COMPLIMENTARY WEBINAR

The Mediterranean Diet and the Immune System: What Are the Potential Effects?

PRESENTED BY Christine Randazzo Kirschner MS, RD, CDN

May 4, 2023 2-3pm ET EARN 1 CEU FREE





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This activity will also award credit for dietetics (CDR CPEU).







Christine Randazzo Kirschner, MS, RDN, CDN

Qualifications

- Co-Founder of Amenta Nutrition
- Registered Dietitian Nutritionist
- Masters of Science in Nutrition, Hunter College
- Monash University-trained in the low-FODMAP diet
- Committee Member of Disorders of the Gut-Brain Interaction Group
- Member of the Academy of Nutrition and Dietetics
- CDR Certificate of Training in Obesity for Pediatrics and Adults

Affiliations

- Academy of Nutrition and Dietetics
- Greater New York Dietetic Association
- Practice Groups:
 - Dietitians in Medical Nutrition Therapy
 - Dietitians in Gluten & Gastrointestinal Disorders
 - Nutrition Entrepreneurs DPG





Learning Objectives

- 1. Acquire a basic understanding of the immune system.
- 2. Recognize which nutrients play a role in supporting the body's immune system.
- 3. Identify foods found in the Mediterranean Diet that contain important immune-supporting nutrients.





The Immune System



Adaptive Innate (acquired) (non-specific) RABBA





Adapted from Barrea, L., et. al. (2021). Nutrition and immune system: from the Mediterranean diet to dietary supplementary through the microbiota. Critical Reviews in Food Science and Nutrition, 61(18), 3066–3090. https://doi.org/10.1080/10408398.2020.1792826



• Physical Barriers

- Skin
- Gastrointestinal tract
- Respiratory tract
- Nasopharynx
- Cilia
- Eyelashes and other body hair
- Defense Mechanisms
 - Secretions
 - Mucous
 - Bile
 - Stomach acid
 - Saliva, tears, urine, and sweat



System



- White Blood Cells/Leukocytes
 - Phagocytes
 - Monocytes/macrophages
 - Mast Cells
 - Neutrophils
 - Eosinophils
 - Basophils
 - Dendritic cells
 - Natural killer (NK) cells
- Innate lymphoid cells
- Endothelial/epithelial cells
- Antimicrobial peptides
- Cytokines (IL-1, IL-10)
- Seric proteins (C-reactive protein)
- Cellular receptors



Adaptive Immune

System



- Lymphocyte
 - B Lymphocyte
 - T Lymphocyte
- Antibodies in the blood and other bodily fluids





GI Tract, Gut Microbiota & the Immune System

The Mucosa of the Gastrointestinal Tract

Epithelium and Intestinal Villi

- Enterocytes: intestinal barrier and antigen uptake (absorption of nutrients/entry of substances)
- **Goblet cells**: production and secretion of mucine
- Tuft cells: as as sensor for host-warns of eukaryotic parasites
- Enteroendocrine cells: hormone-producers, regulate appetite as well as gut microbiota composition and integrity of intestinal epithelium
- Paneth cells: production of antimicrobial peptides → responsible for controlling gut microbiota composition
- **M cells**: capture and translocation of microbes and molecules from intestinal lumen

Lamina Propria

Peyer's Patches:

T and B Lymphocytes

🙀 Dendritic cells, macrophages, mast cells, etc.





Gut Microbiota & Immune System Interactions



García-Montero, C., et al. (2021). Nutritional components in western diet versus Mediterranean diet at the gut Microbiota-immune system interplay. Implications for health and disease. Nutrients, 13(2), 699. https://doi.org/10.3390/nu13020699

Gut Microbiota & Immune System Interplay

Cells of epithelium and immune cells both have receptors that detect...

Pathogens
Microbes
Metabolic products from microbial communities





Detect pathogens coming from outside and metabolic products from from inside the microbiome

Inflammatory Response







Acute Inflammation

The Beneficial Kind

- Mechanism of innate immunity
- Protective response involving immune cells, blood vessels, and molecular mediators
- Goals:
 - eliminate initial cause of cell injury
 - clear out necrotic cells and tissues that were damaged
 - Initiate tissue repair





Chronic Inflammation

The Damaging Kind

- Chronic inflammation is not a specific disease but a mechanistic process.
- Continued tissue damage and scar tissue formation that progresses silently – major threat to health and longevity
- The World Health Organization (WHO) ranks chronic inflammatory disease as the greatest threat to human health.
- Worldwide 3 of 5 people die due to chronic inflammatory diseases such as stroke, chronic respiratory diseases, heart disorders, cancer, obesity, and diabetes.

