



## COPE WEBINAR SERIES FOR HEALTH PROFESSIONALS


September 26, 2018

### The Gut Microbiome-Diabetes Connection




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Nursing Education    Continuing Education Programming    Research





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## OBJECTIVES

1. Describe the microbiome development and maturation
2. Recognize the microbiome relationship to human body metabolism, obesity, metabolic syndrome and Type 2 diabetes and the dietary factors that contribute to disruption
3. Identify 2 clinical applications of the gut microbiome-diabetes relationship in patient care.


## CE DETAILS

- Villanova University College of Nursing is accredited as a provider of continuing nursing education by the American Nurses Credentialing Center Commission on Accreditation
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## CE CREDITS

- This webinar awards 1 contact hour for nurses and 1 CPEU for dietitians
- Suggested CDR Learning Need Codes: 2000, 5000, 5190, 5370
- Level 2
- CDR Performance Indicators: 8.1.2, 8.1.5, 6.3.11



## THE GUT MICROBIOME-DIABETES CONNECTION



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## THE GUT-DIABETES CONNECTION

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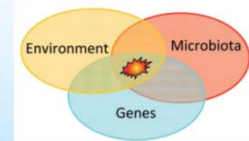
## OBJECTIVES

- DESCRIBE THE MICROBIOME DEVELOPMENT AND MATURATION
- RECOGNIZE THE MICROBIOME RELATIONSHIP TO HUMAN BODY METABOLISM, OBESITY, METABOLIC SYNDROME AND TYPE 2 DIABETES AND THE DIETARY FACTORS THAT CONTRIBUTE TO DISRUPTION
- IDENTIFY 2 CLINICAL APPLICATIONS OF THE GUT MICROBIOME-DIABETES RELATIONSHIP IN PATIENT CARE.

## MICROBIOTA IMPORTANCE

Pathogenesis – linked to inappropriate activation of GI immune system toward the gut microbiota in genetically susceptible hosts & under the influence of environmental factors

Chronic low-grade inflammation is associated with obesity and metabolic dysfunction (insulin resistance)



Gut microbiota (and diet-induced changes in microbiota composition) may contribute to low-grade inflammation

## CONSIDERING ROLE OF MICROBIOTA AND DISEASE

“ALL DISEASE BEGINS IN THE GUT”

“HEALTH IS DETERMINED BY THE MICROBIOTA IN OUR GUT”

HIPPOCRATES 460 BC – 370BC

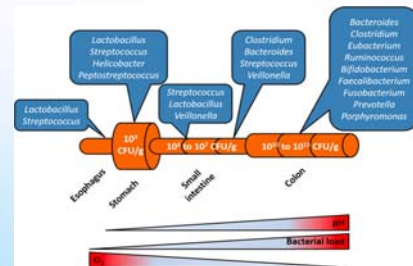
## DEFINITIONS

- Microbiota: the microorganisms (bacteria, viruses, fungi, etc) associated with the human body
- Microbiome: the total number of different genes that the microbiota as a whole possesses
- Gut microbiota: microorganisms in the digestive tract, most of which are present in the large intestine
- Dysbiosis: deviations from a healthy pattern of gut microbiota

## THE ADULT GUT MICROBIOTA

- > 100 trillion organisms (10 x's human cells)
- Most present large intestine
- Mostly bacteria
- 100-200 x's genes (>3 million) than human genome
- 1000 bacterial species
- Phyla firmicutes and bacteroidetes predominate

## MICROBIOTA IN THE GASTROINTESTINAL TRACT



## BACTERIA PREDOMINATING IN HUMAN MICROBIOTA

Phyla	Genus	Percentage
<b>Firmicutes</b>	Ruminococcus	<b>60%-80%</b>
	Clostridium	
	Lactobacillus	
<b>Bacteroidetes</b>	Bacteriodes	<b>20%-30%</b>
	Prevotella	
	Xylanibacter	
<b>Actinobacteria</b>	Bifidobacterium	<b>&lt;10%</b>
<b>Proteobacteria</b>	Escherichia	<b>&lt;1%</b>
	Enterobacteriaceae	

## FUNCTIONS OF HEALTHY MICROBIOTA

- Strengthens the immune system
- Protective metabolites from digestion dietary fiber and resistant starch (short-chain fatty acids acetate, propionate, butyrate)
- Influences serotonin levels
- Maintains intestinal epithelial barrier
- Anti-inflammatory activity
- Competes with pathogens
- Detoxifies drugs and other substances
- Synthesizes biotin, vitamin K, folate

## DEVELOPMENT OF THE MICROBIOTA

- In utero first develops
- Vaginal delivery vs caesarean
- Antibiotic use
- Breast vs bottle feeding
- Solid food
- 2-5 years of age adult-like microbiota

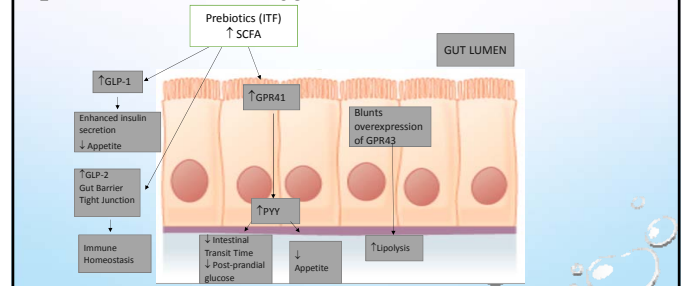
## INFLUENCING FACTORS

- Genetics/epigenetics
- Antibiotic use
- Food and water sanitation
- Drugs (metformin)
- Bariatric surgery
- Weight loss
- Diet

