DR. HYMAN+

Food & Mood

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Disclosures

- Dr. Deanna Minich is the Chief Science Officer of Symphony Natural Health (independent contractor), speaker for Genova Diagnostics and Metagenics, Inc.
- She is a health educator and author of several books on wellness topics.
- She is CEO of her company, Food & Spirit, LLC.

Disclaimer

This presentation contains educational material only and is not intended to take the place of advice from your own physician(s) or to be a means of diagnosing or treating an illness.

Objectives:

- To understand **scientific mechanisms** for why mood disorders exist
- To learn at least **three eating strategies** to help with mental health
- To become familiar with **clinical tools** to help patients with their foods and moods
- To learn about **key nutrients** and a list of foods that contain these nutrients to help with moods

Select “root causes” related to mental health

- Inflammation (“brain on fire”)
- Gut microbiome
- Nutrient imbalances

Brain, Inflammation, and Cortisol

The triangle of mood dysregulation

Inflammation and Mood States: "Brain on Fire"

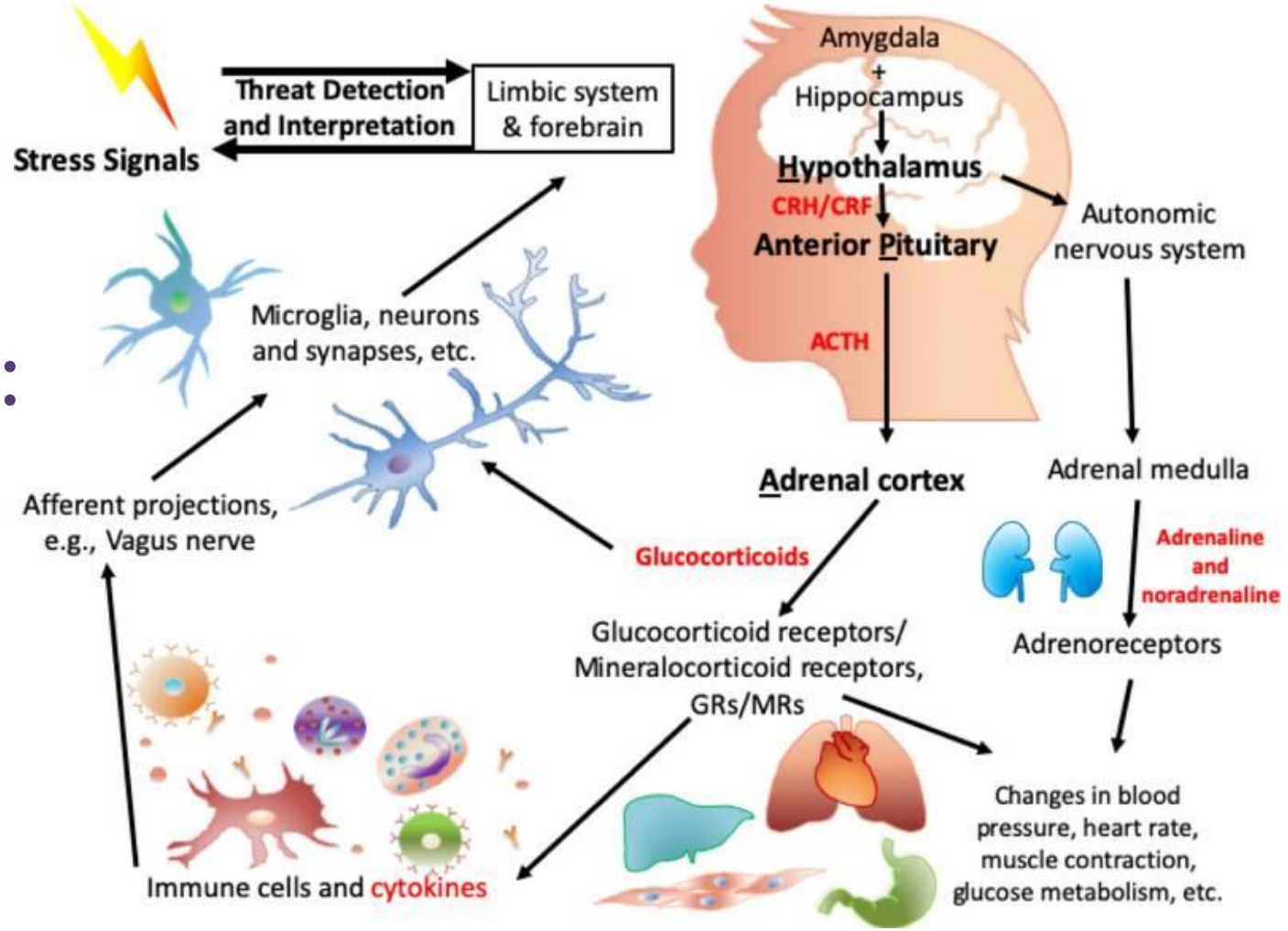


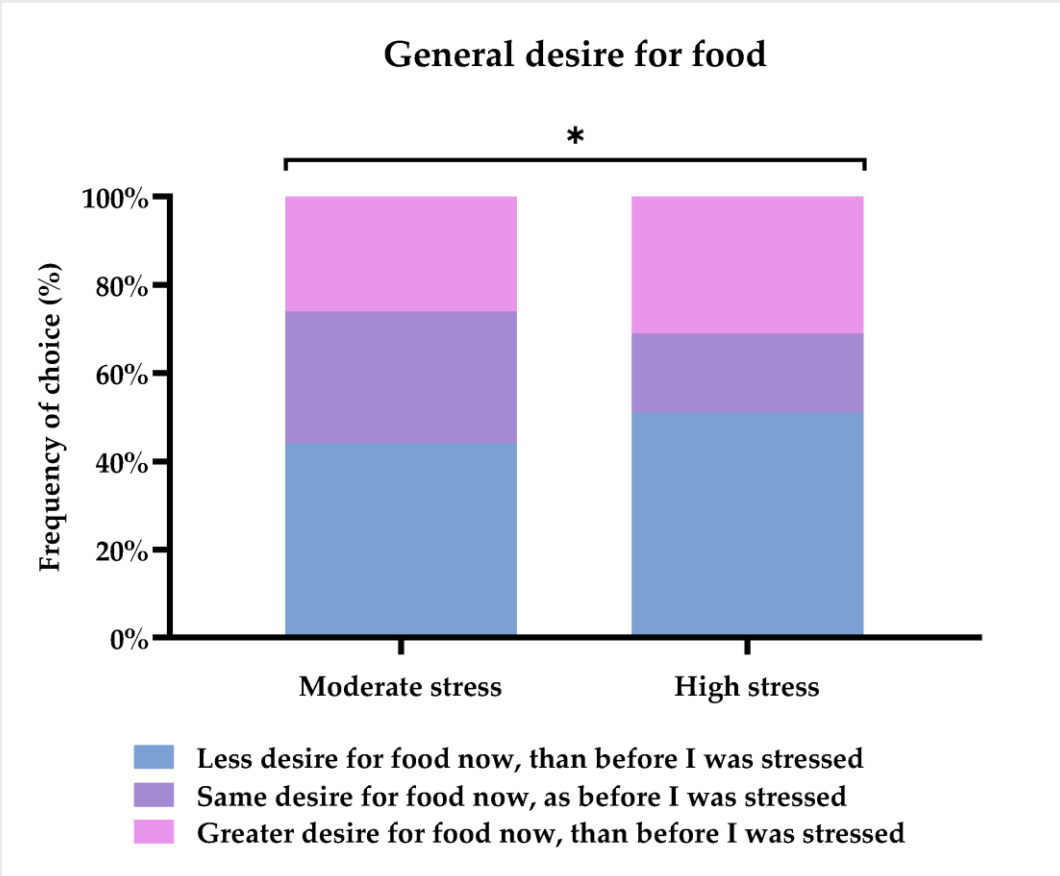
Figure from: Jiang S, Postovit L, Cattaneo A, Binder EB, Aitchison KJ. Epigenetic Modifications in Stress Response Genes Associated With Childhood Trauma. *Front Psychiatry*. 2019;10:808. Published 2019 Nov 8. doi:10.3389/fpsyt.2019.00808; No changes have been made. Copyright © 2019 Jiang, Postovit, Cattaneo, Binder and Aitchison. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0).

Less healthy food & lifestyle choices during stress

- High-calorie food with unhealthy sugars and fats are preferred foods for stressed individuals, especially women.
- For men, stress-coping behaviors include smoking and alcohol intake more than eating.
- High cortisol reactors tend to consume more than low cortisol reactors.

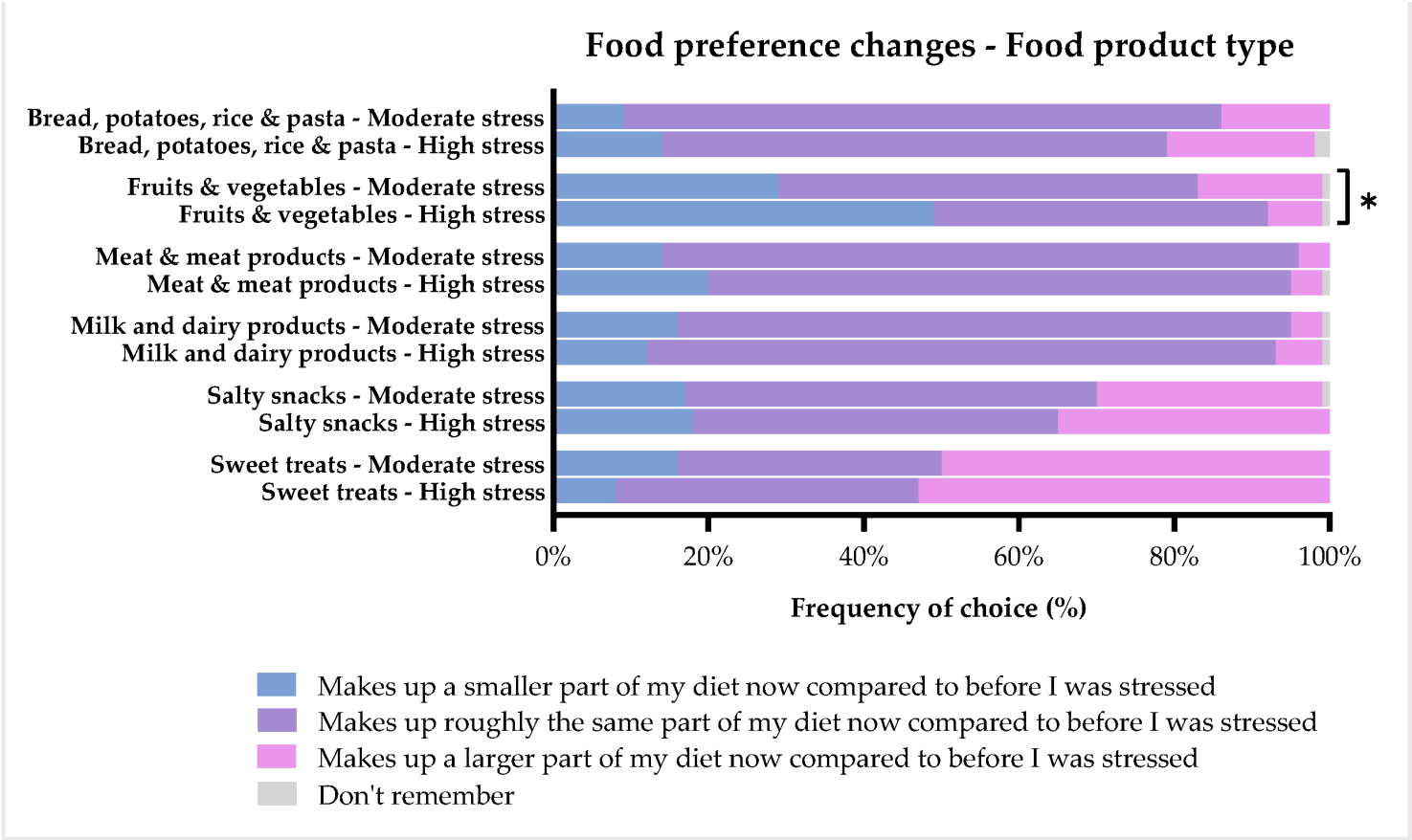
Ans AH, Anjum I, Satija V, et al. Neurohormonal Regulation of Appetite and its Relationship with Stress: A Mini Literature Review. *Cureus*. 2018;10(7):e3032. Published 2018 Jul 23. doi:10.7759/cureus.3032; Newman E, O'Connor DB, Conner M. Daily hassles and eating behaviour: The role of cortisol reactivity status. Psychoneuroendocrinology. 2007 Feb;32(2):125-32. Epub 2007 Jan 2.

Desire for food changes with stress levels



Hyldelund NB, Frederiksen C, Byrne DV, Andersen BV. Is Stress Taking the Pleasure Out of Food?-A Characterization of the Food Pleasure Profiles, Appetite, and Eating Behaviors of People with Chronic Stress. Foods. 2022 Jul 4;11(13):1980. doi: 10.3390/foods11131980. PMID: 35804795; PMCID: PMC9265269. CC-BY 4.0.

