Celebrate®
Nutritional Supplements

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How to address Gut Health after Bariatric Surgery

Katie Chapmon, MS, RD

In This Module...

Section 1: Microbiome and bariatric surgery

Section 2: Gut health nutrition and supplementation

Section 3: Case study

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What is the gut microbiome?

Harvard School of Public Health 2020;
Ursell et al 2012

- Made up of trillions of microorganisms including bacteria, archaea, eukaryotes, and viruses that inhabit the gastrointestinal tract

- Endocrine organ involved in conversation and connection with the body

- Functions
    - Maintenance of homeostasis
    - Stimulate the immune system
    - Synthesize and activate vitamins and hormones
    - Contain enzymatic properties that breakdown food components
    - Secrete metabolites

What is the gut microbiome?

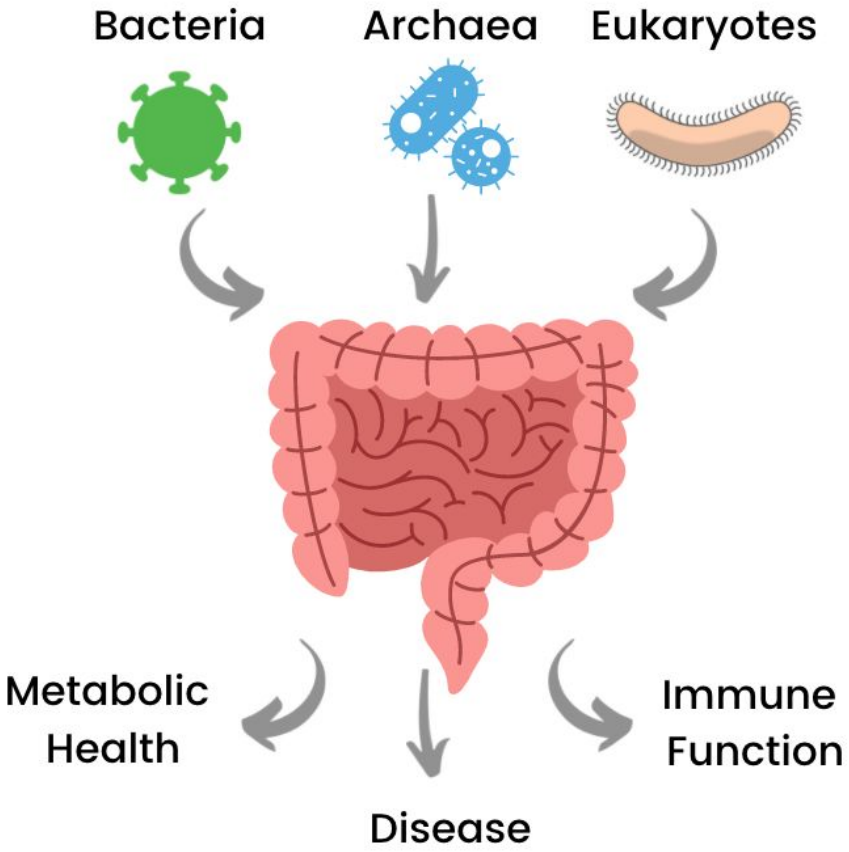
Lv et al 2019; Sheyte et al 2022

- Alternative terms
  - Gut microflora
  - Gut microbiota

- Up to 100 trillion cells and 1,000 species inhabit the microbial community

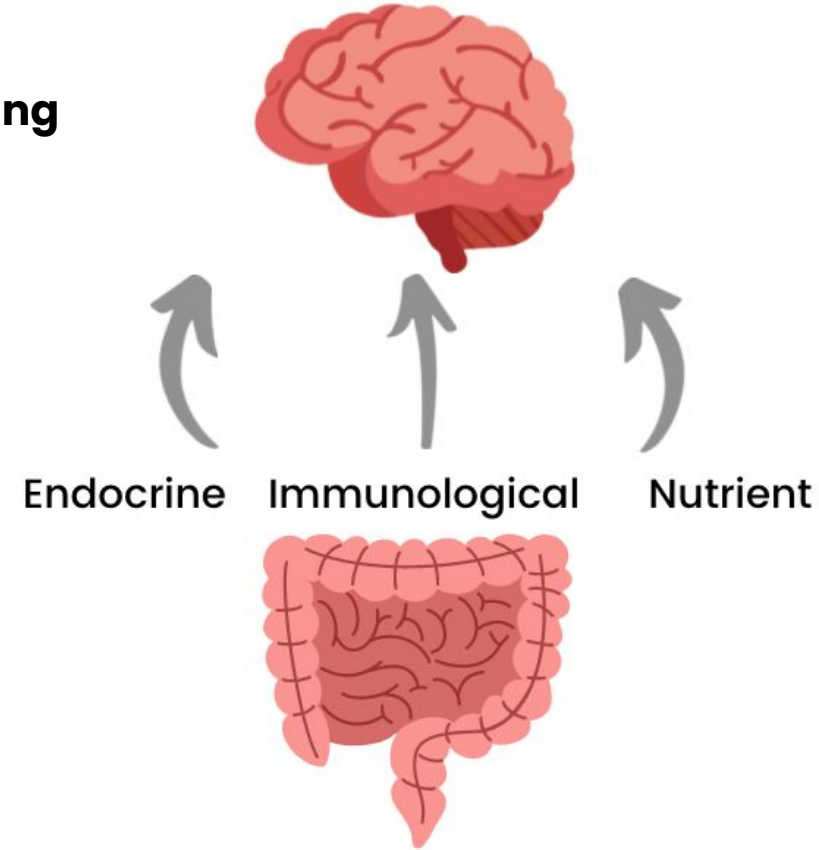
- Composed of 5 different families of microbiota
  - Bacteroidetes
  - Firmicutes
  - Actinobacteria
  - Proteobacteria
  - Verrucomicrobia