Nutrients & Food Compounds



Nutrients: Key Players in the Immune System



Polyphenols Fiber Omega-3 Fatty Acids Zinc, Iron, Selenium

Barrea, L., at. al (2021). Nutrition and immune system: from the Mediterranean diet to dietary supplementary through the microbiota. Critical Reviews in Food Science and Nutrition, 61(18), 3066–3090. https://doi.org/10.1080/10408398.2020.1792826



Anti-Inflammatory Food Compounds

17/1

Dietary Inflammatory Index			
Food Parameter	Weighted number of articles	Raw inflammatory effects score*	Overall inflammatory effect score [†]
Alcohol (g)	417	-0.278	-0.278
Vitamin B ₁₂ (µg)	122	0.205	0.106
Vitamin B ₆ (mg)	227	-0.379	-0.365
Beta-carotene (µg)	401	-0.584	-0.584
Caffeine (g)	209	-0.124	-0.110
Carbohydrate (g)	211	0.109	0.097
Cholesterol (mg)	75	0.347	0.110
Energy (kcal)	245	0.180	0.180
Eugenol (mg)	38	-0.868	-0.140
Total fat (g)	443	0.298	0.298
Fibre (g)	261	-0.663	-0.663
Folic acid (µg)	217	-0.207	-0.190
Garlic (g)	277	-0.412	-0.412
Ginger (g)	182	-0.588	-0.453
Fe (mg)	619	0.032	0.032
Mg (mg)	351	-0.484	-0.484
MUFA (g)	106	-0.019	-0.009
Niacin (mg)	58	-1.000	-0.246
n-3 Fatty acids (g)	2588	-0.436	-0.436
n-6 Fatty acids (g)	924	-0.159	-0.159
Onion (g)	145	-0.490	-0.301
Protein (g)	102	0.049	0.021
PUFA (g)	4002	-0.337	-0.337
Riboflavin (mg)	22	-0.727	-0.068
Saffron (g)	33	-1.000	-0.140
Saturated fat (g)	205	0.429	0.373



Adapted from Shivappa, N., Steck, S. E., Hurley, T. G., Hussey, J. R., & Hébert, J. R. (2014). Designing and developing a literature-derived, population-based dietary inflammatory index. Public Health Nutrition, 17(8), 1689–1696. https://doi.org/10.1017/S1368980013002115

The Role of Fiber



Changes in microbiome



Diet has quick effect on: microbial composition, changes in pH, intestinal permeability, bacterial metabolites





ASM Journals Microbiology

American Gut: An Open Platform for Citizen Science Microbiome Research

ABSTRACT

Although much work has linked the human microbiome to specific phenotypes and lifestyle variables, data from different projects have been challenging to integrate and the extent of microbial and molecular diversity in human stool remains unknown. Using standardized protocols from the Earth Microbiome Project and sample contributions from over 10,000 citizen-scientists, together with an open research network, we compare human microbiome specimens primarily from the United States, United Kingdom, and Australia to one another and to environmental samples. Our results show an unexpected range of beta-diversity in human stool microbiomes compared to environmental samples; demonstrate the utility of procedures for removing the effects of overgrowth during room-temperature shipping for revealing phenotype correlations; uncover new molecules and kinds of molecular communities in the human stool metabolome; and examine emergent associations among the microbiome, metabolome, and the diversity of plants that are consumed (rather than relying on reductive categorical variables such as veganism, which have little or no explanatory power). We also demonstrate the utility of the living data resource and crosscohort comparison to confirm existing associations between the microbiome and psychiatric illness and to reveal the extent of microbiome change within one individual during surgery, providing a paradigm for open microbiome research and education.