Food product preference changes with different levels of stress



Hyldelund NB, Frederiksen C, Byrne DV, Andersen BV. Is Stress Taking the Pleasure Out of Food?-A Characterization of the Food Pleasure Profiles, Appetite, and Eating Behaviors of People with Chronic Stress. Foods. 2022 Jul 4;11(13):1980. doi: 10.3390/foods11131980. PMID: 35804795; PMCID: PMC9265269. CC-BY 4.0.

Emotional eating leads to eating high-energy, low-nutrient foods

- Emotions as immediate; mood as prolonged.
- Emotional eating can present as eating high-calorie, intensely-tasting foods rich in sugar and fats in response to emotion (positive & negative).
  - Sweet-tasting foods: cake, ice cream, soda
  - Salty foods: chips, breads, pastas, snack foods

- Fuente González CE, et al. Relationship between Emotional Eating, Consumption of Hyperpalatable Energy-Dense Foods, and Indicators of Nutritional Status: A Systematic Review. J Obes. 2022 May 18;2022:4243868. doi: 10.1155/2022/4243868. PMID: 35634585; PMCID: PMC9132695.
- Nguyen-Michel ST, et al. Dietary correlates of emotional eating in adolescence. Appetite. 2007 Sep;49(2):494-9. doi: 10.1016/j.appet.2007.03.005. Epub 2007 Mar 19. PMID: 17466408; PMCID: PMC2020451.

Emotions affect taste

- N=550 hockey game attendees
- 4 wins, 3 losses, 1 tie
- Positive emotions were associated with more sweet and less sour taste intensity.
- Negative emotions were associated with more sour and less sweet taste.

Noel C, Dando R. The effect of emotional state on taste perception. Appetite. 2015 Dec;95:89-95. doi: 10.1016/j.appet.2015.06.003. Epub 2015 Jun 27. PMID: 26122754.

Taste can be affected by mental or physical stress

- Bitter, sour, and sweet tastes were tested after either mental tasks on a computer or physical tasks on an ergometer for 10-40 min.
- After mental tasks:
  - Duration of bitter, sour, and sweet taste was shortened compared with control.
  - The amount of each of these flavors was also decreased.
- After physical stress:
  - Sourness shortened

Nakagawa M, Mizuma K, Inui T. Changes in taste perception following mental or physical stress. Chem Senses. 1996 Apr;21(2):195-200. doi: 10.1093/chemse/21.2.195. PMID: 8670698.

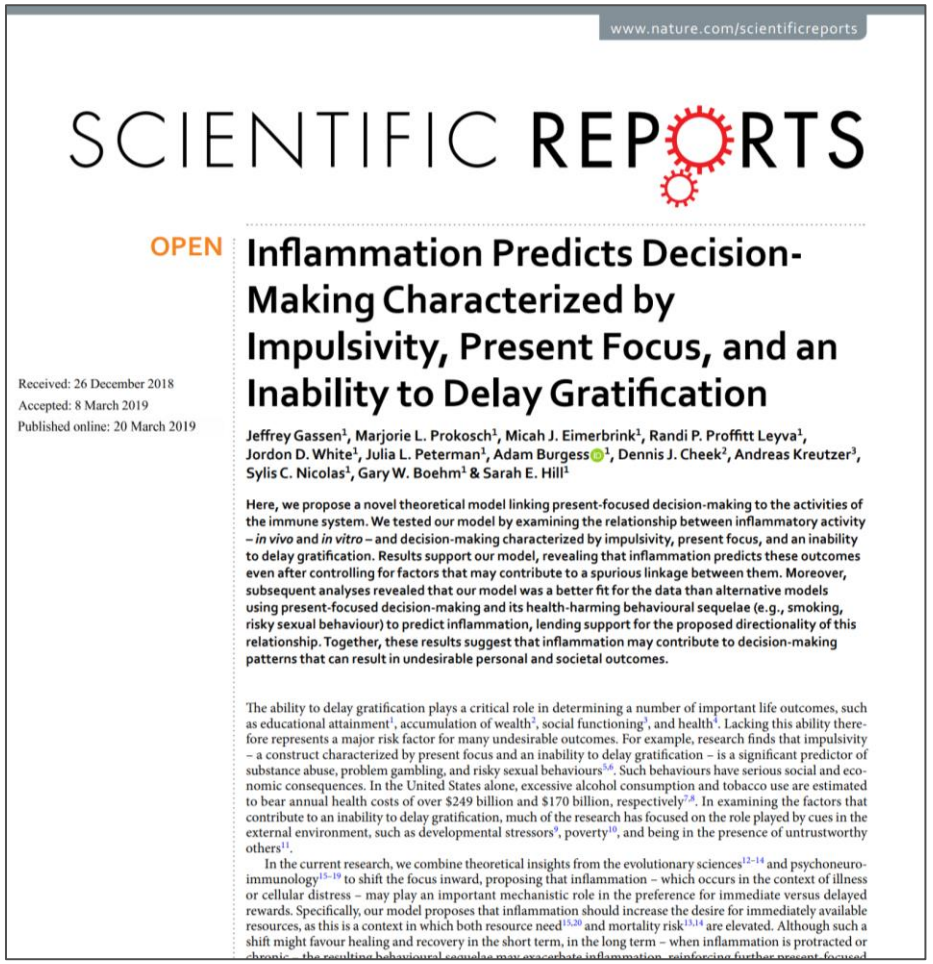
Psychoneuroendocrine Interface with Inflammation

Body and mind are one.

Inflammation

Impulsivity

Biology & psychology are interrelated.



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Inflammation Predicts Decision-Making Characterized by Impulsivity, Present Focus, and an Inability to Delay Gratification

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Published online: 20 March 2019

Jeffrey Gassen[1], Marjorie L. Prokosch[1], Micah J. Eimerbrink[1], Randi P. Proffitt Leyva[1], Jordon D. White[1], Julia L. Peterman[1], Adam Burgess[1], Dennis J. Cheek[2], Andreas Kreutzer[3], Sylis C. Nicolas[1], Gary W. Boehm[1] & Sarah E. Hill[1]

Here, we propose a novel theoretical model linking present-focused decision-making to the activities of the immune system. We tested our model by examining the relationship between inflammatory activity – *in vivo* and *in vitro* – and decision-making characterized by impulsivity, present focus, and an inability to delay gratification. Results support our model, revealing that inflammation predicts these outcomes even after controlling for factors that may contribute to a spurious linkage between them. Moreover, subsequent analyses revealed that our model was a better fit for the data than alternative models using present-focused decision-making and its health-harming behavioural sequelae (e.g., smoking, risky sexual behaviour) to predict inflammation, lending support for the proposed directionality of this relationship. Together, these results suggest that inflammation may contribute to decision-making patterns that can result in undesirable personal and societal outcomes.

The ability to delay gratification plays a critical role in determining a number of important life outcomes, such as educational attainment[1], accumulation of wealth[2], social functioning[3], and health[4]. Lacking this ability therefore represents a major risk factor for many undesirable outcomes. For example, research finds that impulsivity – a construct characterized by present focus and an inability to delay gratification – is a significant predictor of substance abuse, problem gambling, and risky sexual behaviours[5,6]. Such behaviours have serious social and economic consequences. In the United States alone, excessive alcohol consumption and tobacco use are estimated to bear annual health costs of over $249 billion and $170 billion, respectively[7,8]. In examining the factors that contribute to an inability to delay gratification, much of the research has focused on the role played by cues in the external environment, such as developmental stressors[9], poverty[10], and being in the presence of untrustworthy others[11].

In the current research, we combine theoretical insights from the evolutionary sciences[12–14] and psychoneuroimmunology[15–19] to shift the focus inward, proposing that inflammation – which occurs in the context of illness or cellular distress – may play an important mechanistic role in the preference for immediate versus delayed rewards. Specifically, our model proposes that inflammation should increase the desire for immediately available resources, as this is a context in which both resource need[15,20] and mortality risk[13,14] are elevated. Although such a shift might favour healing and recovery in the short term, in the long term – when inflammation is protracted or chronic – the resulting behavioural sequelae may exacerbate inflammation, reinforcing further present-focused

Gassen J, Prokosch ML, Eimerbrink MJ, et al. Inflammation Predicts Decision-Making Characterized by Impulsivity, Present Focus, and an Inability to Delay Gratification. *Sci Rep*. 2019;9(1):4928. Published 2019 Mar 20. doi:10.1038/s41598-019-41437-1; This article is licensed under a Creative Commons Attribution 4.0 International License

Physiology & Psychology Related to Chronic Stress States

PHYSIOLOGY

- ↑Stress hormones (CRH, ACTH, cortisol)
- ↑Glucose and insulin
- ↑Free fatty acids
- Insulin resistance
- ↑Catecholamines
- ↑Heart rate
- ↑Blood pressure
- ↑Heart rhythm

PSYCHOLOGY

- “Type A”
- Difficult to relax
- Reactive
- Anxious, agitated, angry
- Nervous energy
- Impatient/Irritable

HPATG DOWNREGULATED – Stress non-responsive

PHYSIOLOGY

- ↑CRH hyper-secretion leading to down-regulation of pituitary CRH receptors
- Increased negative HPA axis feedback
- Morphological changes (i.e. adrenal atrophy)
- Reduced synthesis or depletion of stimulating factors and hormones (i.e. CRH, ACTH, cortisol)

PSYCHOLOGY

- Lack of interest (anhedonia)
- Fatigue (debilitating)
- Low self esteem and self-blame or guilt
- Difficulty concentrating
- Thoughts of death or suicidal behavior
- Sleepiness
- Poor appetite
- Weight loss, catabolism
- Lack of interest in sex

Stress can get in the way of eating healthy.

Eating unhealthy creates more inflammation and stress.

- Nakagawa M, Mizuma K, Inui T. Changes in taste perception following mental or physical stress. Chem Senses. 1996 Apr;21(2):195-200. doi: 10.1093/chemse/21.2.195. PMID: 8670698.
- Newman E, O'Connor DB, Conner M. Daily hassles and eating behaviour: the role of cortisol reactivity status. Psychoneuroendocrinology. 2007 Feb;32(2):125-32. Epub 2007 Jan 2.