Gut Microbiome



Barko et al 2018

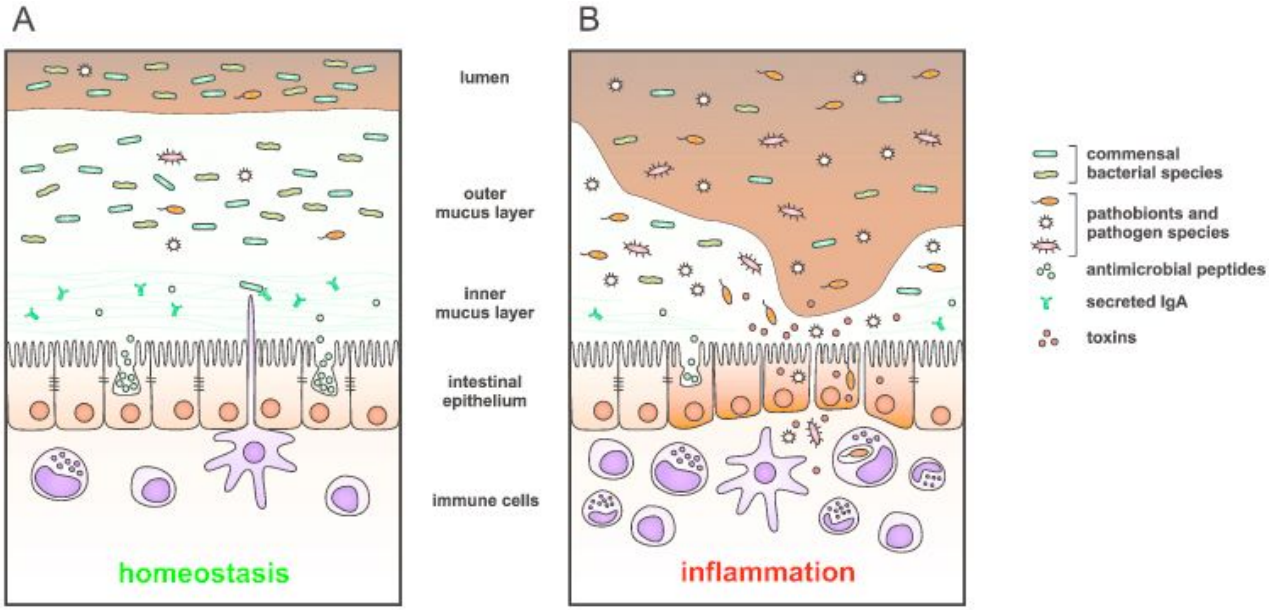
Gut-brain signalling



Barko et al 2018

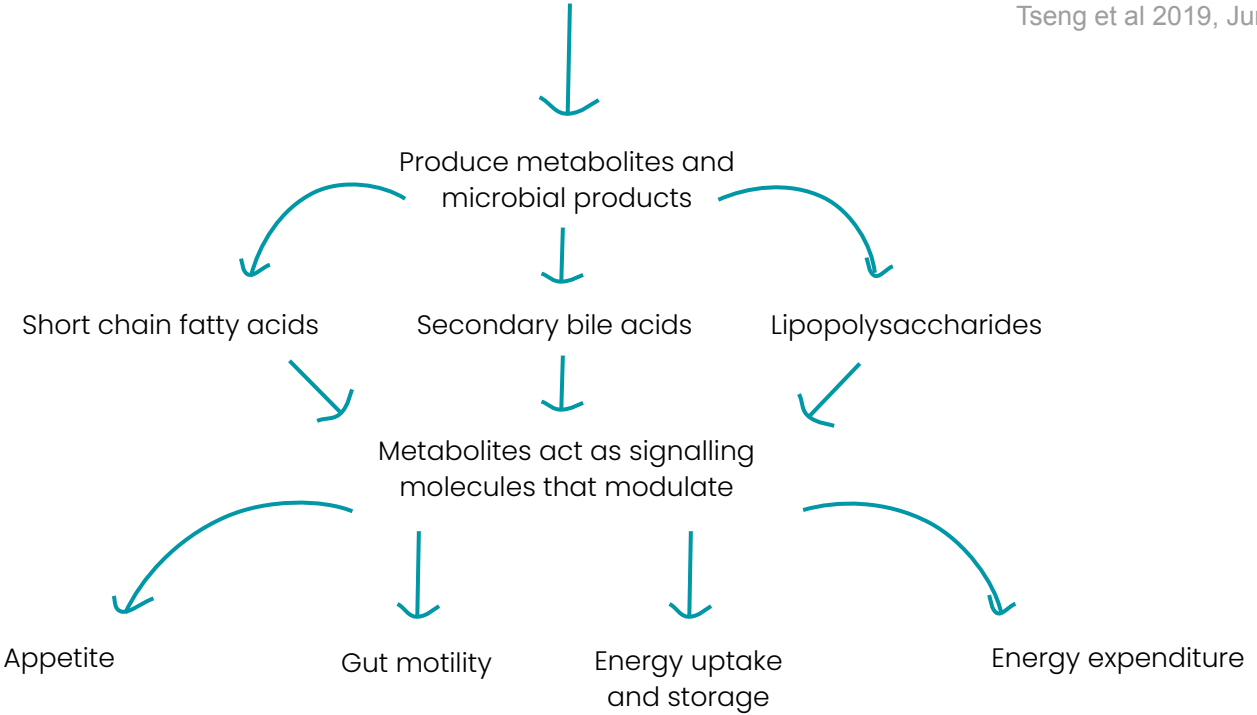
Microbiome lining

Matijasic et al 2016



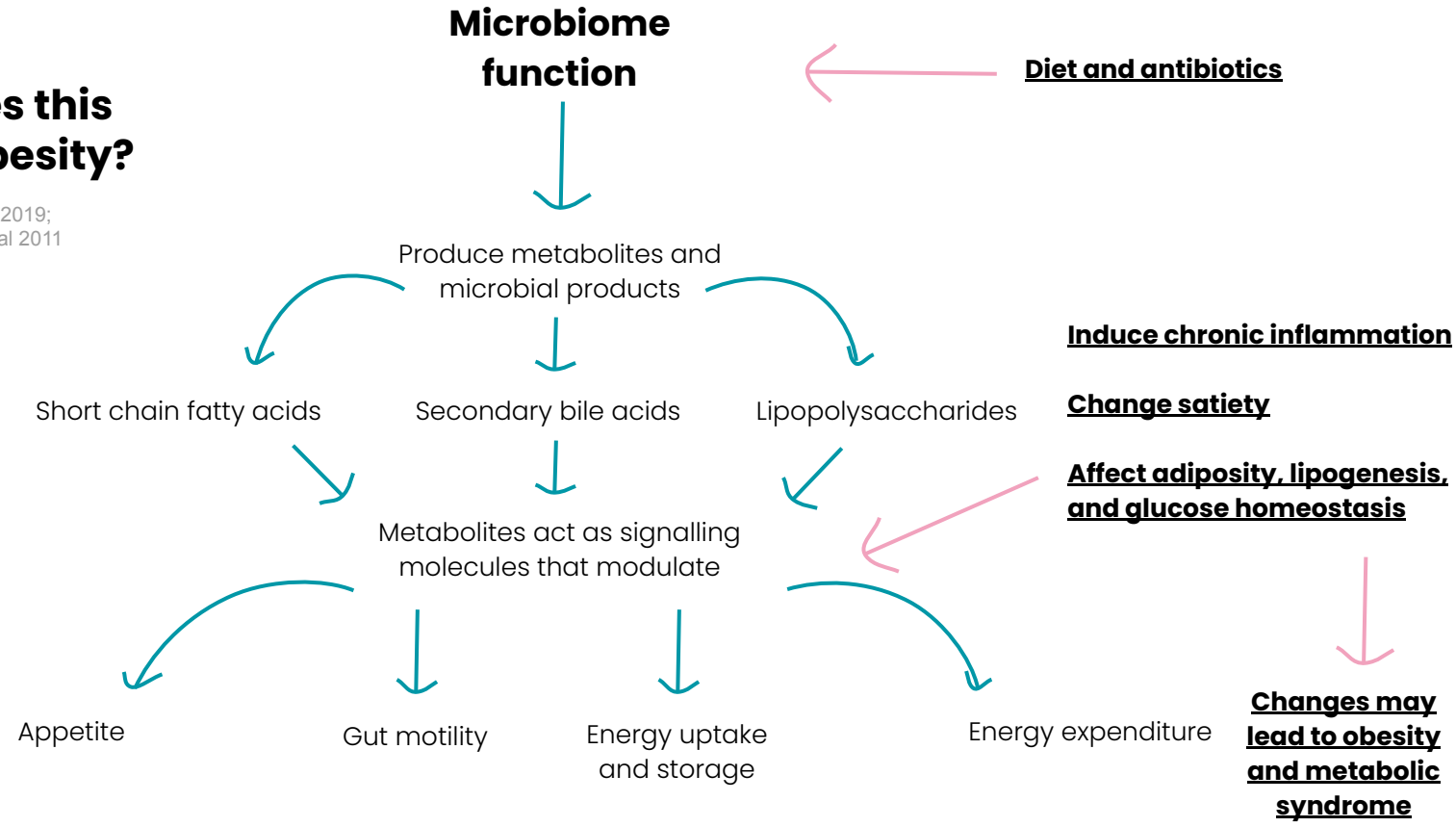
Microbiome function

Tseng et al 2019, Jumpertz et al 2011

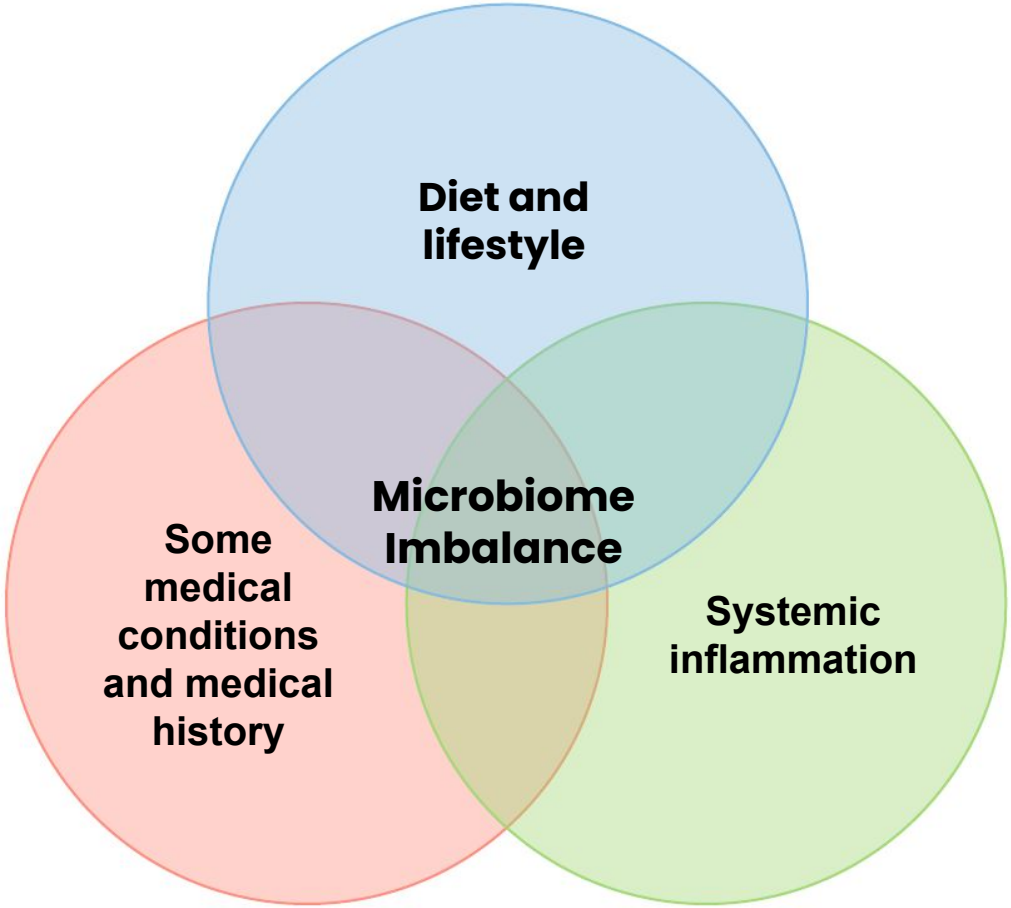


How does this affect obesity?

Tseng et al 2019;
Jumpertz et al 2011



Causes


Diet and lifestyle
Microbiome Imbalance
Some medical conditions and medical history
Systemic inflammation

Microbiome after bariatric surgery

Pournaras et al 2009; Zhang et al 2009; Patel et al 2017

- Changes in hormones
  - Gut-brain axis
  - Insulin secretion

- Double impact
  - Nutrient absorption changes → leads to changes in microbiota composition
    - Changes in surface area for absorption also contribute
  - Nutritional intake / recommendations after surgery

Specific microbiome changes after surgery

Sabate et al 2017; Zhang et al 2009; Koulas et al 2021; Dietary Guidelines After Bariatric Surgery, 2022; Al-Akwaa 2010; Küper et al 2010; Giacolone 2019

Positive benefits

- Statistically significant decrease in Firmicutes to Bacteroidetes ratio
- Decrease in Methanogens
  - As species is primarily undetected in 16S rDNA stool samples in normal weight / post surgical patients
- Increase in Gammaproteobacteria
  - By 52-fold after RYGB

Possible conditions

- Overgrowth / SIBO may precipitate
  - Found in 15-40% of patients after surgery
- H. Pylori
