwater contamination at airports and military bases where firefighting training occurs).

- **Workplace**, including production facilities or industries (e.g., chrome plating, electronics manufacturing or oil recovery) that use PFAS.

- **Drinking water**, typically localized and associated with a specific facility (e.g., manufacturer, landfill, wastewater treatment plant, firefighter training facility).

- **Living organisms**, including fish, animals and humans, where PFAS have the ability to build up and persist over time.

https://www.epa.gov/pfas/basic-information-pfas
In the Beginning

- Earth
- Human
- Spirit
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.
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
Guatemala: The Mendoza 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"
Stop Killing All the Bacteria
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
Household cleaners may alter kid’s gut flora

- Canadian Med Association found that common household disinfectants may increase the risk of obesity in children.
- However, the children in households that used eco-friendly cleaners were less likely to be overweight.
- More research is needed “to explore the intriguing possibility that use of household disinfectants might contribute to the complex causes of obesity through microbially mediated mechanisms”.
Bacterial Cells Outnumber Human Cells 10 to 1

10 trillion human cells
Host 100 trillion bacterial and fungal cells
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
Quick Question

- How much does your gut bacteria weigh?
  A. 24 ounces
  B. 3 pounds
  C. Less than 1 pound
  D. 1.5 pounds

- How much does your brain weigh?
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?
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

Microbes maketh man
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
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
Quick Question

In general, how does immigrating to the U.S. impact individual’s gut microbiota?

A. Increased diversity due to new food exposure.
B. A generational decline in bacterial diversity
C. They experience a sudden increase in Akkermansia muciniphila
D. Decrease in helicobacter pylori.
Just Months of American Life Change the Microbiome

Immigrants’ gut bacteria “westernize” soon after they move to the U.S., which might influence obesity in immigrants and Americans alike.

A Hmong woman carries grass in Vietnam. (NGUYEN HUY KHAM / REUTERS)
From Vietnam to America – Hmong immigrants microbiome shifts associated with worse health

- In Minneapolis—scientists followed a group of Hmong immigrants for 9 months.
- Increased intake of protein, sugar, and fat and processed food.
- Researchers found that the immigrants’ gut microbiomes “westernized” and became less diverse.
- Within a generation, Hmong women experiencing a BMI of >30 increased from 5% to 30%.
Moving to America isn’t good for your health

Researchers don’t know if eating a less-healthy diet increases the rate of obesity and changes the microbiome, or if a less healthy diet changes the microbiome so it makes people experience higher BMI.

Atlantic.com  Nov 2018
“Lack of microbial diversity, which is greatly influenced by diet, is a common thread among metabolic diseases.”  Ruchi Mathur, MD, FRCP
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%
- 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
BMI >30 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
High-fat diet linked to negative changes in gut microbiome

A study published in Gut, an international journal in gastroenterology and hepatology, revealed that a diet low in carbohydrates and high in fat can lead to a detrimental shift in a person’s gut microbiome. Duo Li, PhD of the Institute of Nutrition and Health at Qingdao University in China, believes this study is particularly important to countries becoming more westernized.

“Evidence has shown that humans gut microbiota diversity and richness are reduced with consumption of high-fat diets compared with more traditional diets with a higher proportions of carbohydrates. Such diet-induced ‘dysbiosis’ in gut-associated microbial communities has been postulated as a major trigger of metabolic impairments associated with obesity.”

High-fat diet linked to unfavorable gut microbiota changes

February 19, 2019
With diabetes, a high fat meal appears to trigger:

- Passage of bacterial endotoxins through intestinal wall
- Increase levels of inflammatory cytokines and triglycerides
- Contributing to insulin resistance
- Seems to be worse if eating frequent fatty meals throughout the day – increases presence of lipopolysaccharide endotoxins

*Research by Alison Harte, PhD - Clinical Endocrinology News- Nov 11, 2011*
Leaner people appear to have more bacterial diversity and a higher proportion of bacteroidetes.

People with BMI >30 appear to have higher levels of firmicutes.