Eating can initiate inflammation

The physiology and psychology of one meal


Healing
Truths
Mind
Dreams
Intuition
Mood
Spirituality
Purpose
Consciousness
Survival
Body
Community
Expression
Creativity
Emotions
Balance
Goals
Energy
Love
Passions
Food is **more** than calories.
It connects to our **whole** self.
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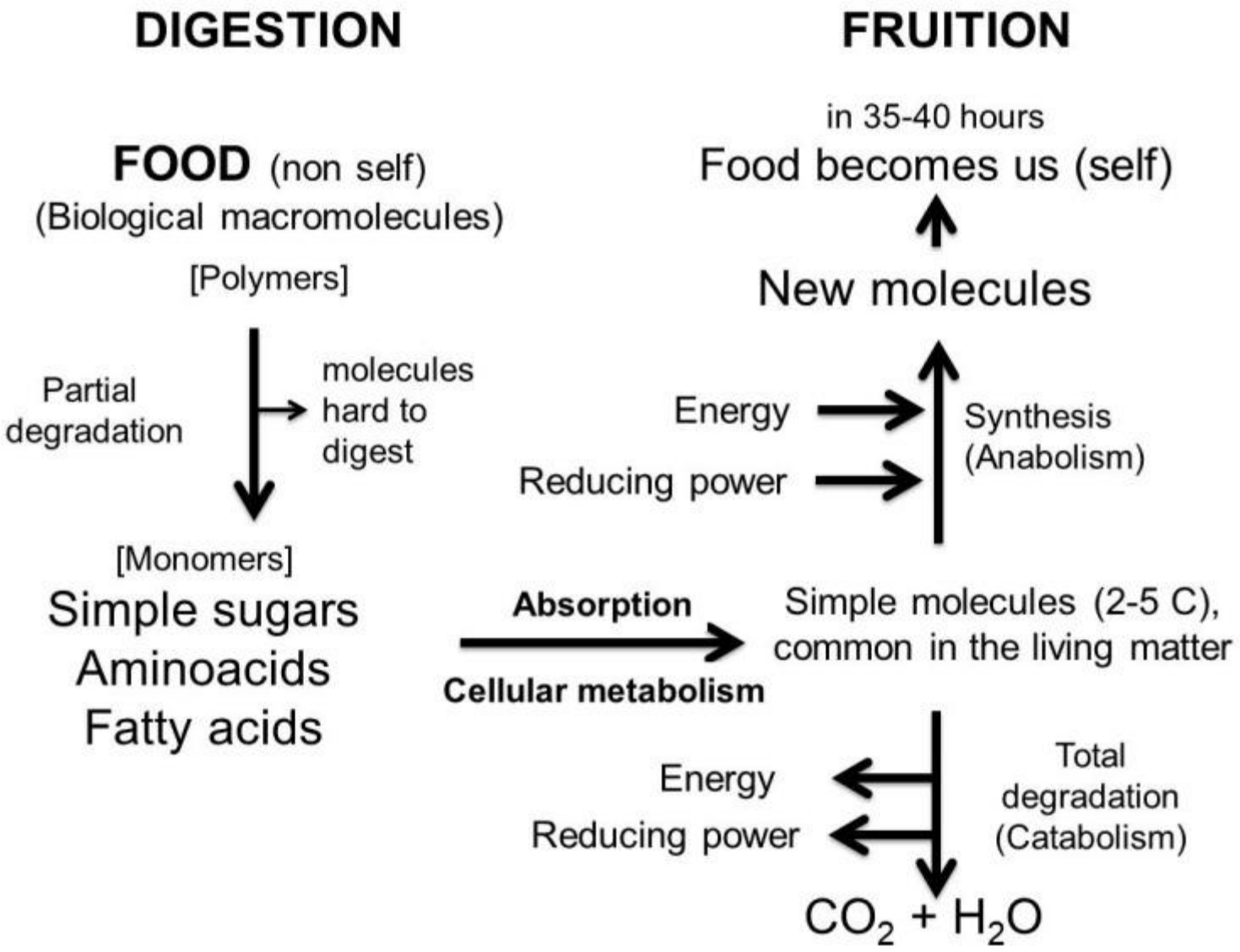
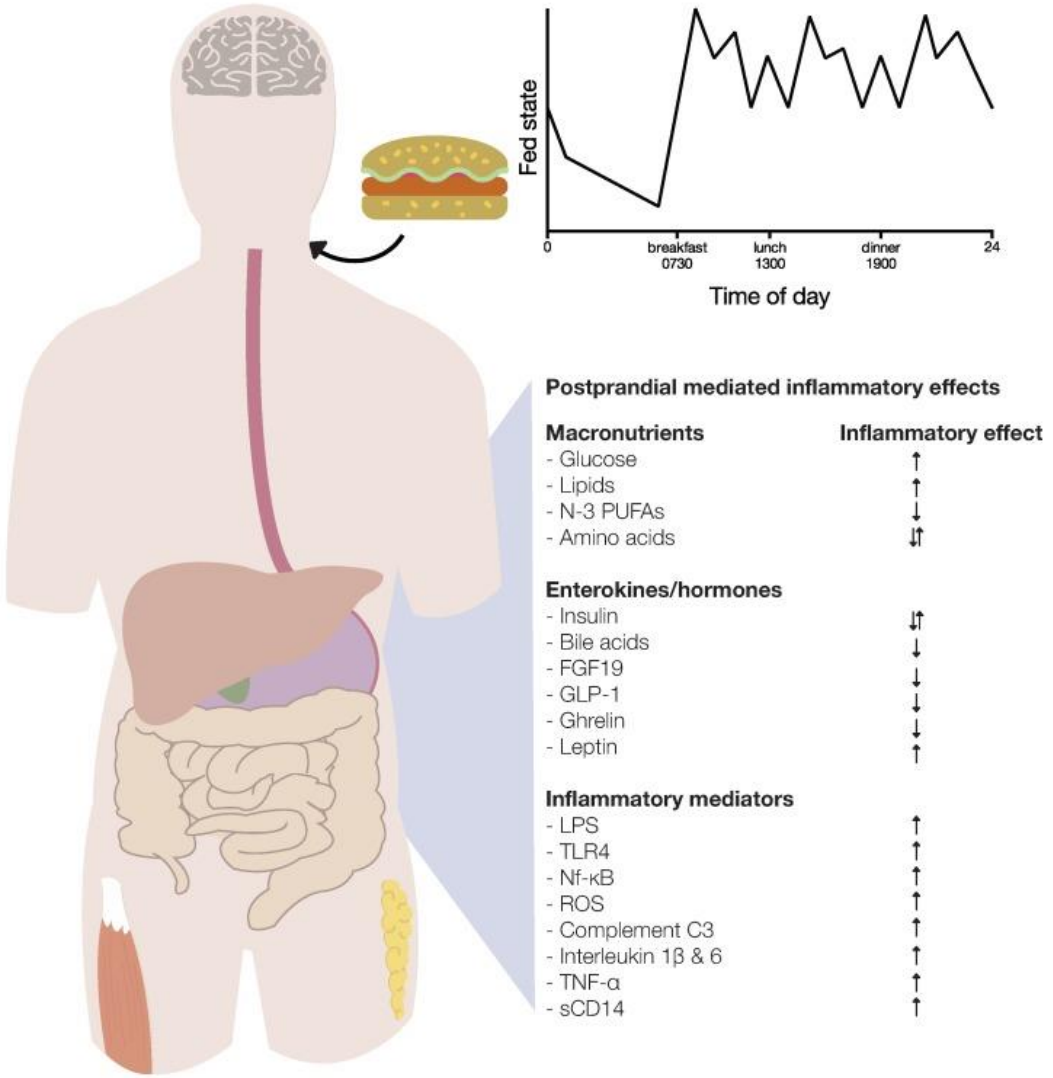


One meal can result in postprandial inflammation



One meal can create hours of inflammation

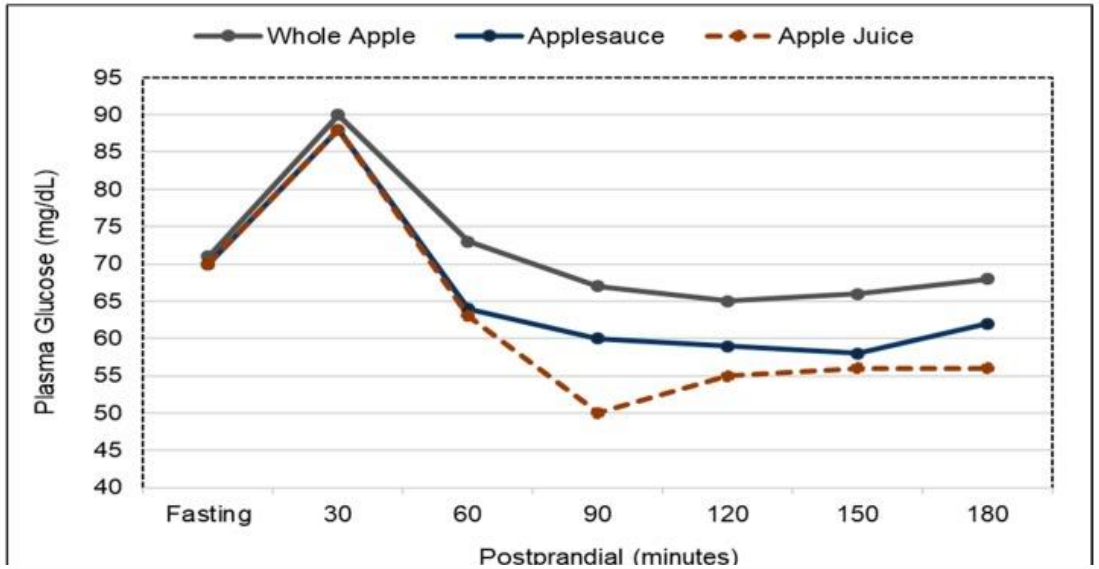
A single fast food-style meal can increase serum IL-6 by 100%, peaking about 6 hours after a meal.

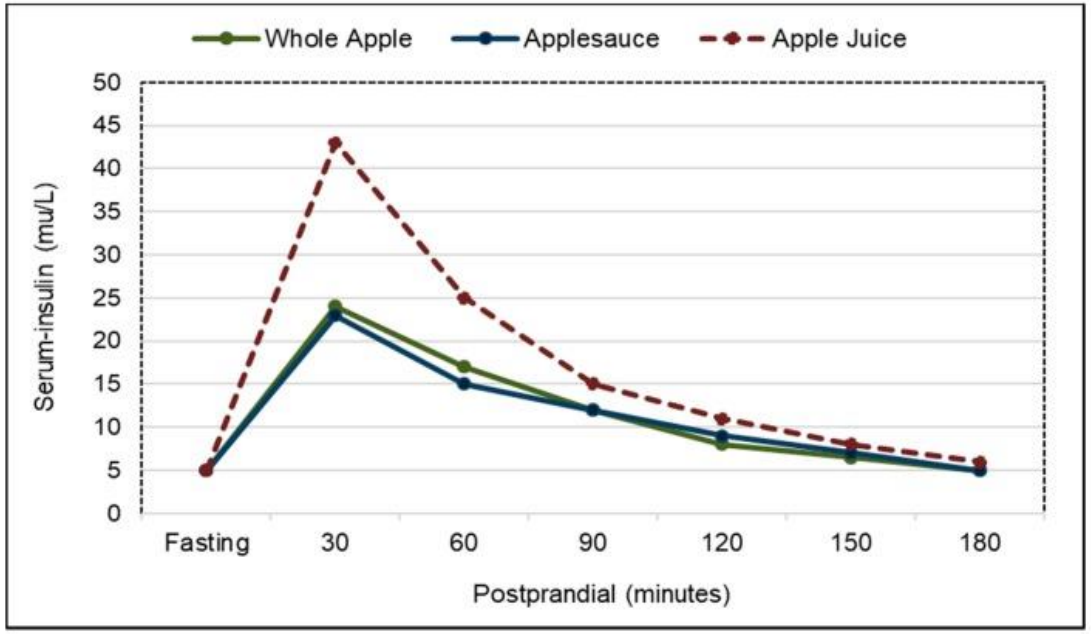
Sample meals included in the review:

- White bread, butter, cheese, milkshake
- Eggs, muffin, butter, sugary drink
- Sugar, heavy cream, chocolate syrup, powdered milk
- Bagel, cream cheese, potato, milk, apple juice

Emerson SR, Kurti SP, Harms CA, et al. Magnitude and Timing of the Postprandial Inflammatory Response to a High-Fat Meal in Healthy Adults: A Systematic Review. *Adv Nutr*. 2017 Mar 15;8(2):213-225. doi: 10.3945/an.116.014431. Print 2017 Mar.

The format of food is essential to consider with inflammation.





Inflammatory foods

1. Sugar
2. Cooking oils (corn, cottonseed, safflower, soy, sunflower)
3. Trans fats
4. White flour/refined grains
5. Excessive alcohol
6. Browned, fried foods

Reducing advanced glycation endproducts (AGEs) to reduce inflammation

- Endogenous & dietary compounds resulting from nonenzymatic reactions between the aldehydes of reducing sugars with proteins, lipids, or nucleic acids
- Formation/accumulation of AGEs related to accelerated aging and diabetes perhaps through gut inflammation and permeability
- Marker of oxidative stress and inflammation
- Binding to rAGE and upregulating cellular inflammation
- Reduce high heat cooking like grilling or broiling
- Use of phytonutrients to buffer effects (e.g., resveratrol, spices)

Del Turco S, Basta G. An update on advanced glycation endproducts and atherosclerosis. *Biofactors.* 2012 Apr 10. doi: 10.1002/biof.1018. [Epub ahead of print]; Snelson M, Lucut E, Coughlan MT. The Role of AGE-RAGE Signalling as a Modulator of Gut Permeability in Diabetes. *Int J Mol Sci*. 2022 Feb 3;23(3):1766. doi: 10.3390/ijms23031766. PMID: 35163688; PMCID: PMC8836043.

Herbs and spices help to reduce glycation with cooking:
Apply to foods before heat

- Spice more effective than herb extracts; inhibition of glycation was associated with phenolic acid content
- Most potent were extracts of cloves, ground Jamaican allspice, and cinnamon, followed by sage, marjoram, tarragon, and rosemary.
- Consider quality, expiration dates, storage and rancidity

Dearlove RP, Greenspan P, Hartle DK, Swanson RB, Hargrove JL. Inhibition of protein glycation by extracts of culinary herbs and spices. *J Med Food*. 2008 Jun;11(2):275-81. doi: 10.1089/jmf.2007.536.

Address inflammation with general principles of an anti-inflammatory diet

- Less high-heat cooking and frying
- Balanced omega-3/omega-6 index
- Higher dietary antioxidants
- Low to moderate glycemic index/load
- Reduce or avoid ultraprocessed foods
- Eat the rainbow of whole plant foods
- Avoid allergenic foods

Calle MC, Andersen CJ. Assessment of Dietary Patterns Represents a Potential, Yet Variable, Measure of Inflammatory Status: A Review and Update, Disease Markers, vol. 2019, Article ID 3102870, 13 pages, 2019. https://doi.org/10.1155/2019/3102870.

Consider total amount and balance of omega-3 fatty acids

- For many people eating a processed food diet, dietary omega-6 fats exceeds that of omega-3 fats.
- The current n-6/n-3 ratio is 20-50/1.
- Higher ratios of n-6/n-3 in modern diets translate into greater allergic, inflammatory, proliferative, and cardiovascular symptoms.
- Recommendation would be to keep n-6/n-3 ratio at 4-5/1.