  - Preoperative prevalence 8.7% (German cohort) - 85.5% (Saudi cohort) with series of intermediate values
  - May show up post op as well
- IBS
  - Prevalence ranges from 8-31% in patients with obesity

Gut health after bariatric surgery

Dietary Guidelines After Bariatric Surgery, 2022

Possibly review for post surgery

- Slow peristalsis right after surgery
  - Bowel movements change depending on surgery type

- Eating behaviors to prevent GI distress
  - Slow eating
  - Food mastication
  - Bite size
  - Food texture
  - Sugar, fat, fiber content

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Standard Information for Gut Health

Nutrition

- Increase Fiber or Fiber supplement
- Use of fermented foods
    - Yogurt, sauerkraut, kimchi
- Manage stress, increase physical activity, get adequate sleep

Supplementation

- Prebiotics
- Probiotics
- Saccharomyces boulardii

5 R's of Gut Health

1. **Remove:**
   Remove all the foods, which cause a reaction, intolerance, or other sensitivity

2. **Replace:**
   Replace digestive enzymes or fiber that may be missing
   Lessen dysbiosis to create space to reinoculate

3. **Reinoculate:**
   AKA rebuilding the gut flora with beneficial bacteria and an environment to support growth

4. **Repair:**
   Repair the gut lining with products to support gut lining integrity.

5. **Rebalance:**
   Emphasize lifestyle along the way because of the high impact of stress on the gut.

Microbiome evidence - Mediterranean or plant-based diet

Kim et al 2019; Najjar & Feresin 2019