Bacteria tend to run in families.
Women who have a greater diversity of “healthy” gut bacteria may have a lower risk of developing cardiovascular disease. According to research published in the European Heart Journal, arterial stiffness was discovered in women with a lower diversity of gut bacteria. Women who had greater microbiome diversity, including bacteria from the Ruminococcaceae family which lowers stiffness in the arteries and also the risk of obesity, were at a lower risk of developing symptoms of cardiovascular disease.

“So, our results reveal the first observation in humans linking the gut microbes and their products to lower arterial stiffness. It is possible that the gut bacteria can be used to detect risk of heart disease and may be altered by diet or drugs to reduce the risk” said Ana M. Valdes, PhD, of the University of Nottingham’s School of Medicine and NIHR Nottingham Biomedical Research Center.


May 16, 2018
Evidence-Based, Personalized Nutrition at Your Fingertips

DayTwo’s science empowers clinicians and people with diabetes, providing a food-as-medicine approach to manage glucose levels and improve overall health.

Research + Results

People process the same foods differently, nutrition based on averages does not work well for any one person.
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)
Keeping blood sugar in target may reduce risk of Alzheimer’s

In a recent panel discussion moderated by David Holtzman, Chairman of Neurology at Washington University in St. Louis, researchers discussed the association between blood sugar and Alzheimer’s. It seems that keeping blood glucose in target may reduce risk of developing Alzheimer’s.

“The risk for dementia is elevated about twofold in people who have diabetes or metabolic syndrome,” Holtzman says. “But what’s not been clear is, what’s the connection?”

To explore this link, one team experimented on two different groups of mice. In one group, they fed the mice only sugar and fat dense foods. In the other, they gave them a protein called ApoE2. ApoE2 positively affects glycolysis, which allows brain cells to turn sugar into energy. That increase in energy helps brain cells to get rid of toxins associated with Alzheimer’s.

After the treatments were put into place, the mice who were fed a high fat and sugar diet were more lethargic and developed memory loss. In contrast, the mice who were fed ApoE2 were much more energetic and their brains even seemed healthier than before.
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 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)

*Benoit Chassaing, Shreya M. Raja, James D. Lewis, Shanthi Srinivasan, Andrew T. Gewirtz*  
*Cellular and Molecular Gastroenterology and Hepatology* (September 2017)
40 Volunteers with overweight and obesity displaying insulin resistance were randomly selected to take a daily dose of:
- live bacteria or pasteurized (heat inactivated) form of the beneficial bacteria *A. muciniphila* or a placebo for three months.

**Conclusion**: daily oral supplementation of pasteurized *A. muciniphila* reduced various cardiovascular risk factors, such as insulin resistance, total blood cholesterol and fat tissue storage, in participants with overweight compared to the placebo group.

Akkermansia Muciniphila

A. muciniphila in our mucus lining is inversely correlated with obesity and diabetes in both mice and humans.

Mucus lining protector and increases presence of short chain fatty acids.

High levels of A. muciniphila is associated with improved health.

“AKK” is associated with enhanced intestinal barrier function and incretin secretion from intestinal endocrine cells. Together, these actions suppress obesity, insulin resistance, and intestinal inflammation.

How to increase A. muciniphila

- Metformin is associated with increased levels of A. muciniphila.
- **Research** has also shown that avoiding a high-fat diet and heavy alcohol intake can increase A. muciniphila abundance.

- Eating certain whole foods and avoid high fat diets
- **Studies show that polyphenols** derived from grapes and cranberries increase the abundance of Akkermansia.
- Apple-derived macromolecular procyanidins increased the abundance of intestinal Akkermansia leading to anti-inflammatory effects in a mouse model with metabolic syndrome.

See Diabetes Ed Nov 2019 Newsletter
Metformin alters gut metabolism

Metformin boosts good gut bacteria! Great news!

Benefits of metformin may involve gut bacteria

Researchers have shown 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...