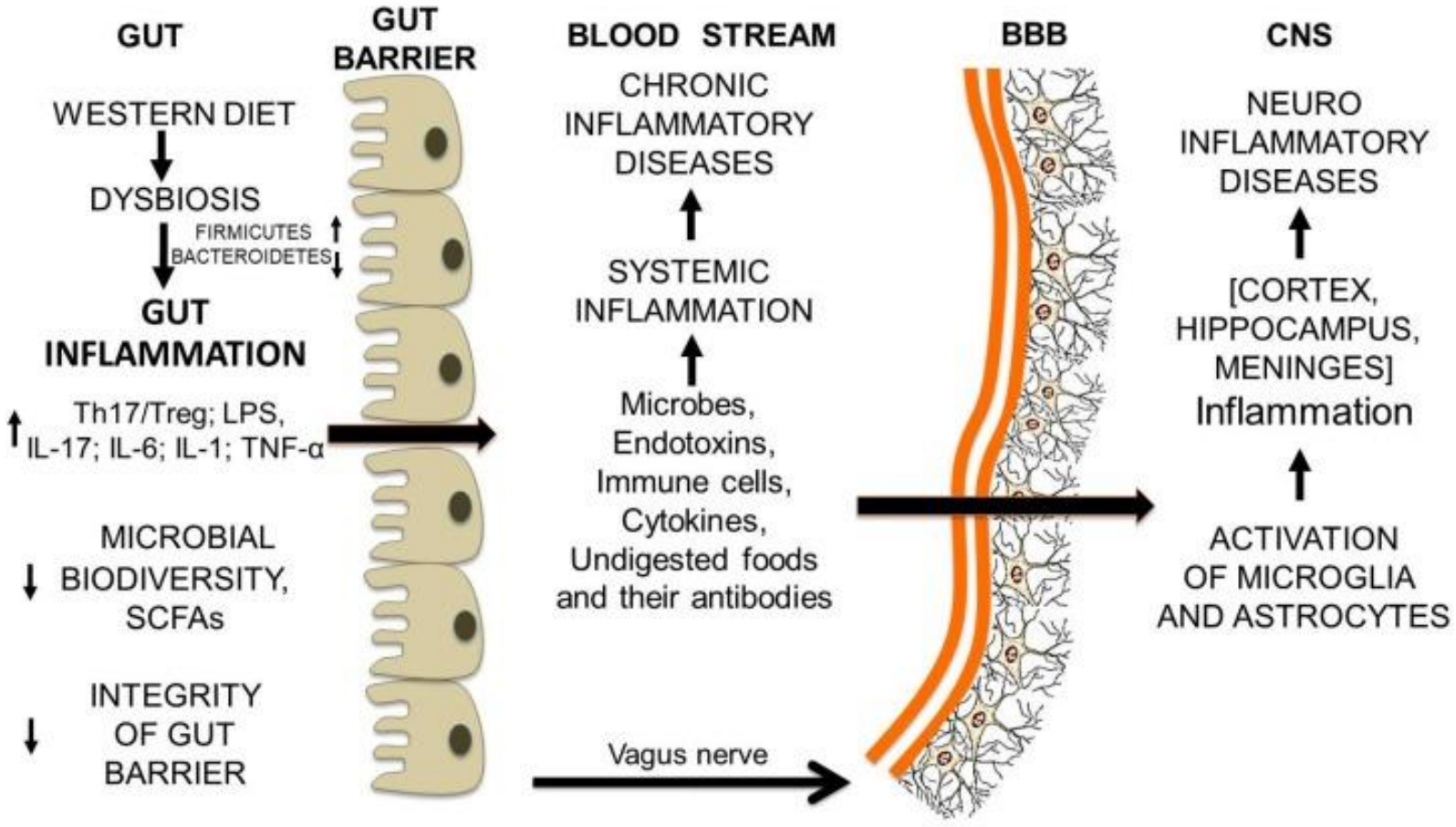
Mariamenatu AH, Abdu EM. Overconsumption of Omega-6 Polyunsaturated Fatty Acids (PUFAs) versus Deficiency of Omega-3 PUFAs in Modern-Day Diets: The Disturbing Factor for Their "Balanced Antagonistic Metabolic Functions" in the Human Body. *J Lipids*. 2021 Mar 17;2021:8848161. doi: 10.1155/2021/8848161. PMID: 33815845; PMCID: PMC7990530.

The Omega-3 Index:
Aim for 8% or higher

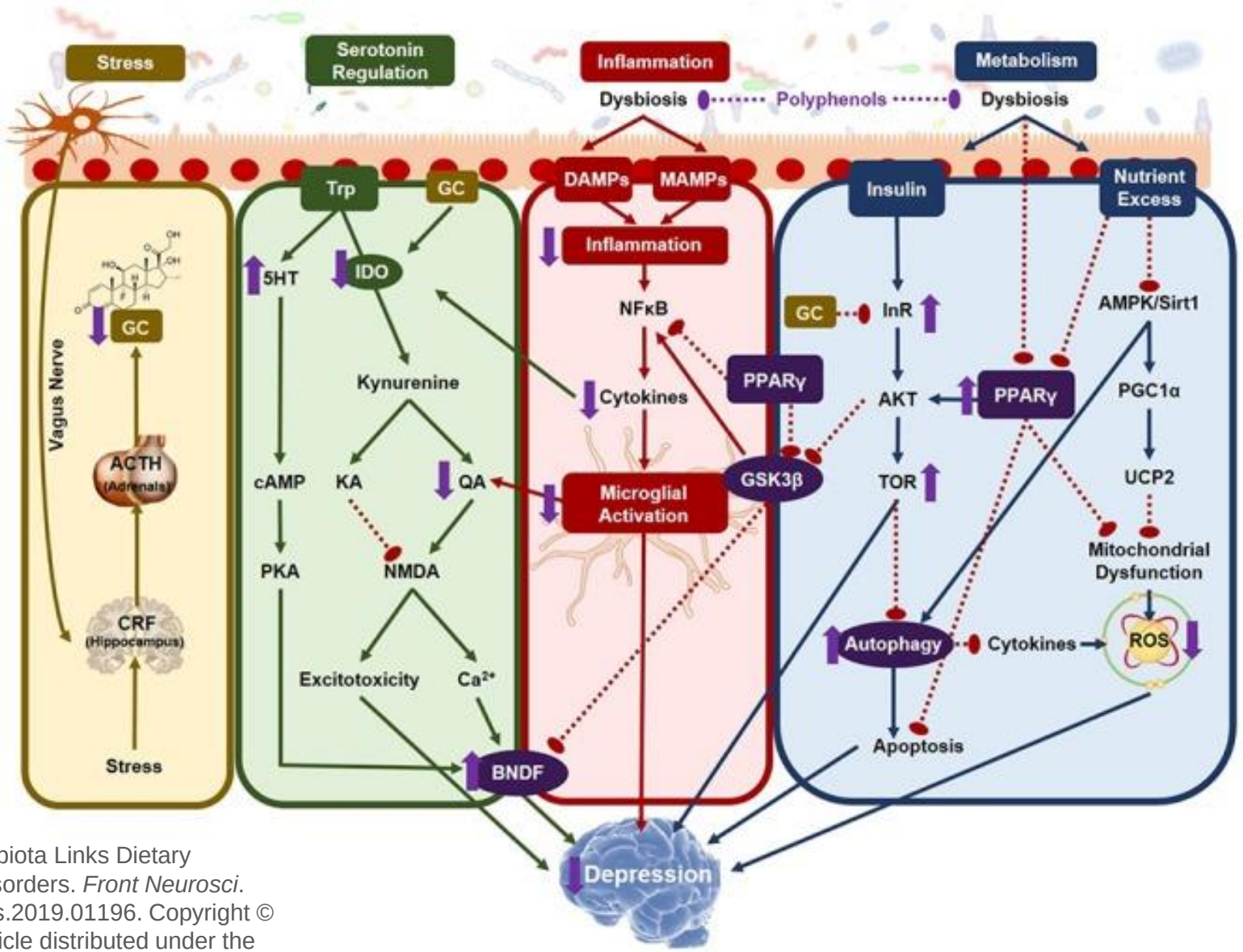
- 'ω-3 index' is the % eicosapentaenoic acid (EPA, 20:5 n-3) and docosahexaenoic acid (DHA, 22:6 n-3) in red blood cells relative to other fatty acids
- Used as an index of coronary heart disease mortality.
- Average omega-3 Index in the U.S. is about 4%
- Ideal is 8% for cardiovascular health
- Risk for fatal CHD could be reduced by ~ 30% with shifting from 4% to 8%.
- **Personal clinical experience** has indicated that even those who are relatively healthy, and supplement with omega-3s may have lower levels (5-6%).

Harris WS, Del Gobbo L, Tintle NL. The Omega-3 Index and relative risk for coronary heart disease mortality: Estimation from 10 cohort studies. *Atherosclerosis*. 2017 Jul;262:51-54. doi: 10.1016/j.atherosclerosis.2017.05.007. Epub 2017 May 6.

Barriers in the gut and brain: A connection to mental health



Pathways to depression through the gut



Anxiety and the GI tract

- Anxiety may be caused by a disturbance in the gut microbiome or even by gut inflammation.
- Mood disorders like anxiety can lead to changes in the gut microbiome and result in dysfunction

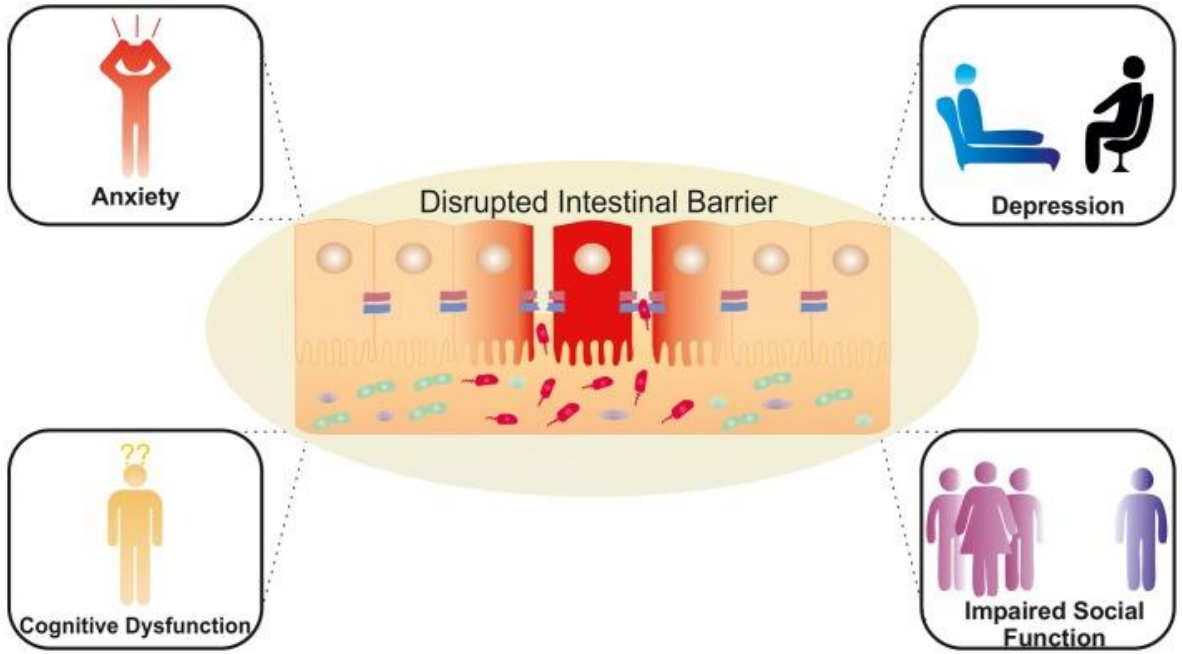


Image Credit: Kelly JR, Kennedy PJ, Cryan JF, Dinan TG, Clarke G, Hyland NP. Breaking down the barriers: The gut microbiome, intestinal permeability and stress-related psychiatric disorders. *Front Cell Neurosci*. 2015;9:392. Published 2015 Oct 14. doi:10.3389/fncel.2015.00392. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0).