- Research shows plant-based dietary patterns are effective in:
  - Achieving weight loss
  - Maintenance of healthy weight

- High-fiber fruits, vegetables, whole grains, legumes, nuts and seeds
  - Decreased meat and meat product consumption
  - Avoidance of high-sugar, high-fat processed foods

- Foods contain lower caloric density and improved nutritional value

- Fiber increases satiety and improves microbiota composition through fermentation

Microbiome evidence - Low FODMAPs

Bellini et al 2020; Vincenzi et al 2017

- Fermentable Oligosaccharides, Disaccharides, Monosaccharides And Polyols
    - Fermented in the lumen of the colon producing distention and GI symptoms
- Diet regime low in these sugars for 4-8 weeks followed by a reintroduction phase
- Short term studies have been successful in diagnosis of symptom inducing foods and decrease in gas producing GI symptoms

Potential downfalls:

- Nutritional adequacy
    - May decrease fiber intake and contain low amounts of iron, B vitamins, and calcium
- Difficult to teach and follow elimination diet
- Difficulty of reintroduction of eliminated foods may lead to unnecessary avoidance
- Potentially expensive

Microbiome evidence - SCD

Vincenzi et al 2017;
Kakodkar et al 2017

- Specific carbohydrate diet by restricts all sugars except for monosaccharides (glucose, fructose, galactose)
- Diet is supplemented with homemade yogurt, fermented for 24 hours to free it of lactose
- Hypothesized to reduce GI symptoms in IBD patients due to minimal digestion