American Gut Project: >30 Plants per Week

Identified several putative short-chain fatty acid (SCFA) fermenters

> Associated with a reduction in certain antibiotic resistance genes

> > Detected feature was comprised of multiple isomers, including linoleic acid (LA) and conjugated linoleic acid (CLA)

> > > A diet containing various types of dietary fibers and resistant starches likely supports a more diverse microbial community

McDonald, D., et. al. (2018). American gut: An open platform for citizen science microbiome research. MSystems, 3(3). https://doi.org/10.1128/mSystems.00031-18

The Role of Antioxidants



Adapted from Amir Aslani, B., & Ghobadi, S. (2016). Studies on oxidants and antioxidants with a brief glance at their relevance to the immune system. Life Sciences, 146, 163–173. https://doi.org/10.1016/j.lfs.2016.01.014

The Role of Micronutrients

Immune Response

Inflammatory and Innate Immune Response

Adaptive Immune Response

Micronutrients & the Immune System

Vitamin A

Integrity of epithelia
Differentiation and function of NK-cells
Promotion of Foxp3+ Treg generation
Inhibition of Th1/Th17 generation
Phagocytic and oxidative burst activity of macrophages
Secretion of the pro-inflammatory cytokines IL-12 and IL-23
<u>Vitamin C</u>
Barrier integrity

- Scavenger of ROS

- Chemotactic ability and anti-bacterial activity of neutrophils
- Reduction of formation of neutrophil extracellular traps (NETs)

Vitamin D

- Production of antimicrobial peptides
- Modulation of macrophages/monocytes and dendritic cells functions
- Limits over-production of pro-inflammatory cytokines from macrophages (IL1, TNFalfa)

<u>Zinc</u>

- Maintenance of membrane barrier integrity
- Direct antiviral effects
- Decreases oxidative stress

Omega 3 FA

- Structures of cell membranes
- Inhibition of cytokine production
- Inhibiting neutrophil migration
- Clearance of polymorphonuclear leukocytes

Vitamin A

- Growth and differentiation of B cells
- Production of antibodies
- Immunoregulatory function of Treg cells

Vitamin C

- Differentiation and proliferation of B- and T-cells
- Immunostimulator of antibody production (IgM and IgG)
- T-cell maturation via epigenetic mechanisms

<u>Vitamin D</u>

- Limits over-production of pro-inflammatory cytokines from T cells (INFgamma, IL2, IL8, IL6)
- Th1 to Th2 shift, increases Th2 cytokines (IL4, IL10)
- Induces differentiation of T reg
- Reduces excessive antibody production

<u>Zinc</u>

- Limits excessive relate of pro-inflammatory cytokines (IL-2, IL-6, and TNF-alfa)
- Enhances the number of T reg

Omega 3 FA

- (specialized pro-resolving mediators (SPMs)
- Treg cells formation
- B cells activation
- Upregulate CCR5 expression



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The Role of High Quality Fats: MUFA, PUFA, Omega-3s

Dietary Fatty Acids & Immune Response

MUFA PUFA



• Omega-6 FAs

Microbiome Epithelium Macrophages Dendritic Cells Neutrophils T-Cells B-Cells Decreases:

- Barrier permeability
- Mucus production
- Pro-inflammatory cytokine production
- Oxidative stress

Increases:

- Tight junctions
- Healing

The Role of Polyphenols



Adapted from Shakoor H, Feehan J, Apostolopoulos V, Platat C, Al Dhaheri AS, Ali HI, Ismail LC, Bosevski M, Stojanovska L. Immunomodulatory Effects of Dietary Polyphenols. Nutrients. 2021; 13(3):728. https://doi.org/10.3390/nu13030728

Individual Nutrients vs. Individual Food vs. Overall Eating Pattern:

Which is the Winner?





Overall Eating Pattern

(aka, diet 🛃)

The Western Diet:



Low in fiber from...

Higher in...

- Whole Fruits
- Vegetables
- Whole Grains

- Saturated Fat
- Salt
- Ultra-Processed Foods (UPF)

Which can lead to chronic diseases like CVD, metabolic syndrome, T2DM, and cancer

It's not only about what you eat, but what you're not eating



What is the Mediterranean Diet?
Lifestyle vs. Eating Pattern

- Daily consumption of various fresh vegetables and fruit; nuts, seeds
- Grain products (bread, pasta, rice), mostly whole
- Consumption of legumes several times per week
- Cold pressed extra virgin olive oil for cooking & for seasoning as the main source of fat
- Herbs and spices, adding flavor to dishes
- Fresh fruit daily as dessert; infrequent consumption of sweets, cakes, and dairy desserts
- Fish and seafood (2 to 3 times weekly)
- Daily consumption of dairy, in particular yogurt (small portions of cheese less frequently)
- Eggs, source of high-quality proteins, 2 to 4 times weekly
- Infrequent consumption of red/processed meat, small portions (1-2x/month)
- Water as the main beverage
- Drinking moderate amounts of wine always with meals (Women: ≤1; for Men: 1-2 drinks/day)
- Preferring fresh, locally produced foods, which have been minimally processed
- Connection and respect with nature
- Flavorsome cooking
- Moderate portion sizes
- Moderate physical active every day
- Preparing & consuming meals in the company of other people
- Have an appropriate rest (enough time & quality of night-sleep & sleeping for a short period of time during the day if necessary [siesta])



