Leadership & Innovation in Healthcare

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Hidden Health Role of the Gut Microbiome

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The Gut Microbiome

- Bowel microbial environment
- Bacteria, archaea, fungi and viruses
- 1,800 genera
- 15,000 – 36,000 distinct species
The Gut Microbiome

- 37.2 trillion human cells
- 100 trillion gut bacteria
- 150 x larger genome
  - Human: 23,000 genes
  - Microbiome: 3.3 million genes
  - DNA: 1% human; 99% microbial

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Gut Microbiome Functions

- Digestive functions
  - Fermentation of indigestible carbohydrates
  - Produce short-chain fatty acids
  - Energy substrate for colonocytes
  - Contributes approx. 30% daily energy
- Produce Vitamin K and biotin
Gut Microbiome Functions

• Influence gene expression in microvilli development
Gut Microbiome Functions

• Energy metabolism, obesity and DM2
  • Decreased microbial diversity in obesity
  • Alterations in gut microbiota in DM2
  • Decreased butyrate production
  • Increased caloric harvesting
Gut Microbiome Functions

• Maintain “gut-brain axis”
  • Regulate GI motility and secretions
  • Influence pain perception
  • Regulate appetite
  • Modulate mood and emotional response
Gut Microbiome Functions

- Support immune functions
- Oppose pathogenic micro-organisms
  - Prevent adhesion
  - Provide competitive colonization
  - Produce bacteriocins
Gut Microbiome Functions

- Support immune function
- Participate in GALT formation
- Reduce inflammatory cytokines
- Decrease allergic response
- Improve gut barrier function
Gut Microbiome Functions

- Support immune function
- Display anti-carcinogenic effects
- Reinforce mucosal barrier
- Bind toxic metabolites produced by pathogenic micro-organisms
Development of Microbiome

- Colonization of the fetal gut
  - Placental transfer
  - Vaginal delivery
  - Breastfeeding
- Digestive and immune benefits
- Vaginally-delivered infants:
  - ↓ pediatric otitis, allergies, asthma and atopy
Dysbiosis

- Imbalance between beneficial and potentially pathogenic microorganisms
Causes of Dysbiosis

- Antibiotic therapy
  - Decreases stability and diversity of microflora
  - Only partial recovery at 4 years
- Stress
  - Increases intestinal permeability
  - Increases inflammation
Causes of Dysbiosis

- Poor diet
  - Low fiber intake
  - Lack of fermented foods
- Hypochlorhydria
  - Acid-blocking rx
- Toxic exposure
  - PCBs
Conditions Associated with Dysbiosis

- Inflammation
- Compromised immune function
- Inflammatory/Irritable Bowel disease
- Nutritional deficiencies
- Allergies
Conditions Associated with Dysbiosis

• Neurocognitive changes
• Depression
• Obesity
• Type 2 Diabetes
• Increased oxidative stress
• Increased cancer risk
Maintaining the Microbiome

- Decreased microbial diversity in developed world compared to traditional diets
- Decreased resilience and disease resistance
- Mice study:
  - Diet-induced changes in microbiota were reversible in one generation
  - Progressive decrease in diversity over multiple generations
  - Not reversible with dietary changes

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Maintaining the Microbiome

- DNA does not equal destiny
- Phenotype subject to epigenetic influence.
- Food may be most powerful influence within our control.
Maintaining the Microbiome

• Probiotics
  • “Live micro-organisms which, when administered in adequate amounts, confer a health benefit on the host”
    - World Health Organization
  • Functional foods and supplements
  • Modulate microbiome
Maintaining the Microbiome

• Benefit of probiotics:
  • Interfere with the growth or survival of pathogenic micro-organisms
  • Improve mucosal barrier and immune function
Maintaining the Microbiome

- Consume fermented foods
  - Zymology: *Food produced or preserved by micro-organisms*
    - Naturally-occurring bacteria
    - Pellicle/SCOBY
      - Symbiotic Colony of Bacteria and Yeast
Maintaining the Microbiome

- Traditional Asian fermented foods:
  - Tofu
  - Soy/tamari/fish sauce
  - Miso
  - Tempeh
  - Amazake
  - Preserved duck eggs
  - Fresh pickles
Maintaining the Microbiome

- Traditional Asian fermented foods:
  - Kim chi
  - Fermented cabbage
  - Atchara
  - Bagoon
  - Soybean paste
  - Natto
Maintaining the Microbiome

• Kombucha
  • Fermented green/black tea
  • SCOBY fermentation
  • Lightly effervescent
  • Varying alcohol content
  • Unknown origin - possibly Japanese
Maintaining the Microbiome

- Other Fermented Foods
  - Yogurt
  - Kefir
  - Cheese
  - Buttermilk
  - Crème fraiche
  - Lassi
  - Ayran/doogh/tan
  - Fresh sauerkraut
  - Cacao beans
  - Kvass
  - Poi
  - Sauces
    - Worchestershire
    - Tabasco
Maintaining the Microbiome

- Fermented foods may not contain live cultures in the finished product
  - Sourdough bread or cooked cheese
  - Smoked/cooked fermented meats
  - Filtration removes most active bacteria in alcoholic beverages
  - Preservatives can destroy bacteria
Maintaining the Microbiome

- Minimize refined carbohydrates and sugars
- Impair immune function
- Promote inflammation
- Feed pathogenic organisms
Maintaining the Microbiome

- Avoid processed fructose
  - Alters the gut microbiome
  - Overharvesting of sugars and fat
  - Increased gut permeability
  - Increased inflammation
  - Promotes NAFLD
Maintaining the Microbiome

- Prebiotics
  - Non-digestible fiber
  - Stimulate development/activity of beneficial bacteria.
  - Enhance immune function
  - Improve absorption of dietary minerals
Maintaining the Microbiome

- Prebiotic foods
  - FOS (Fructo-oligosaccharides)
    - Inulin/chicory root, asparagus, Jerusalem artichoke, leeks, onion, garlic, bananas
  - Often included in probiotic supplements
Maintaining the Microbiome

- Prebiotic foods
  - Arabinogalactans
  - Carrots, pears, tomatoes, turmeric, Shitake mushrooms
  - Astragalus and Echinacea
Maintaining the Microbiome

- Other prebiotic sources: Almonds, burdock root, endive, leafy greens, jicama, kiwifruit, oats, salsify, whole wheat
Maintaining the Microbiome

- Probiotic Supplements
  - Broad-spectrum/Multiple species
  - Reputable manufacturers
  - Internal and third-party analysis
  - High Colony-Forming Units (billions)
  - Refrigerated/freeze-dried products

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Maintaining the Microbiome

• Probiotics in supplements and food
  • Sensitive to environmental factors:
    • Heat
    • Moisture
    • Oxygen
    • pH
  • Food labels: “Live, active cultures”
Making a Difference

- Model healthy choices
- Educate patients
- Encourage traditional diet
- Utilize nutrition professionals
References and Resources

• Books
  • *I Contain Multitudes*, Ed Yong
  • *The Swift Diet*, Kathie M. Swift
  • *The Inside Tract*, G Mullin & Kathie Swift
References and Resources

Publications

References and Resources

- Shen, S, Wong, CH, “Bugging Inflammation: Role of the Gut Microbiota, Clin Transl Immunology, 2016 Apr 15; 5 (4)
References and Resources