Downfalls:

- Nutritional adequacy
    - Iron, calcium, folic acid, zinc, magnesium, vitamin A, D, B12 deficiencies may occur
- Very restrictive and difficult to follow
- Studies show low FODMAP diet more successful in symptom reduction

Microbiome evidence - GAPS Diet

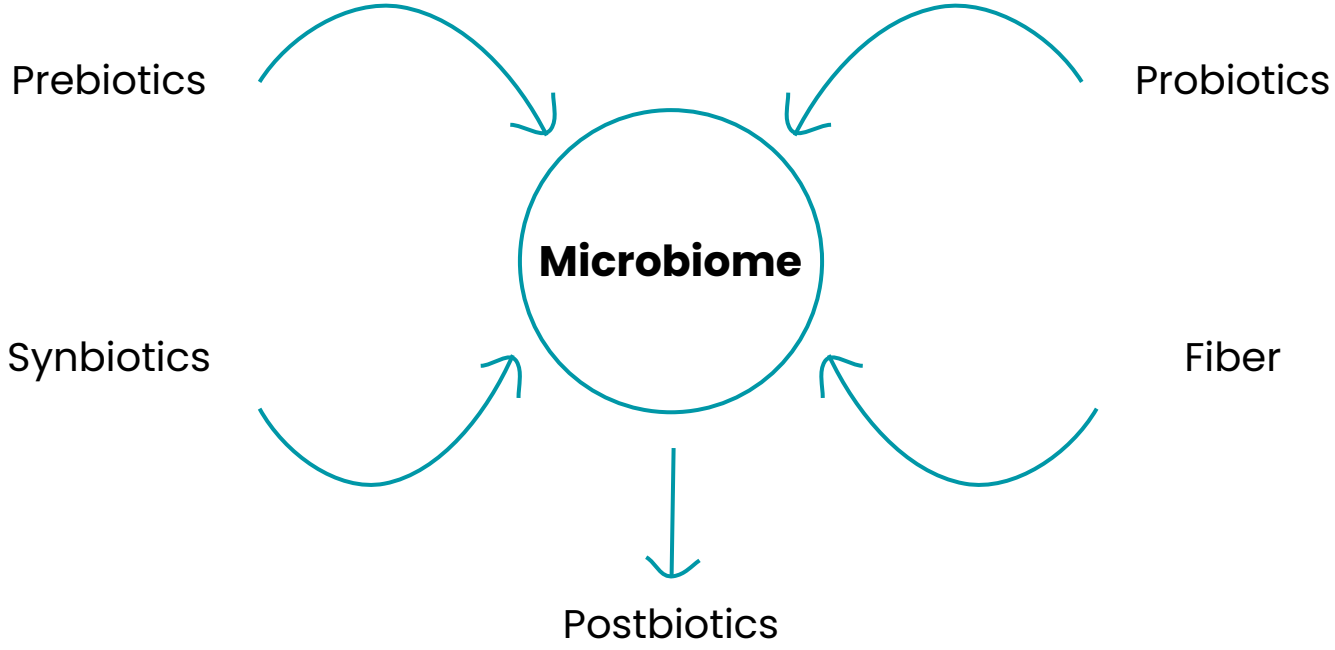
Khan and Richter 2020

- Gut and Psychology Syndrome (GAPS) and used as natural treatment for brain disorders like autism, ADHD, depression, schizophrenia, bipolar disorder, etc.
- Most often used for children and may assist with intolerances or allergies
- Strict elimination diet that involves restriction of
    - Grains
    - Pasteurized dairy
    - Starchy vegetables
    - Refined carbohydrates

Potential downfalls:

- Nutritional adequacy
    - May decrease intake of B vitamins, folate, and minerals
- Difficult to teach and follow elimination diet, especially in children
- Difficulty of reintroduction of eliminated foods may lead to unnecessary avoidance
- May take years to get to reintroduction phase

Overview


Prebiotics
Probiotics
Microbiome
Synbiotics
Fiber
Postbiotics

Terms to define

Lindshield 2018; Herman 2020

Prebiotics

- Food components that are not digested and promotes growth of good bacteria
- Plant fibers found in fruits, vegetables, whole grains, powders or capsules
    - Garlic, onions, leeks, asparagus, barley, oats
- “Food for microbes” as it feeds the healthy bacteria in the gut and supports growth of probiotics
- Plant fibers found in fruits, vegetables, whole grains, powder, or capsule
- Capsules contain inulin, fructo-oligosaccharides, galacto-oligosaccharides, mannan-oligosaccharides, and polydextrose

Probiotics

- Live microorganism that is eaten and populates in the digestive tract
- Yogurt, kefir, kimchi, sauerkraut, kombucha
- “Good microbes” used to repopulate a damaged microbiome or after the use of antibiotics
- Capsule form look for at least 1 billion colony forming units containing Lactobacillus, Bifidobacterium or Saccharomyces boulardii strains

Terms to define

Herman 2020

Fiber

- Non-digestible component of food that travels to the large intestine to be fermented
- Essential for gut health and feeds the GI tract
- Fermented to form postbiotics
- Found in fruits, vegetables, whole grains, nuts, seeds, & legumes, pill or powder supplementation

Postbiotics

- Products secreted by the microbes using prebiotics as fuel
- Postbiotics can be used to feed other microbes
- Examples: short-chain fatty acids, functional proteins (butyrate or pickled foods)
- Support the immune system and improve gut barrier function

Supplements to support healthy digestion

Markowiak & Slizewska et al 2017; Takakura & Pimentel 2020; Kelesidis & Pothoulakis 2012; Zang et al 2016