Especially increases Akkermansia and Bifidobacterium.
GUT MICROBIOME AND SLEEP

All of the microbes that live in our intestines are known as the gut microbiome. Some even call it our “second brain.”

Taking special care of your gut health can have great effects on the quality of your sleep. This is true even if you are going through a stressful period which would normally disrupt your sleep length and quality.

HOW ARE SLEEP AND MICROBIOME CONNECTED?

Elderly get better sleep with better microbial composition

Better sleep showed a increase in Verrucomicrobia strain which is believed to be linked with better cognitive function.

Study authors hope that improving gut microbiome could lead to a new way of cognitive decline treatment in older adults.

www.sleepline.com
INSOMNIA, DEPRESSION AND GUT MICROBIOME

Insomnia and depression often come together. When we don’t sleep well, we may become more susceptible to stress, anxiety, bad mood, and pessimism.

90% of serotonin is produced by our gut microbes. They also produce GABA which relaxes us by inhibiting stress. Low levels of GABA mean more stress and less chance to fall asleep.

People with insomnia and depression usually don’t have the right balance of microbes or their microbes don’t work properly.

HOW CAN I IMPROVE MY GUT MICROBIOME?

You can help your gut by sleeping well, eating healthy and exercising.

If you have poor sleep habits, you should change them. The first step is to recognize what you are doing wrong and substitute it with good sleep practices.

FOODS THAT ARE GOOD FOR YOUR MICROBIOME INCLUDE:

- **Unprocessed Food**
  Unprocessed food contains more nutrients and fiber, which is excellent for gut microbes.

- **Fiber**
  Broccoli, artichoke, wholegrain, bananas are just a few fiber-rich foods.

- **Eat All the Fruit and Vegetables**
  Good bacteria love various plants and herbs.

- **Fermented Dairy – Yogurt and Kefir**
  These are very rich in probiotic cultures and are very helpful with supplementing your gut with more of the friendly bacteria.

www.sleepline.com
Quick Question

- How many teaspoons of added sugar are Americans eating a day
  a. 3 Tablespoons
  b. 22 Teaspoons
  c. 3 servings
  d. 75 gms (5 serving)
Sugar, Sugar, everywhere

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<th>Category</th>
<th>Percentage</th>
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<td>Regular Soft Drinks</td>
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<tr>
<td>Sugars and Candy</td>
<td>16.1%</td>
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<td>Cakes, Cookies, Pies</td>
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<tr>
<td>Fruit Drinks</td>
<td>9.7%</td>
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<tr>
<td>Dairy Desserts and Milk</td>
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<tr>
<td>Other Grains</td>
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</tbody>
</table>
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
How Many Teaspoons of Sugar?

Here is the angry panda. Let's look 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.

<table>
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<th>Serving Size</th>
<th>5.3oz (150g)</th>
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<tr>
<td>Servings per Container</td>
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<table>
<thead>
<tr>
<th>Amount per Serving</th>
<th>%DV*</th>
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<tbody>
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<tr>
<td>Calories from Fat</td>
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<tr>
<td>Total Fat</td>
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<tr>
<td>Saturated Fat</td>
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<tr>
<td>Trans Fat</td>
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<tr>
<td>Cholesterol</td>
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<tr>
<td>Potassium</td>
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<tr>
<td>Sodium</td>
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<tr>
<td>Protein</td>
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<tr>
<td>Vitamin C</td>
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<tr>
<td>Calcium</td>
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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.
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

1 OUT OF 2 Latino children will get Type 2 Diabetes

Share Diabetes with Maria

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.

European Journal of Endo, 10-2016

- 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
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.
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”
More Breast Milk

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

**ProBiotic**
- Contains healthy super hero bacteria
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
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

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

—Health & Nutrition Letter
Tufts University
February 2009
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
From 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!
CDE® Coach App – Download Success

Coach in your pocket.

Med Pocket Cards. Resources. Courses.

Question of the Week
Standards of Care
PocketCards
Other great stuff
Thank You

- Email
  bev@diabetesed.net
- Web
  www.diabetesed.net