Dominguez, L. J., Di Bella, G., Veronese, N., & Barbagallo, M. (2021). Impact of Mediterranean diet on chronic non-communicable diseases and longevity. Nutrients, 13(6), 2028. https://doi.org/10.3390/nu13062028

Overall Eating Pattern Includes:

- Plant foods
 - whole grains/cereals
 - seeds, nuts
 - fruits, vegetables
 - beans, legumes
- Olive oil as the principal source of fat
- Limited dairy products
- Moderate amounts of fish, poultry, and wine
- Low amounts of red meat
- Fresh fruit daily

The diet does not single out specific food items or limit calories!



Mediterranean Diet Pyramid





Vegetarian & Vegan Diet Pyramid



Mediterranean Diet-like eating patterns have many faces!

Debit Water & Tor Log Dâme Debit Water & Tor Log Dâ

OLDWAYS

Asian Diet Pyramid





OLDWAYS



Food pyramids used with permission from www.Oldwayspt.org.

Common Nutrients Found in a Mediterranean Diet Eating Pattern



Principle Nutrients in the Mediterranean Diet



Adapted from Barrea, L., et. al. (2021). Nutrition and immune system: from the Mediterranean diet to dietary supplementary through the microbiota. Critical Reviews in Food Science and Nutrition, 61(18), 3066–3090. https://doi.org/10.1080/10408398.2020.1792826

Polyphenols: Anti-Inflammatory & Antioxidant-Rich Foods

Flavones



Isoflavones



Hydroxytyrosol



Flavanols



Herbs/Spices



Flavonols



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Other Anti-Inflammatory & Antioxidant-Rich Foods



Practical Applications During Nutrition Counseling Sessions

Patient's Diet Recall

B: Oatmeal + berries + coffee

L: Salad (romaine, tomatoes, cucumbers, feta, grilled shrimp)+ side of sliced baguette

S: Apple + saltine crackers

D: Lemon chicken + green beans + Yukon baby potatoes

Ask yourself: where are those anti-inflammatory foods, antioxidants, fiber-rich foods, color, etc.?





Patient's Diet Modifications

B: Oatmeal + berries + coffee + cinnamon + nuts + chia seeds

L: Salad (romaine, tomatoes, cucumbers, feta, grilled shrimp + carrots + artichokes + asparagus + fresh basil + lemon vinaigrette) + side of sliced baguette whole wheat baguette OR lentil soup

S: Apple + almond or sunbutter + saltine crackers OR hummus + crudité

D: Pork chop Grilled Salmon + green beans + Yukon baby potatoes (+ oregano) + cannellini beans w/ cherry tomatoes & garlic

Global Meal Ideas

Soba noodles + spinach + edamame + shredded cabbage + diced carrots + cucumber + miso dressing + salmon

Chickpea tajine + yam + dates + cauliflower + tomatoes + couscous + almonds

Lentil curry stew + fresh or frozen vegetables + whole wheat naan + cucumber raita + chutney

Corn tortillas + grilled fish + shredded cabbage + lime + cilantro + mint + avocado + tomato