Synbiotics

- Mixture of both probiotics and prebiotics
- Used to populate in the digestive tract with a prebiotic component that favors the probiotic strains
- Look for combination of *Bifidobacterium* or *Lactobacillus* genus bacteria with fructooligosaccharides
- May survive the digestive tract better than probiotics alone

Ginger

- Flowering plant used as a spice available as an extract, tea, or capsule form
- Soothes digestive tract, improves symptoms of digestive distress
- Look for an organic form
- Functional medicine form of soothing digestion used for 100s of years

Supplements to support healthy digestion

Parikh et al 2019; Piuri et al 2021

Ground flax	Grapefruit seed extract
• Plant-based food that provides healthful fat, antioxidants, and soluble fiber • May help improve of microbiome composition and also works to decrease constipation and lowers high lipids • Ensure it is ground, not whole flaxseed and there is a robust nutty smell • Also aids in estrogen metabolism	• Liquid extract derived from the seeds, pulp, and white membranes of grapefruit • Contains antibacterial and antifungal properties • Liquid concentrate or capsules around 150 mg • Helps to support digestive balance

Supplements to support healthy digestion

Weiss & Hennet 2017

Digestive enzymes

- Enzymes to support protein, carbohydrate, fat, fiber, and dairy digestion
- Facilitates breakdown of food components to ease GI distress and replace missing enzymes
- Comprehensive blend of enzymes including proteases, lipases, amylase, and lactase
- Look for a product without Betaine if H. Pylori is suspected or patient has Hx of H. Pylori

Magnesium

- Essential mineral
- Assists with chronic constipation by promoting healthy microbiota composition and decreasing inflammation
- Best form is Magnesium Citrate for constipation while Magnesium Glycinate is used for hormonal balance and stress
- Use in conjunction with probiotic supplementation

Dysbiosis

Weiss & Hennet 2017

- Imbalanced gut microbiota composition
- Reduction of diversity
- Contributing factors include diet, antibiotics, immunity, intestinal barrier, and oxidative stress

SIBO

Sabate et al 2017

- Abnormal increase in the overall bacterial population in the small intestine
- Diagnosed via breath test, but limitations exist
  - No standardized testing procedures leading to high variability
  - Tests only pick up if in high amounts
  - Does not specify overgrowth in one section of the GI tracts
- May be accompanied by symptoms ranging from loss of appetite or fullness to abdominal pain, nausea, bloating, and diarrhea
- Surgery may facilitate SIBO and related symptoms

Dysbiosis and SIBO Supplementation

Guillamon et al 2021; Braun & Cohen 2015; Mahady et al 2005; Chen et al 2014; Kaiser Permanente 2015

Allium

- Organosulfur plant compounds within the onion family
- Anti-bacterial and help restore dysbiosis of species in GI tract
- Dietary consumption of onion, leeks, chives, and garlic 2-5 g/day but also through a dried power capsule supplementation 0.4-1.2g/day
- Beneficial to overall gut health, dietary consumption may increase fiber intake

Oregano Oil

- Wild-growing herb part of the mint family that is crushed and blended with oil
- Anti-bacterial/fungal and filled with antioxidants
- Crushed leaves blended with oil that can be consumed up to 200 mg/day or applied topically
- Treat digestive symptoms like cramping, bloating and H. pylori infection

Dysbiosis and SIBO Supplementation

Guillamon et al 2021; Braun & Cohen 2015; Mahady et al 2005; Chen et al 2014; Kaiser Permanente 2015

Berberine

- Alkaloid plant extract
- Contains antimicrobial, antimotility, and antisecretory properties
- Tablets or capsules, doses of 0.2–1.0 g/day
- May be beneficial in the treatment of diarrhea, gastroenteritis and other chronic diseases like diabetes

Sweet wormwood

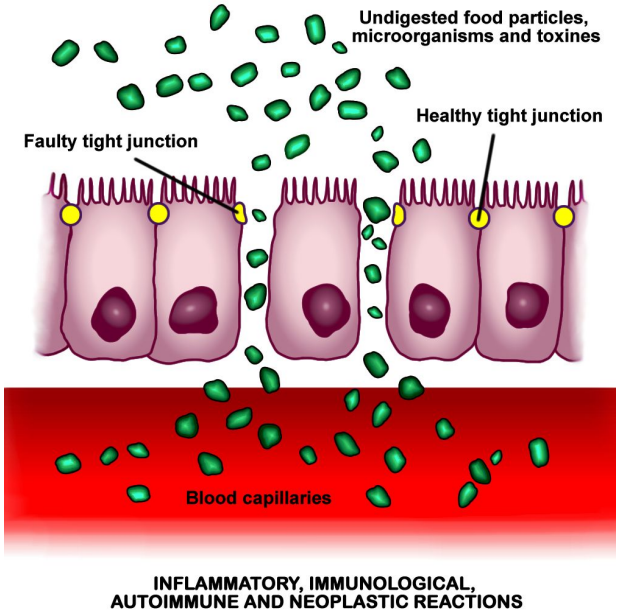
- Perennial herb native to Asia and Europe
- Promotes secretion of saliva, gastric juices, and proteins
- Bitters are generally taken by mixing 1–3 ml tincture into water and sipping 10–30 minutes before eating
- May be beneficial in relieving indigestion, heartburn, symptoms of IBS

Intestinal permeability

- Opportunistic bacteria may degrade protective gut barrier potentially leading to translocation of gut species into the general circulation

- Increased permeability associated with obesity
    - Decreased tight junction cohesion
    - High exposure of the liver to metabolites and inhibition of pro-inflammatory pathways