## HEALTHY MICROBIOTA

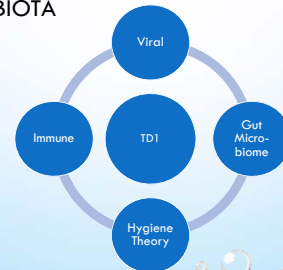
- Higher proportion of bacteroidetes, actinobacteria
- Lower proportion of firmicutes
- Greater SCFA production
- Less methane production
- Greater diversity of species
- Less nitrogenous fermentation products (hydrogen sulfide)
- Anti-inflammatory cytokines

## GUT MICROBIOME GLUCOSE HOMEOSTASIS SUMMARIZED

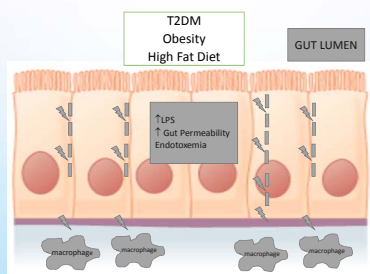


## MICROBIOTA DIABETES CONNECTION TYPE AND TYPE 2?

## CONNECTION TYPE1 DIABETES AND MICROBIOTA



## GUT MICROBIOME AND TYPE 2 DIABETES DIABETES RELATED MICROBIOME DYSBIOSIS



## DYSBIOSIS AND ENERGY AND MACRONUTRIENT IMBALANCES

- Enhanced absorption of nutrients
- Enhanced SCFA production and lipogenesis
- Reduced activity of fasting-induced adipose factor
- Reduced activity of amp-activated protein kinase
- Inflammation and intestinal permeability
- Hyperactivity of the endocannabinoid system

## DYSBIOSIS CONTINUED

- Altered bile acid metabolism
- Methanogens
- Nitrogenous metabolic products
- Fat-rich, high animal protein, low fiber diet

## APPETITE REGULATION

- Enteroendocrine peptides- regulation of energy balance, appetite, glucose regulation
- Gut peptide -GLP-1
  - SCFAs directly influence endogenous secretion
  - Acetate plays a role in this important regulation, modulation of plasma SCFAs
- Gut peptide- PYY

**Link between microbial activity and gut peptide secretion and appetite**

## HORMONE REGULATION

Leptin, Ghrelin  
Appetite Regulation

GLP-2 Regulation of  
Energy Storage  
Gut Barrier Integrity

Insulin  
Inflammation, Insulin  
Resistance, Glucose  
excursions

## NUTRITION AND MICROBIOME DISRUPTION MACRONUTRIENT

- Food ingredients absorbed and utilized by gut microbiota
- High fat diet
  - Inc exposure to pro-inflammatory FFAs
  - Leads to metabolic endotoxaemia and dysbiosis
  - T2DM and obesity
  - Alterations in GLP-2 production and mucosa integrity

## NUTRITION AND MICROBIOME DISRUPTION DIETARY PATTERNS

- Western diet
- Vegetarian/ Vegan
- Dietary composition effects enterotypes or gut flora
- Acute changes in diet
- Calorie intake relative to need
  - > Kcal to wt maintenance needs = inc firmicutes and dec bacteroidetes = inc nutrient absorption of 150 kcal
  - > Kcal to needs = > kcal absorbed to needs and less excreted
  - < Kcal to need= inc bacteroidetes and more excreted

## NUTRITION AND MICROBIOME DISRUPTION CARBOHYDRATES

- Resistant starch (RS) and non starch polysaccharides (NSP)
- RS and NSP improve microbial fermentation
  - Release of insulin (RS) and phytochemicals (NSP)
  - RS more residue = fermentation

## NUTRITION AND MICROBIOME DISRUPTION PRE-BIOTICS

- Non-digestible food ingredients stimulate the growth of microbes in the gut
- Examples:
  - Common: Inulin, Jerusalem artichokes, Chicory
  - Novel: Polyphenols, Calcium, B-vitamins
- Fermentation of prebiotics by gut
  - Long term intake > then short/acute intake – mixed
  - Specialized infant formulas –oligosaccharides

## PRE-BIOTICS BENEFITS



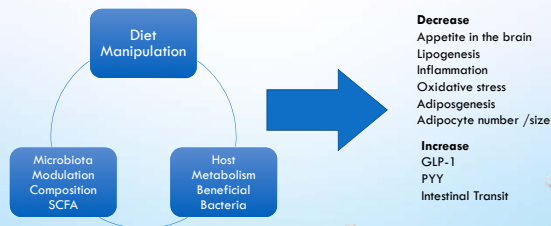
## NUTRITION AND MICROBIOME DISRUPTION PROBIOTICS

- Probiotics are “live microrganisms, which, when administered in adequate amounts, confer a health benefit on the host”.
- Two main groups: lactobacillus and bifidobacterium
  - Food examples: fermented milk, miso, tempeh, soy beverages and some juices
  - Supplements: come in different forms such as capsules, tablets, and powders

## NUTRITION AND MICROBIOME DISRUPTION PROBIOTICS

- Benefits
  - Mucosal integrity
  - Reduce gut permeability
  - Increase secretions
  - Weight management
- Strain specificity- Lactobacillus and bifidobacterium

## INTERACTION OF DIET AND GUT MICROBIOTA SUMMARIZED



## CLINICAL APPLICATION

- The GI tract is colonized by a large number of complimentary bacteria
- Composition is heavily influenced by environment (diet)
- Microbiota provides essential signals to ensure health host-microbial homeostasis
- Microbial dysbiosis is found in many different diseases
- A causal link and mechanistic insight will pave the way to new therapies to treat and prevent disease

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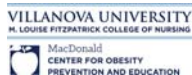
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### QUESTIONS & ANSWERS



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