Multiple potential “root causes” in Irritable Bowel Syndrome (IBS)

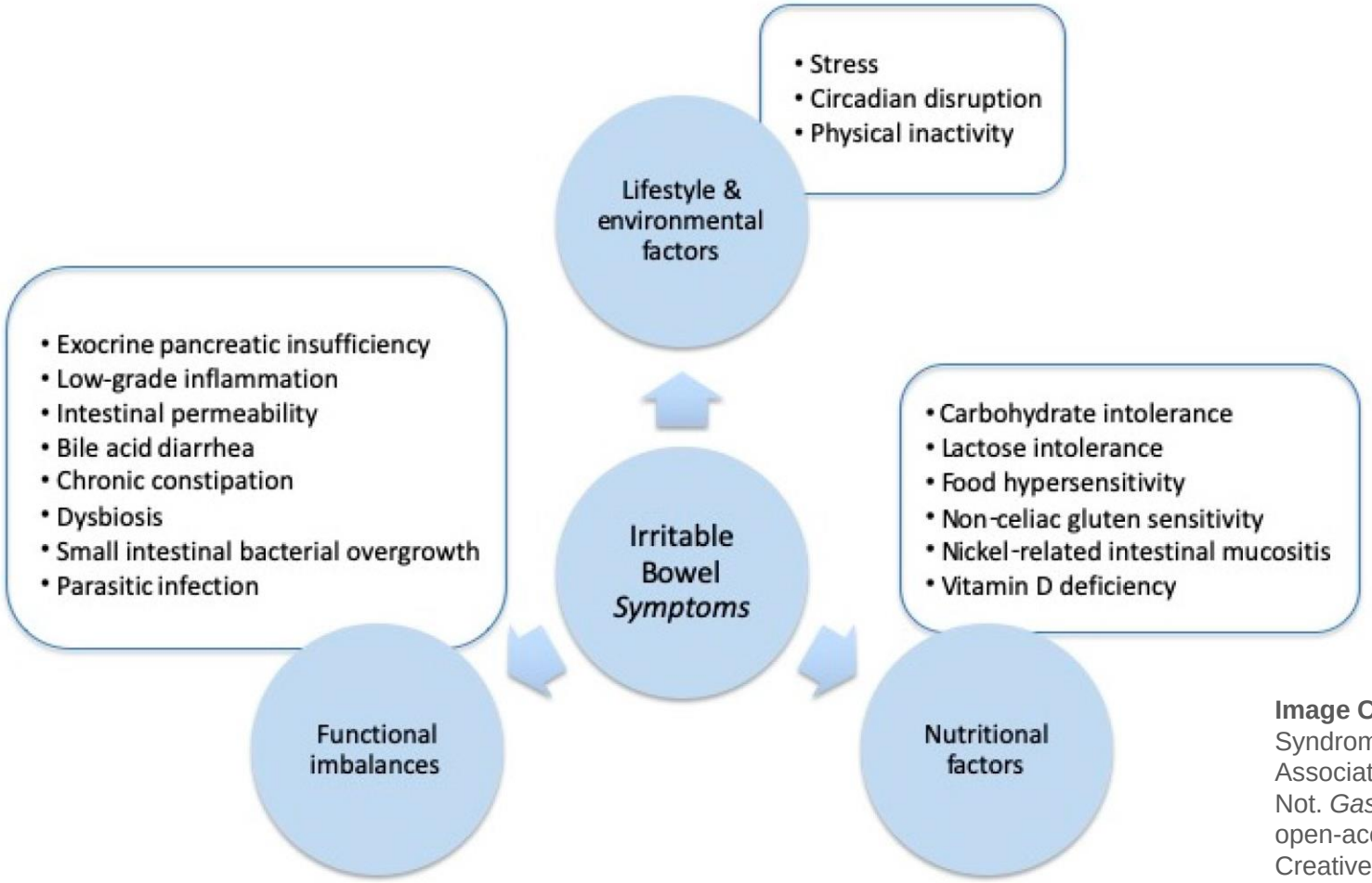


Image Credit: Brown, B.I. Does Irritable Bowel Syndrome Exist? Identifiable and Treatable Causes of Associated Symptoms Suggest It May Not. *Gastrointest. Disord.* **2019**, *1*, 314-340. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0).

Anxiety and/or depression and active gut dysfunction

Figure 1

Percentage of patients found to have anxiety and/or depression at present with active and inactive disease. Error bars represent 95% CI.

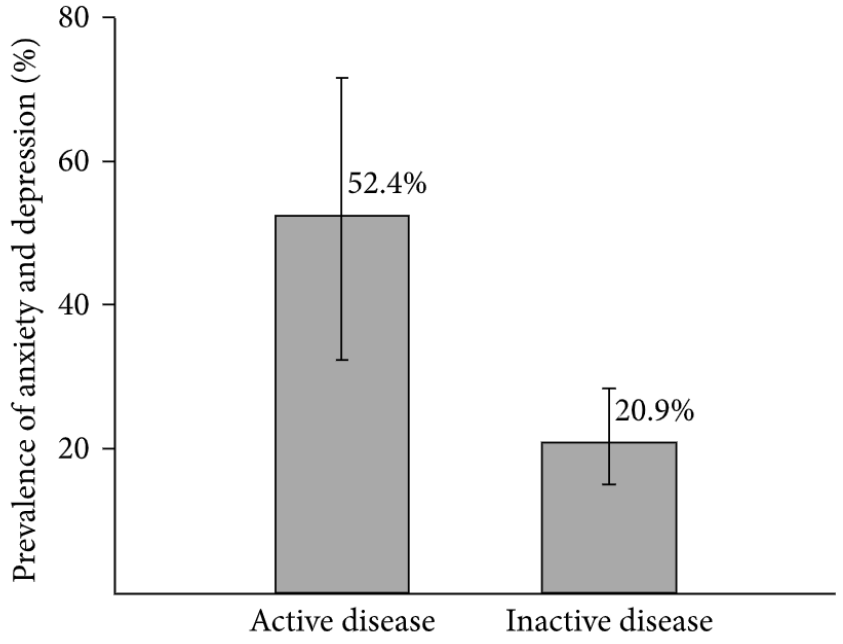


Image Credit: Byrne G, Rosenfeld G, Leung Y, et al. Prevalence of Anxiety and Depression in Patients with Inflammatory Bowel Disease. *Can J Gastroenterol Hepatol*. 2017;2017:6496727. doi:10.1155/2017/6496727; CC-BY 4.0.

Metabolic endotoxemia:
The inflammatory potential of high-fat meals

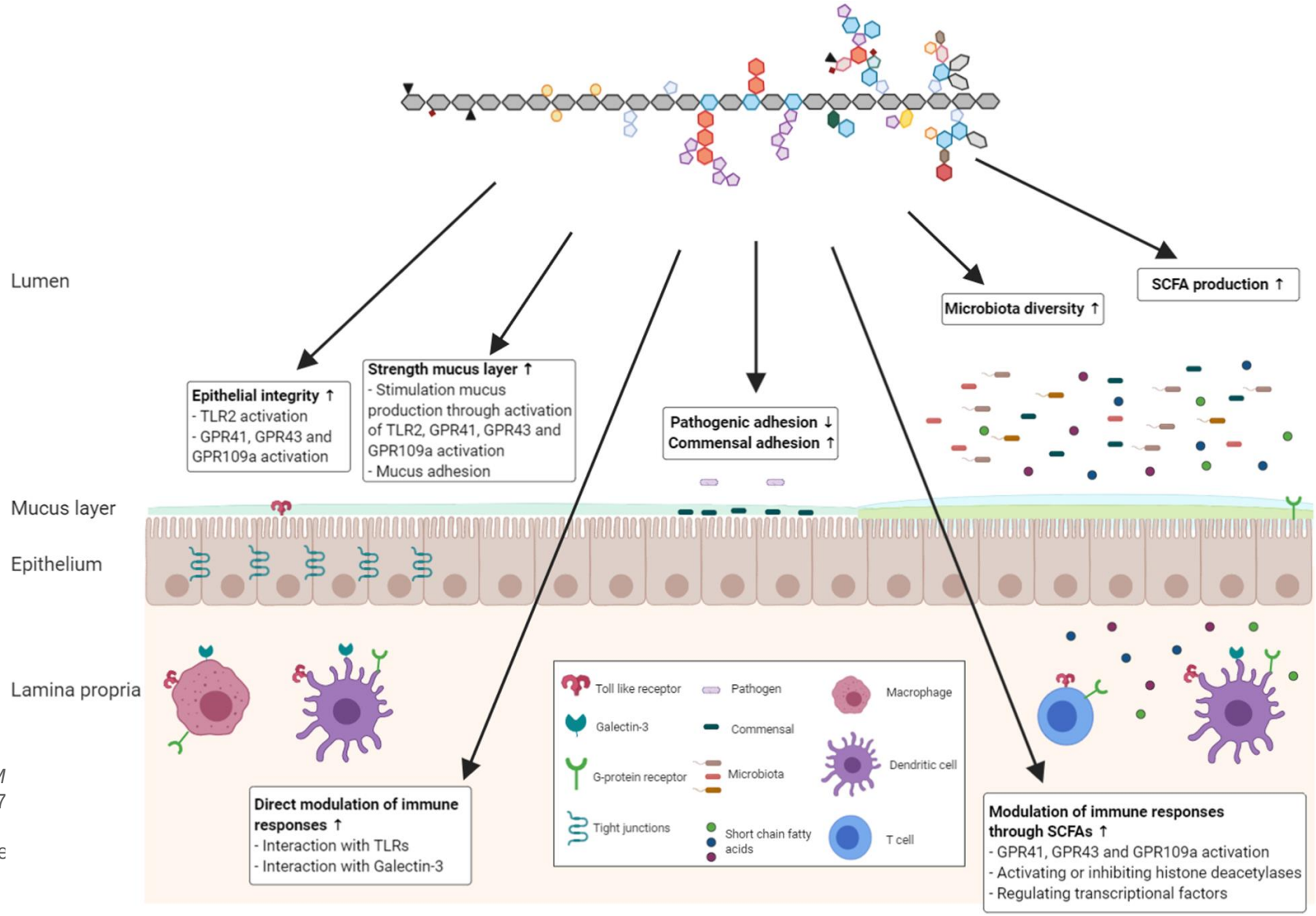
Metabolically-triggered inflammation, metabolic endotoxemia effects (1)

An acute high-fat meal (42 g vs. 1 g) can impair vascular function (SBP, DBP, total peripheral resistance) in healthy, normotensive people (2)

Polyphenol-rich oils may help to reduce inflammatory effects (3)

1. Arya F, Egger S, Colquhoun D, Sullivan D, Pal S, Egger G. Differences in postprandial inflammatory responses to a 'modern' v. traditional meat meal: a preliminary study. *Br J Nutr*. 2010 Sep;104(5):724-8. doi: 10.1017/S0007114510001042. Epub 2010 Apr 9.
2. Jakulj F, Zernicke K, Bacon SL, et al. A high-fat meal increases cardiovascular reactivity to psychological stress in healthy young adults. *J Nutr*. 2007 Apr;137(4):935-9. doi: 10.1093/jn/137.4.935
3. Widmer RJ, Freund MA, Flammer AJ, et al. Beneficial effects of polyphenol-rich olive oil in patients with early atherosclerosis. *Eur J Nutr*. 2013 Apr;52(3):1223-31. doi: 10.1007/s00394-012-0433-2. Epub 2012 Aug 8.

Fiber restores the gut



The food-gut-mood-brain axis:

The foods we take in become signaling agents for the brain

"The gut-brain axis [GBA] is a bidirectional information regulatory pathway composed of the central nervous system (CNS), neuroendocrine system, neuroimmune system, autonomic nervous system and enteric nervous system."

Quote reference: Liu, S.; Cheng, L.; Liu, Y.; Zhan, S.; Wu, Z.; Zhang, X. Relationship between Dietary Polyphenols and Gut Microbiota: New Clues to Improve Cognitive Disorders, Mood Disorders and Circadian Rhythms. *Foods* **2023**, *12*, 1309. https://doi.org/10.3390/foods12061309