Koutoukidis et al 2022



Intestinal permeability supplementation

Koutoukidis et al 2022

Immunoglobulins

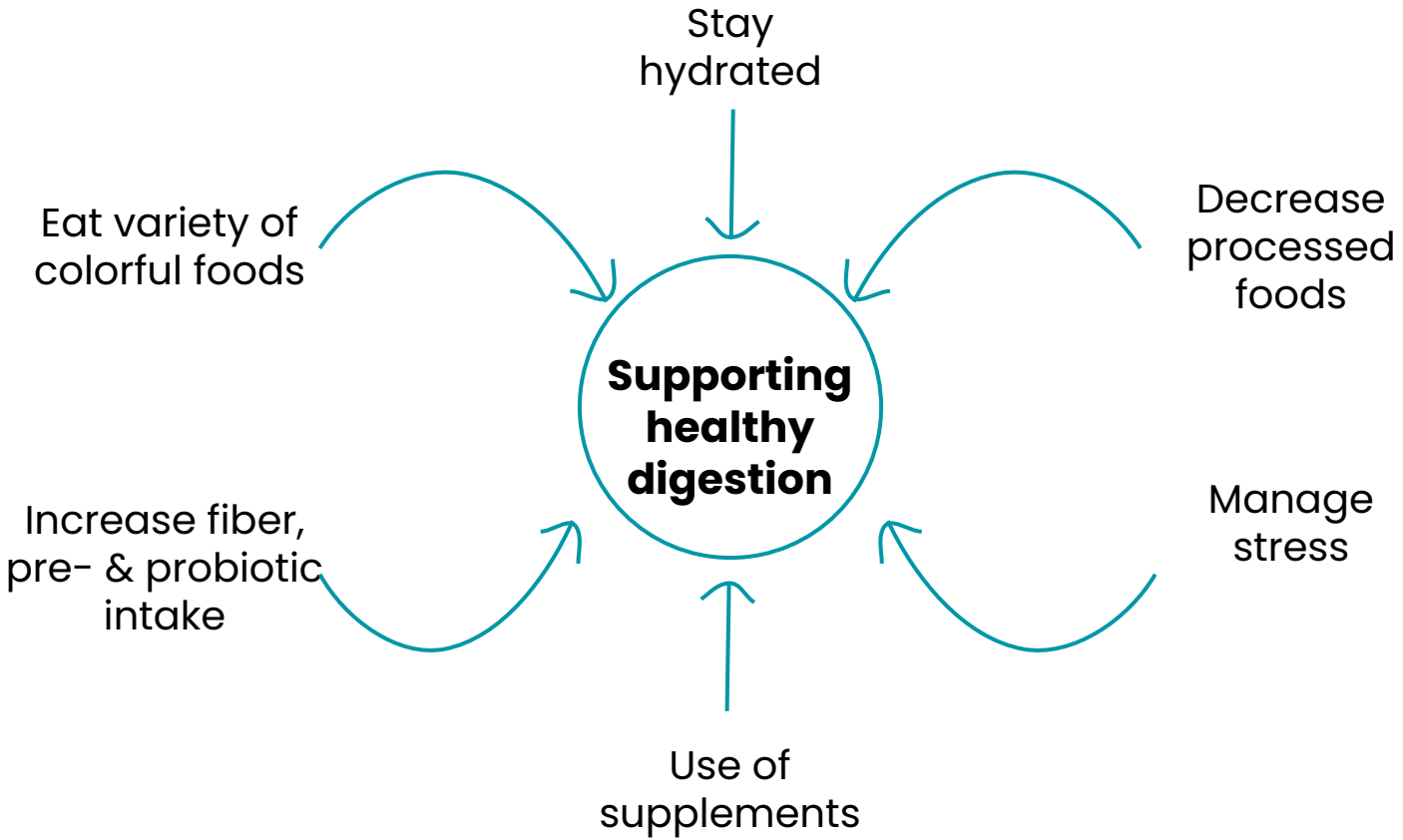
- Derived from serum of adult cows
- Used to strengthen the immune barrier and in treating diarrhea, loose stools, and maintaining the lining of the GI tract
- Look for a variety of immunoglobulin forms (A, B, etc) in a product
- Use for enteropathy and similar symptoms post op

S. Boulardii

- Probiotic Saccharomyces boulardii, live yeast found in capsule form
- Used for treating and preventing diarrhea
- Lyophilized (freeze-dried, no refrigeration needed) or heat-dried (refrigeration needed) preparations from a GMP certified facility
- Use for diarrhea flare ups

Supporting healthy digestion

Hydration	Movement	Manage Stress
• Water intake from drinking and eating foods with high water content • Supports gut motility by softening stools, helps breakdown foods/absorb nutrients • Aim for ~100 oz liquid intake and high water content foods like spinach, cucumber, apples and melons	• Daily exercise and body movement • Increases blood flow to the digestive tract, reduces stress, increases diversity of microbiome • Get 30 minutes of enjoyable exercise 5+ days a week ranging from simply walking to more intensive training	• Stress may delay stomach emptying from decreased blood flow to digestive tract • Assists gut-brain axis functioning, helps maintain normal digestive functions • Deep breathing, exercise, perform self-care, minimize screen time during eating


Stay hydrated
Eat variety of colorful foods
Decrease processed foods
Supporting healthy digestion
Increase fiber, pre- & probiotic intake
Manage stress
Use of supplements

Supplementation Summary

Healthy digestion	Constipation	Diarrhea	Bloating / Gas
Synbiotic Omega-3s	Ground flax, fiber, probiotic Mg Citrate	S. Boulardii Mucus membrane support	Dysbiosis Support Digestive Enzymes