Global Meal Ideas



Meal	Nutrients
Soba Noodles + spinach + edamame + shredded cabbage + diced carrots + cucumber + miso dressing + salmon	Soba: zinc, iron, manganese, thiamin, protein, soluble fiber Olive oil: vit E, MUFA; Spinach: vit E, vit C, iron Edamame: Isoflavones, protein, vit C, calcium, iron, magnesium, copper, fiber, Purple cabbage: vit C, iron, anthocyanins; Carrots: Beta Carotene; Cucumber: Vit K Miso: Isoflavones, Zinc; Salmon: omega 3
Chickpea tajine + yams + dates + cauliflower tomatoes + couscous	Chickpea: fiber, zinc; Couscous: selenium Dates: iron, copper, B6, fiber, polyphenols, antioxidants Cauliflower: vit C, K; Tomato: lycopene, vit C, vit A; Yam: beta carotene Olive oil: vit E, MUFA; Almonds: vit E
Lentil curry stew + fresh or frozen vegetables + rice or whole wheat naan + cucumber raita + chutney	Lentil: protein, iron, zinc, copper, fiber, flavanols & other polyphenols Curry: spices/antioxidants Mixed frozen veg like peas + carrots: vit C, vit A, Zinc (green peas) Cucumber raita: probiotics in yogurt, vit K Whole wheat Naan: vit E, fiber
Corn tortillas + grilled fish + shredded cabbage + lime + cilantro + mint + avocado + tomato	Corn: vit C, fiber Grilled fish: omega 3, protein Purple cabbage: vit C, iron, anthocyanins; Tomato: vit C, vit A, antioxidant, lycopene Lime: vit C; Cilantro, mint: herbs: antioxidant Avocado: vit C, vit E, MUFA; Black beans: fiber, zinc, isoflavones



Pantry Meal Ideas



Frozen shrimp sauteed in olive oil + garlic + red pepper + sauteed frozen kale or spinach + canned tomatoes + grain like farro or polenta

Brown rice + frozen spinach served with poached or crispy egg (or canned salmon) + edamame + seaweed strips + sesame seeds + dash of soy sauce

Veggie chili: canned beans (kidney, black, chickpeas, cannellini) + frozen vegetables (zucchini, corn, carrots) + chili powder, paprika, garlic, onion powder, cumin + canned tomatoes

Shakshuka: canned tomatoes, frozen spinach + cauliflower or other vegetable, chickpeas + spices + eggs





Pantry Meal Ideas



	Meal	Nutrients
	Frozen shrimp sauteed in olive oil + garlic + red pepper + sauteed frozen kale or spinach + canned tomatoes + grain like farro or polenta	 Shrimp: lean protein; Olive oil: MUFA Garlic: flavonol, prebiotic; Red pepper flakes: flavones Kale/spinach: vit E, vit C, iron; Tomatoes: lycopene, vit c, vit A Farro: zinc, fiber, iron, protein, polyphenols, carotenoids, phytosterols and selenium
	Brown rice + frozen spinach + poached or crispy egg (or canned salmon) + edamame + seaweed strips + sesame seeds + dash of soy sauce	 Brown rice: protein, iron, zinc, copper, B vitamins Frozen spinach: vit E, vit C, iron, vit A Egg: protein, vit A, selenium, zinc, choline; Canned Salmon: omega -3, protein Frozen edamame: Isoflavones, protein, vit C, calcium, iron, magnesium, copper, fiber, Seaweed strips: iodine, vit C, vit A; Sesame seed: zinc, iron, B6, fiber, vit E
	Veggie chili: canned beans (kidney, black, chickpeas, cannellini) + frozen veggies (zucchini, corn, carrots) + chili powder, paprika, garlic, + onion powder, + canned tomatoes + cumin	Canned beans : iron, isoflavones, fiber, protein, zinc Zucchini : vit A, C; Corn : vit C, B vitamins, zinc; Carrots : vit A Spices : antioxidants, flavones; Olive oil or canola: MUFA, vit E, Cumin : flavonoids (quercitin) Onion : prebiotic, flavonols; Garlic : prebiotic, flavonols; Canned tomatoes : lycopene, vit c, vit A
	Shakshuka: canned tomatoes, frozen spinach + cauliflower or other veg, chickpeas + spices + eggs	Canned tomatoes : lycopene, vit c, vit A Spinach : vit E, vit C, iron, vit A, Cauliflower : vit C, K, B6, folate Canned chickpeas : zinc, fiber, protein; Dried spices : antioxidants, flavones Eggs : protein, vit A, selenium, zinc, choline



Key Takeaways

- Increase your intake of fruits, vegetables, whole grains, seeds, fish, poultry, & legumes
- Use a plant-based oil as staple cooking oil
- Pay particular attention to foods high in antioxidants, polyphenols, and other antiinflammatory compounds
- Omega-3 fats: salmon, trout, mackerel, soy, walnuts, and flaxseeds
- High-fiber foods encourage friendly gut microbes to help reduce inflammation
- Avoid charring foods when cooking at high temperatures
- Limit inflammatory foods: red/processed meats, fried fatty foods, saturated fats, foods
 & drinks w/ added sugar, refined carbohydrates, and ultra-processed foods











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