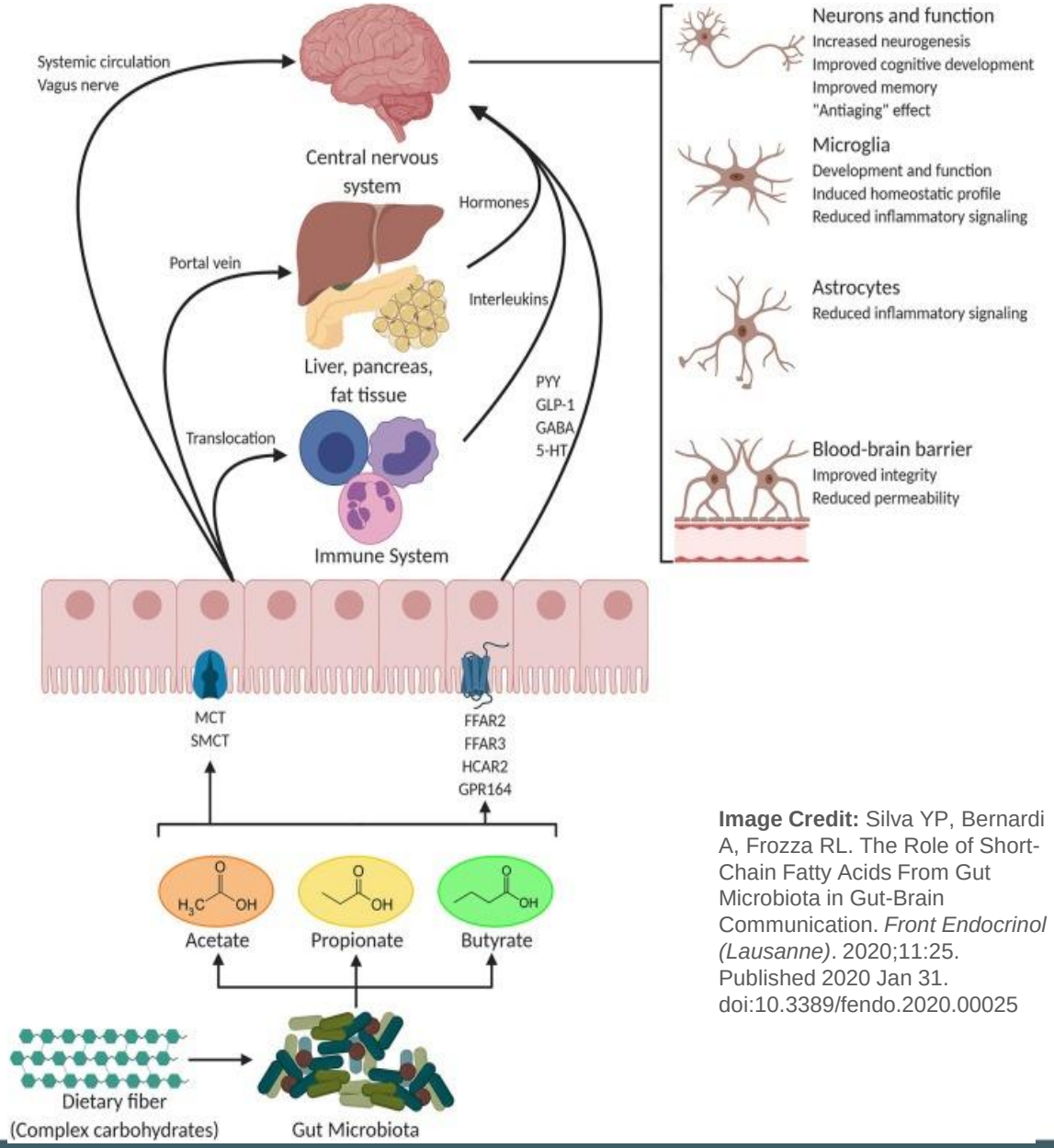


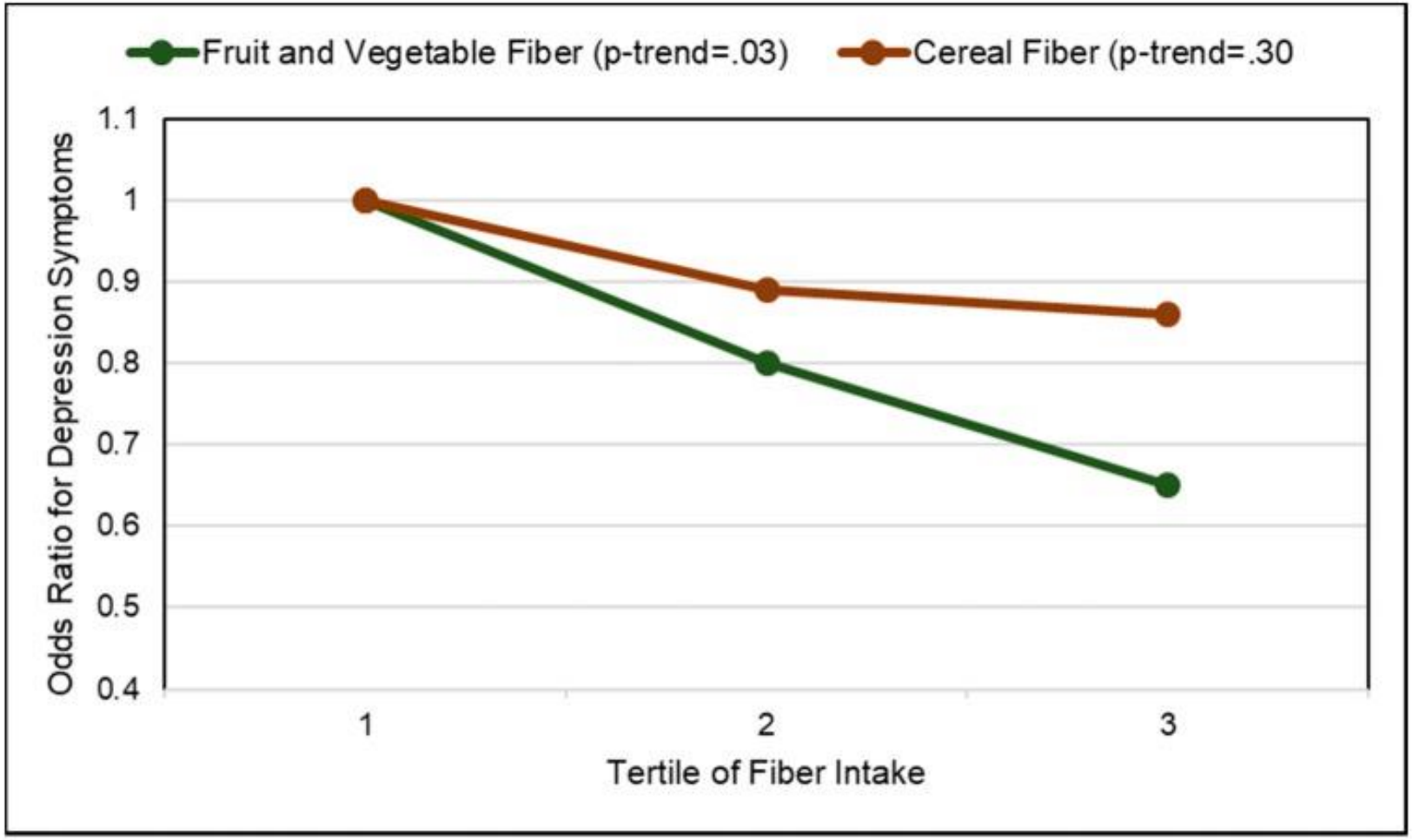
Image Credit: Silva YP, Bernardi A, Frozza RL. The Role of Short-Chain Fatty Acids From Gut Microbiota in Gut-Brain Communication. *Front Endocrinol (Lausanne)*. 2020;11:25. Published 2020 Jan 31. doi:10.3389/fendo.2020.00025

Short-chain fatty acids (SCFAs) for the gut-brain axis

- Stimulates the production of mucin
- Helps to promote manufacture of antibacterial peptides and tight junction proteins
- Provides energy source for colonocytes
- Signals from gut through G-protein coupled receptors to affect gut and immune function
- Reduce the production of cortisol
- Enhances the production of BDNF

1. van der Merwe, M. (2021). Gut microbiome changes induced by a diet rich in fruits and vegetables. *International Journal of Food Sciences and Nutrition*, 72(5), 665–669. https://doi.org/10.1080/09637486.2020.1852537. 2. Dalile, B., Vervliet, B., et al. (2020). Colon-delivered short-chain fatty acids attenuate the cortisol response to psychosocial stress in healthy men: A randomized, placebo-controlled trial. *Neuropsychopharmacology: Official Publication of the American College of Neuropsychopharmacology*, 45(13), 2257–2266. https://doi.org/10.1038/s41386-020-0732-x. 3. van de Wouw, M., Boehme, et al. (2018). Short-chain fatty acids: Microbial metabolites that alleviate stress-induced brain-gut axis alterations. *The Journal of Physiology*, 596(20), 4923–4944. https://doi.org/10.1113/JP276431. 4. Suda, K., & Matsuda, K. (2022). How microbes affect depression: Underlying mechanisms via the gut-brain axis and the modulating role of probiotics. International Journal of Molecular Sciences, 23(3), 1172. https://doi.org/10.3390/ijms23031172

Depressive symptoms reduce with increasing dietary fiber



THE THREE NUTRITIONAL PILLARS OF GUT HEALTH

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PREBIOTIC FIBERS


CHICORY


DANDELION GREENS


LEEKS


ASPARAGUS


ONION


BANANA

PROBIOTICS


YOGURT


SAUERKRAUT


PICKLES


TEMPEH (SOY)


MISO (SOY)


KIM CHI

POLYPHENOLS


BERRIES & GRAPES


TEA

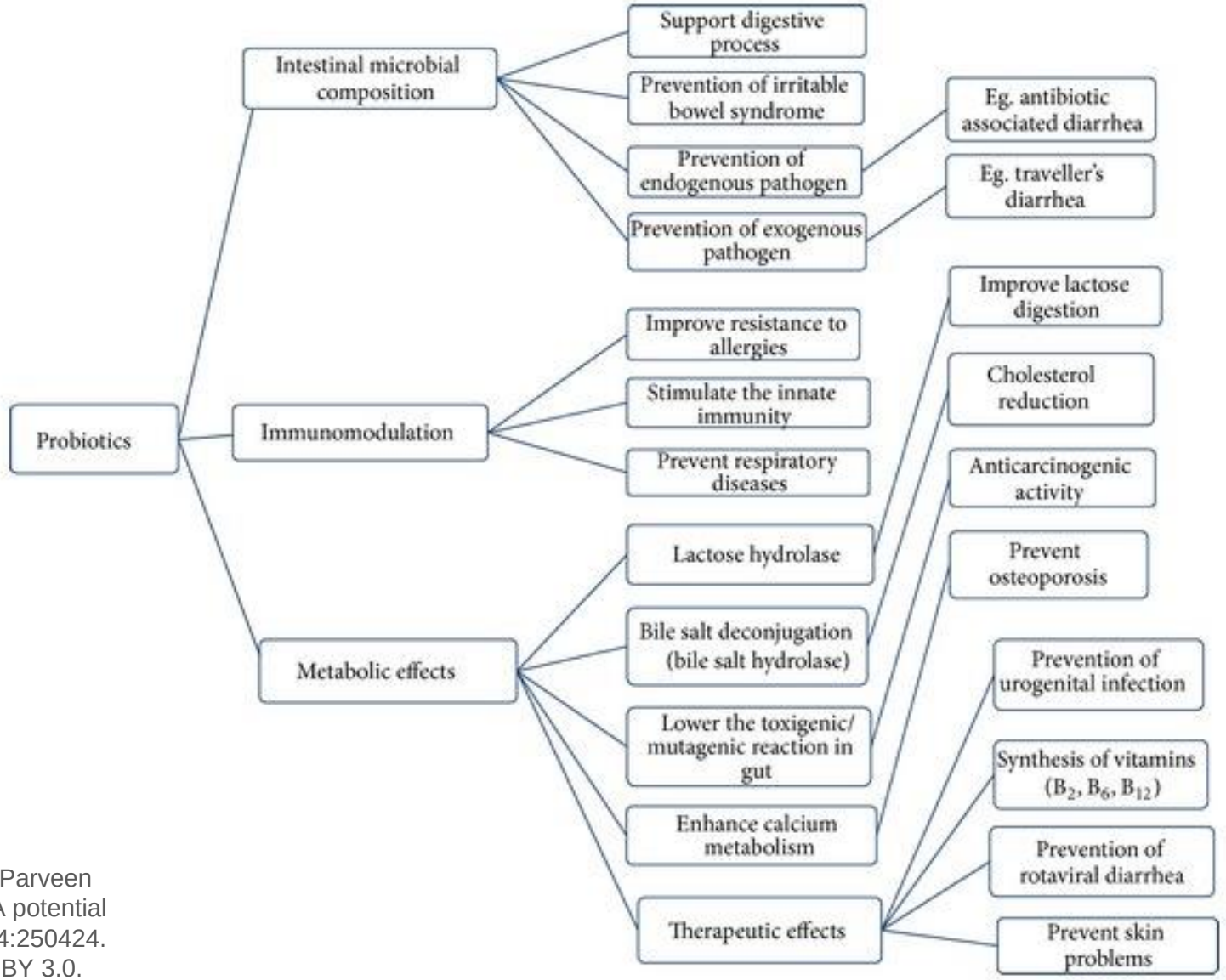

COCOA


HERBS


SPICES

Improving Gut Health Through the Functional Medicine 5Rs

Potential Benefits of Probiotics



Psychobiotics

"…probiotics that can impact neuropsychiatric conditions, may influence depressive and anxiety phenotypes."

"…patients diagnosed with both IBS and major depression, a twice daily dose of *Bacillus coagulans* MTCC 5856 was administered, and treated patients demonstrated reduced depressive phenotypes on multiple scales (Majeed et al. 2018)."

Westfall S, Pasinetti GM. The Gut Microbiota Links Dietary Polyphenols With Management of Psychiatric Mood Disorders. Front Neurosci. 2019 Nov 5;13:1196. doi: 10.3389/fnins.2019.01196. PMID: 31749681; PMCID: PMC6848798.