Dysbiosis	SIBO	Intestinal permeability
Single use or blend of the following: Allium/Oregano Oil/Berberine/Sweet wormwood Digestive Enzymes	Single use or blend of the following: Allium/Oregano Oil/Berberine/Sweet wormwood Mucus membrane support	Immunoglobulins S. Boulardii

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Case #1 - 35 y/o F

- Height: 5'3”
- Weight: 185 lbs (#). Weight gain has been gradual over the past 6-7 years
- Medical diagnosis (Dx): Diabetes Mellitus - dx 4 yrs ago.
- Medications: Metformin 500 mg BID (twice a day)
- Supplements: has tried several probiotics and they haven't seemed to help. Tried fiber supplements and those felt worse (bloating and didn’t help diarrhea)

Case #1 - 35 y/o F

Patient (Pt) reports:

- Difficult time eating and feels worse when trying to eat "healthy".
- Vegetables are really difficult to digest and will usually result in stomach pains and diarrhea. Overall has diarrhea after eating.
- Sometimes will not eat during the day because pt. is concerned with having diarrhea at work
- Pt has been evaluated with colonoscopy and ultrasound with no results found

Case #1 - 35 y/o F

Food log:

Day	Time	Description of food
Day 1	8:15 AM	Coffee
	12:00 PM	Chips/packaged snack
	3:00 PM	Protein granola bar
	5:30 PM	Frozen microwave meal with chicken, broccoli, and cheese sauce
Day 2	8:45 AM	Coffee
	12:30 AM	Packaged strawberry yogurt cup with granola
	6:15 PM	Fast food hamburger and fries
		Fast food french fries
Day 3	7:50 AM	Coffee
	1:00 PM	Protein granola bar
	4:00 PM	Chocolate covered peanut candy
	5:45 PM	2 slices of pizza
		2 breadsticks

Bowel movements

- Vary between constipation and diarrhea
- 0-10 x / day
- Some urgency and dull cramping throughout the day

Bloating

- Wakes up fine but begins postprandial
- Gets worse and increases throughout the day
- Everyday occurrence

Case #1 - 35 y/o F

	Normal flora		
Enterococcus spp.	1.02e5	Low	1.9e5 - 2.00e8
Escherichia spp.	**2.21e7**		3.70e6 - 3.80e9
Lactobacillus spp.	**<dl**		8.6e5 - 6.20e8
Clostridia (class)	1.22e4	Low	5.00e6 - 5.00e7
Enterobacter spp.	6.19e5	Low	1.00e6 - 5.00e7
Akkermansia muciniphila	**<dl**		1.00e1 - 5.00e4
Faecalibacterium prausnitzii	**<dl**		1.00e3 - 5.00e8
Phyla Microbiota	Result		Normal
Bacteroidetes	2.05e11	Low	8.61e11 - 3.31e12
Firmicutes	2.25e9	Low	5.70e10 - 3.04e11

Case #1 - 35 y/o F

Opportunistic flora

Additional Dysbiotic/Overgrowth Bacteria	Result		Normal
Bacillus spp.	**1.51e4**		<1.50e5
Enterococcus faecalis	**<dl**		<1.00e4
Enterococcus faecium	**<dl**		<1.00e4
Morganella spp.	**<dl**		<1.00e3
Pseudomonas spp.	**2.85e1**		<1.00e4
Pseudomonas aeruginosa	**<dl**		<5.00e2
Staphylococcus spp.	**2.12e3**		<1.00e4
Staphylococcus aureus	**3.62e2**		<5.00e2
Streptococcus spp.	**2.80e3**	**High**	<1.00e3
Methanobacteriaceae (family)	**4.81e6**		<5.00e9

Intestinal health

Immune Response	Result		Normal
Secretory IgA	**3412**	**High**	510 - 2010 ug/g
Anti-gliadin IgA	**158**	**High**	0 - 157 U/L

Case #1 - 35 y/o F

- Initial visit:
  - Goal of plant forward Mediterranean diet.
  - First focus with less eating out and dinner at home. Practice adding in some vegetables
  - Trial run with protein supplementation during the day
  - Supplementation
    - Polyphenols
    - Synbiotic
    - *S. Boulardii*
    - Allium blend

- 1 month later
  - Bowel movement (BM): still diarrhea, but less frequent
  - Bloating is lessened but still present
  - Dinner has been going ok and protein supplement is working
  - Continue supplementation
  - Continue to focus on dinner and having more interest on vegetables

Case #1 - 35 y/o F

- 2 months later
  - BM are more regular with some diarrhea.
  - Bloating really isn't present
  - 4# weight loss
  - Continue supplementation
  - Nutritional changes are adding in anti-inflammatory foods and eat throughout the day

- 3 months later
  - Able to eat w/o diarrhea and having regular BM
  - Able to add in veggies, able to have frequency in eating
  - 13# weight loss
  - Continue supplementation
  - Nutritional changes - anti-inflammatory and now focusing on approx 1500 kcals daily and 80g protein

Case #1 - 35 y/o F

- 6 months later
  - Feels great and more energetic
  - BM are regular, daily
  - Able to consume vegetables daily and eat throughout the day
  - Is mostly following anti-inflammatory / Mediterranean, but could use some fine tuning
  - 32# weight loss

Review

- Addressing the gut microbiome may be a useful and additional tool in bariatric surgery management
- A quick assessment of gut and digestive health during a visit is an easy way to evaluate if the microbiome is part of the obesity picture
- Nutritional changes and supplementation should be considered to assist in healthy microbial function

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Celebrate® Nutritional Supplements

Thank you!

- Reach out if you have any questions
- For Healthcare Professionals: Check out BariatricNutritionPro.com

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