Potential Root Cause: Nutrient imbalance

- Unhealthy diets (brown, yellow, white)
- Lack of omega-3 fatty acids
- Lack of proper macronutrient quantity and quality for energy and neurotransmitter balance
- Lack of vitamins (vitamin C, D, B6, B9, B12, etc.)
- Lack of minerals (Mg, Zn, Fe, Se)
- Lack of phytonutrients for harmonizing cellular activities, hormone/neurotransmitter agonists

LaChance, L. R., & Ramsey, D. (2018). Antidepressant foods: An evidence-based nutrient profiling system for depression. World Journal of Psychiatry, 8(3), 97–104. https://doi.org/10.5498/wjp.v8.i3.97

Poor nutritional quality diets and increased risk of depression

- More studies indicating a relationship between food and mood
- Greater risk for depression with:
  - Fast food intake[1]
  - Ultraprocessed foods[2]
  - Higher added sugars & lower quality of carbohydrate[3]

1. Sánchez-Villegas, A., et al. (2012). Fast-food and commercial baked goods consumption and the risk of depression. Public Health Nutrition, 15(3), 424–432. https://doi.org/10.1017/S1368980011001856 PMID: 21835082; 2. Gómez-Donoso, C., et al. (2020). Ultra-processed food consumption and the incidence of depression in a Mediterranean cohort: The SUN Project. European Journal of Nutrition, 59(3), 1093–1103. https://doi.org/10.1007/s00394-019-01970-1 PMID: 31055621; 3. Sanchez-Villegas, A., et al. (2018). Added sugars and sugar-sweetened beverage consumption, dietary carbohydrate index and depression risk in the Seguimiento Universidad de Navarra (SUN) Project. The British Journal of Nutrition, 119(2), 211–221. https://doi.org/10.1017/S0007114517003361 PMID: 29268815

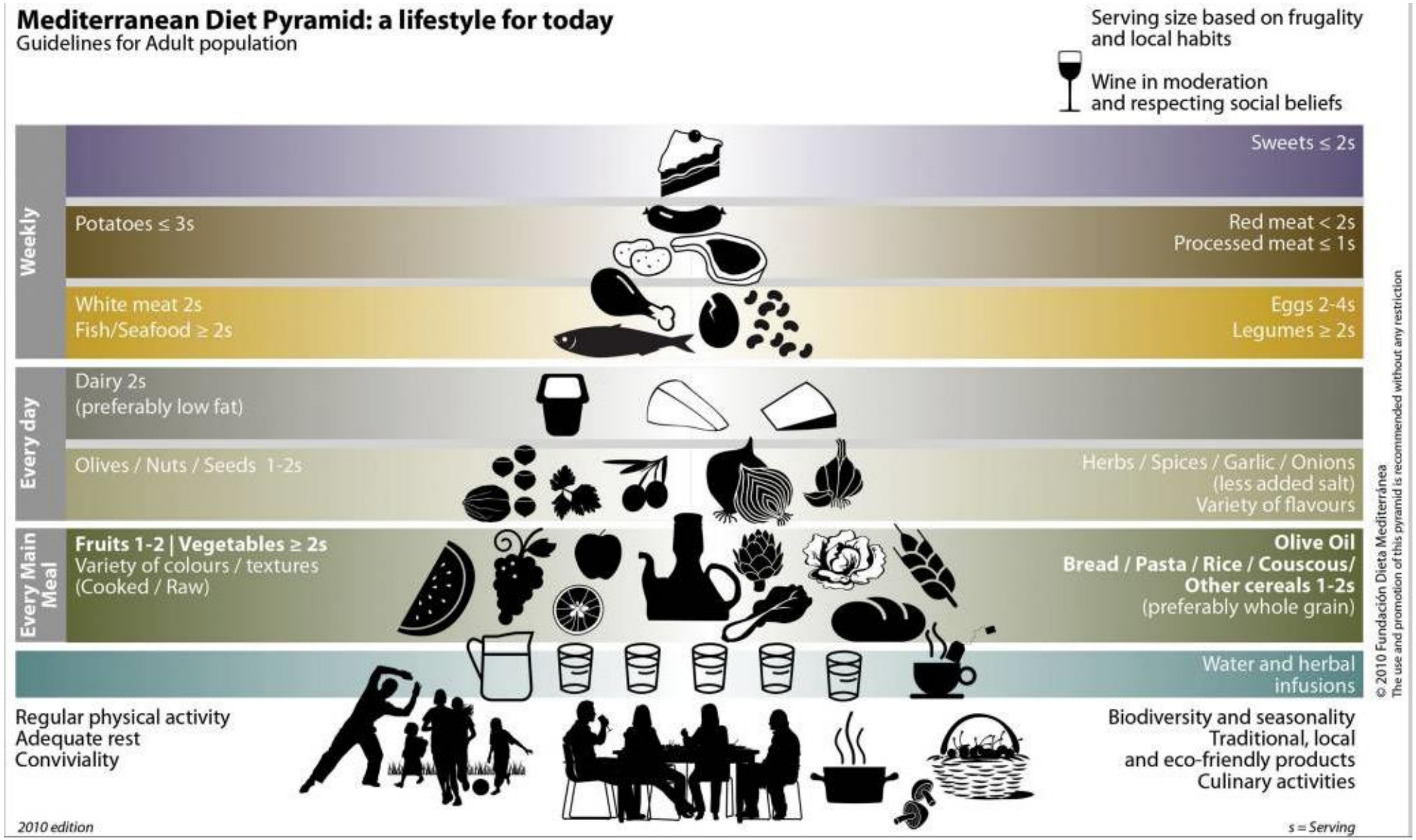


Image Credit: Dernini S, Berry EM. Mediterranean diet: From a healthy diet to a sustainable dietary pattern. *Front Nutr*. 2015 May 7;2:15. doi: 10.3389/fnut.2015.00015. eCollection 2015. No changes made. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license CC BY 4.0.

The Mediterranean Diet and Depression

- *N*=10,094 university graduates
- The greater the adherence to the MedDiet, the less incidence of depression.
- Inverse dose-response relationships for these dietary variables:
  - Fruit and nuts
  - Legumes
  - Monounsaturated to saturated fat ratio

Sánchez-Villegas A, Delgado-Rodríguez M, Alonso A, Schlatter J, Lahortiga F, Serra Majem L, Martínez-González MA. Association of the Mediterranean dietary pattern with the incidence of depression: the Seguimiento Universidad de Navarra/University of Navarra follow-up (SUN) cohort. Arch Gen Psychiatry. 2009 Oct;66(10):1090-8. doi: 10.1001/archgenpsychiatry.2009.129. PMID: 19805699.

Nuts are nutrient dense foods for mood

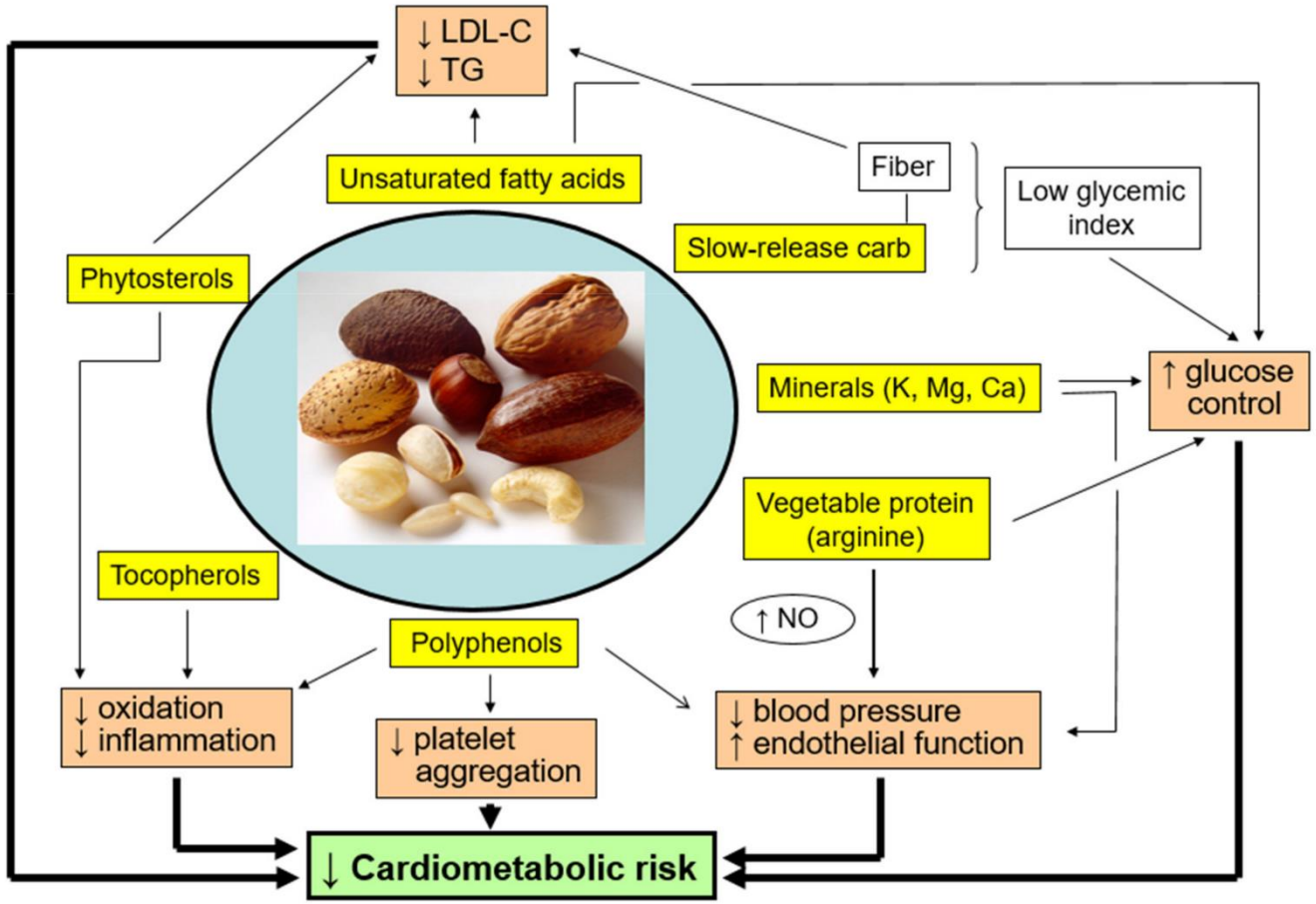


Image Credit: Ros, E.; Singh, A.; O'Keefe, J.H. Nuts: Natural Pleiotropic Nutraceuticals. *Nutrients* 2021, *13*, 3269. https://doi.org/10.3390/nu13093269. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license CC-BY 4.0.

Gut health:
Elimination diet

What is an "elimination diet"?

As used in functional medicine, a defined time period of removing typical dietary offenders: corn, soy, wheat, gluten, alcohol, sugar, eggs, shellfish, overly cooked foods, peanuts, dairy, processed oils, coffee; followed by a reintroduction period to observe symptoms.

- Useful in food allergy, atopy, eczema
- Migraine, headaches, neurological & behavioral issues (e.g., ADHD)
- Gut disorders and dysfunction (e.g., IBS, leaky gut)
- Fibromyalgia

Bunner, A. E., Agarwal, U., Gonzales, J. F., Valente, F., & Barnard, N. D. (2014). Nutrition intervention for migraine: A randomized crossover trial. The journal of headache and pain, 15(1), 69. https://doi.org/10.1186/1129-2377-15-69; Gonsalves, N., Yang, G. Y., Doerfler, B., Ritz, S., Ditto, A. M., & Hirano, I. (2012). Elimination diet effectively treats eosinophilic esophagitis in adults; food reintroduction identifies causative factors. Gastroenterology, 142(7), 1451–e15. https://doi.org/10.1053/j.gastro.2012.03.001; Lamb, J. J., Konda, V. R., Quig, D. W., Desai, A., Minich, D. M., Bouillon, L., Chang, J. L., et al. (2011). A program consisting of a phytonutrient-rich medical food and an elimination diet ameliorated fibromyalgia symptoms and promoted toxic-element detoxification in a pilot trial. *Alternative Therapies in Health and Medicine*, 17(2), 36–44.

Case Study
Dietary Intervention for Mental Health

Challenging Case in Clinical Practice:
Qualitative and Quantitative Improvements in Overall Health and Mood Following a Three-Week Elimination Diet and a Four-Week Detox Food Plan

Claudia de la Espriella, MS, and Deanna Minich, PhD

Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

Chief Complaints

- 35-year-old female presenting with hormonal imbalances, fatigue, brain fog, anxiety, bloating, gas, dizziness, eczema, and allergies, including sinus complaints
- She works at a busy café/restaurant and is also a kayak instructor part of the year
- High stress lifestyle due to work demands and not having healthy food available

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Diet and Lifestyle History

- Activity level is high as she prefers hiking, biking, swimming, and yoga
- BL dietary analysis revealed high intake of alcoholic beverages, caffeine, high glycemic foods such as pizza and pasta, low water consumption, and few servings of fruits and vegetables
  - Daily caloric consumption averaged 1457 calories, with most from carbohydrates, mainly rice, pasta, and pizza.
  - Daily water consumption averaged 1233 g
  - Fiber was low at 17.3 g on average
  - Low intake of vitamin B1, folate, vitamin E, calcium, copper, iron, magnesium, and potassium

Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

Dietary Intervention

- Elimination Diet, followed by Detox Food Plan
- By the end of the first week, she was experiencing improvements, but it took time to get accustomed to this new diet
- Her challenges:
  - The first week was difficult for her as she had the stress of dealing with smoke from a local wildfire.
  - Her busy schedule, sometimes 10- to 11-hour shifts on foot, made it challenging to prepare meals.
  - Socializing with alcohol required an adjustment

Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces
Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

Her progression through the weeks: Elimination Diet

FIGURE 2: Medical Symptoms Questionnaire (MSQ) for the IFM Elimination Diet phase

	Baseline	Week 1	Week 2	Week 3
Head	1	4	2	1
Eyes	5	8	5	2
Ears	1	1	0	0
Nose	11	6	1	3
Mouth/throat	0	0	0	0
Skin	3	3	2	1
Heart	0	0	0	0
Lungs	1	1	2	0
Digestive tract	5	5	4	3
Joints/muscle	3	3	0	1
Weight	6	2	2	2
Energy/activity	4	5	4	1
Mind	9	6	3	1
Emotions	4	3	1	0
Other	1	1	0	1
TOTAL	54	48	26	16
% Improvement		11.1%	51.85%	70.37%

Table modified from: Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

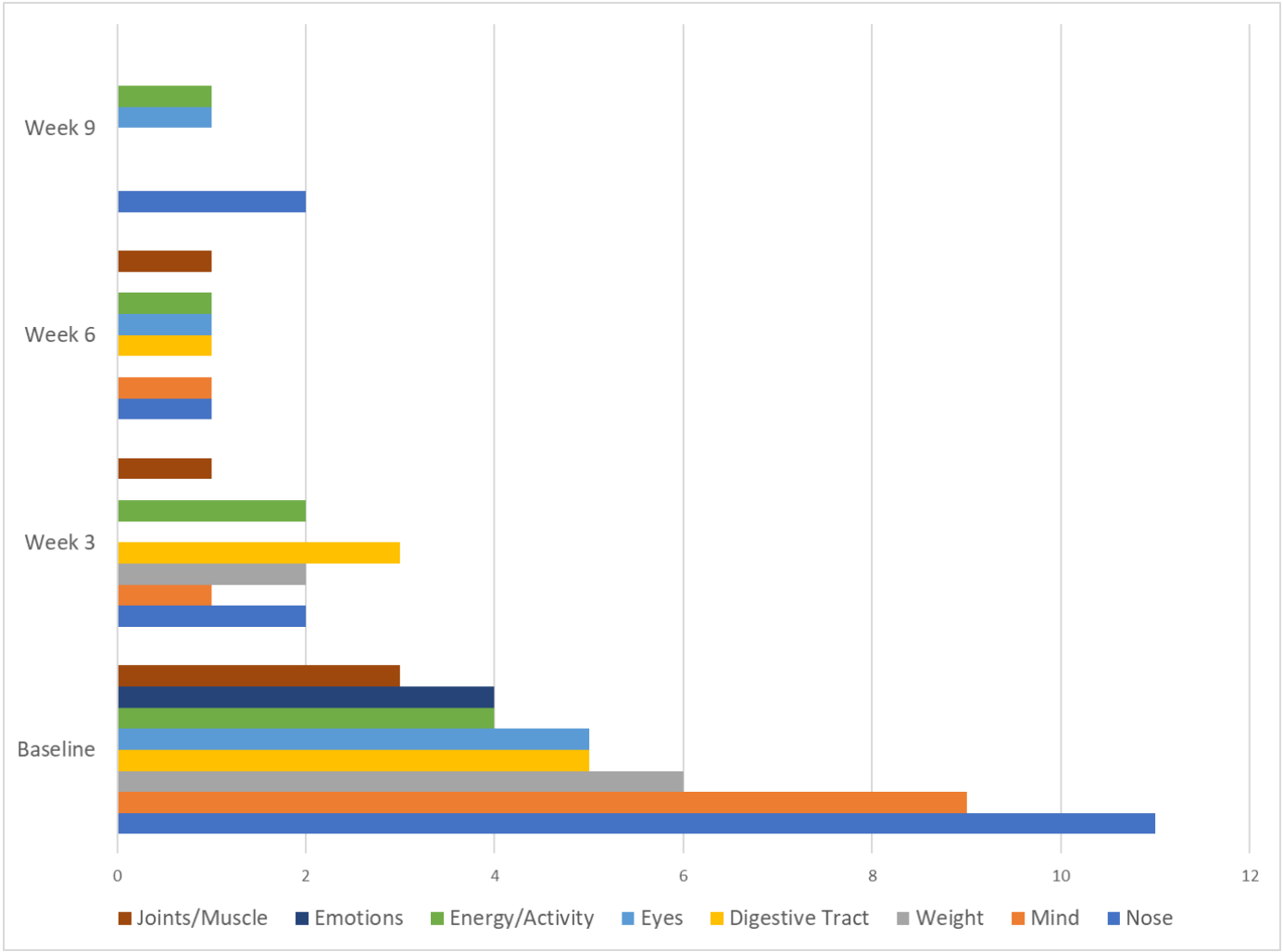
Her progression through the weeks: Detox Food Plan

FIGURE 3: MSQ scores for the Detox Food Plan phase

	Week 6	Week 7	Week 8	Week 9
Head	0	0	1	1
Eyes	1	1	1	1
Ears	1	1	1	1
Nose	1	3	2	2
Mouth/throat	1	0	0	0
Skin	0	0	1	1
Heart	0	0	0	0
Lungs	0	0	0	0
Digestive tract	1	1	0	0
Joints/muscle	1	0	0	0
Weight	0	0	0	0
Energy/activity	1	0	0	0
Mind	1	0	0	0
Emotions	0	0	0	0
Other	0	0	0	
TOTAL	8	6	6	6
% Improvement	85.1%	88.8%	88.8%	88.8%

Table modified from: Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

MSQ Scores over time



Graph modified from: Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

Final Comments

- Overall mental-emotional benefits from the program
- Client reported feeling peaceful during the detox, no longer experiencing anxiety and feeling more headstrong and being able to “let things roll off her shoulders without stressing too much.”
- She noted a shift in her work environment to one being more supportive rather than negative
- She was strengthening relationships and encouraging others to change their eating for improved wellness

Claudia de la Espriella and Deanna Minich. Alternative and Complementary Therapies. Oct 2018.ahead of printhttp://doi.org/10.1089/act.2018.29181.ces Published in Volume: 24 Issue 5: October 11, 2018; Online Ahead of Print: September 4, 2018

12 Nutrients for Better Mood

1. Folate
2. Iron
3. Omega-3 fatty acids
4. Magnesium
5. Potassium
6. Selenium
7. Thiamin (vitamin B_1)
8. Vitamin A
9. Vitamin B_6
10. Vitamin B_{12}
11. Vitamin C
12. Zinc

LaChance LR, Ramsey D. Antidepressant foods: An evidence-based nutrient profiling system for depression. World J Psychiatry. 2018 Sep 20;8(3):97-104. doi: 10.5498/wjp.v8.i3.97. PMID: 30254980; PMCID: PMC6147775.

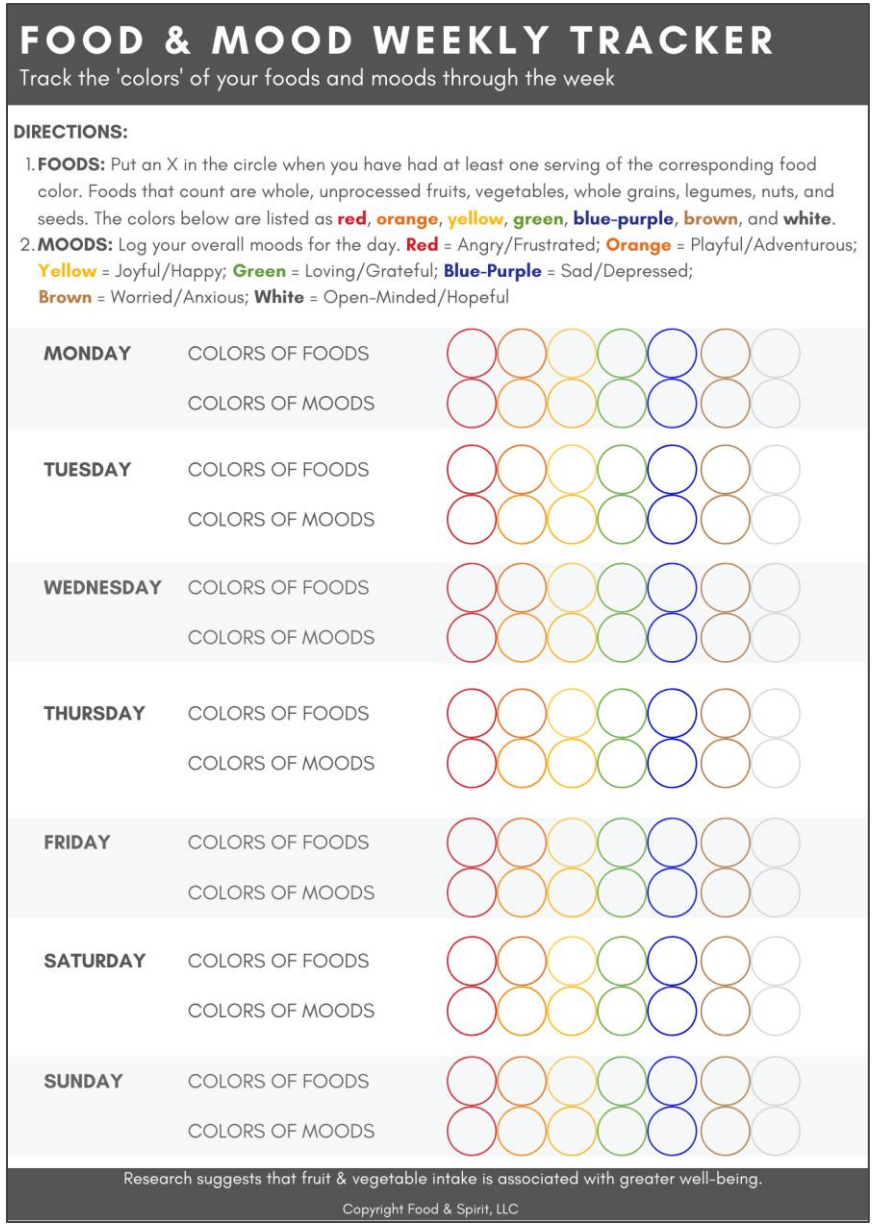
Antidepressant foods from greatest to least score

1. Vegetables
2. Organ meats
3. Fruits
4. Seafood
5. Legumes
6. Meats
7. Grains
8. Nuts and seeds
9. Dairy

LaChance LR, Ramsey D. Antidepressant foods: An evidence-based nutrient profiling system for depression. *World J Psychiatr* 2018; 8(3): 97-104 Available from: URL: http://www.wjgnet.com/2220-3206/full/v8/i3/97.htm DOI: http://dx.doi.org/10.5498/wjp.v8.i3.97

Figure out patterns with clinical assessments

- Food & Mood Tracker
- Food journal tracking emotions & foods
- Eating Timeline (top 10 events)



FOOD & MOOD WEEKLY TRACKER

Track the 'colors' of your foods and moods through the week

DIRECTIONS:

1. **FOODS:** Put an X in the circle when you have had at least one serving of the corresponding food color. Foods that count are whole, unprocessed fruits, vegetables, whole grains, legumes, nuts, and seeds. The colors below are listed as **red**, **orange**, **yellow**, **green**, **blue-purple**, **brown**, and **white**.
2. **MOODS:** Log your overall moods for the day. **Red** = Angry/Frustrated; **Orange** = Playful/Adventurous; **Yellow** = Joyful/Happy; **Green** = Loving/Grateful; **Blue-Purple** = Sad/Depressed; **Brown** = Worried/Anxious; **White** = Open-Minded/Hopeful

MONDAY	COLORS OF FOODS	
	COLORS OF MOODS	
TUESDAY	COLORS OF FOODS	
	COLORS OF MOODS	
WEDNESDAY	COLORS OF FOODS	
	COLORS OF MOODS	
THURSDAY	COLORS OF FOODS	
	COLORS OF MOODS	
FRIDAY	COLORS OF FOODS	
	COLORS OF MOODS	
SATURDAY	COLORS OF FOODS	
	COLORS OF MOODS	
SUNDAY	COLORS OF FOODS	
	COLORS OF MOODS	

Research suggests that fruit & vegetable intake is associated with greater well-being.

FOOD & MOOD WEEKLY TRACKER

Identifying correlations between colors of foods and colors of moods

Tracking emotional patterns

Difficulty identifying and making sense of emotional states and not knowing how to regulate emotions are implicated in the relationship between emotions and binge eating.[1]

- Be specific as to what you are feeling
- Identify “little and important hurts”
- Record what makes you feel strongly for 2 months
- Keep a journal
- HRV biofeedback device

1. Whiteside U, Chen E, Neighbors C, Hunter D, Lo T, Larimer M. Difficulties regulating emotions: Do binge eaters have fewer strategies to modulate and tolerate negative affect? Eat Behav. 2007 Apr;8(2):162-9. Epub 2006 May 22

Creating one's eating timeline

In-depth life-story interviewing and narrative analysis revealed:

- Distinct 'food mood' events based in childhood memories about dinnertime
- Parental attitudes important

Hooper CM, Ivory VC, Fougere G. "Dinner's ready!" A qualitative exploration of the food domain across the lifecourse. Appetite. 2015 Sep;92:133-42. doi: 10.1016/j.appet.2015.04.073. Epub 2015 Apr 29.

Eating strategies to help with mental health

1. Color
2. Creativity
3. Variety

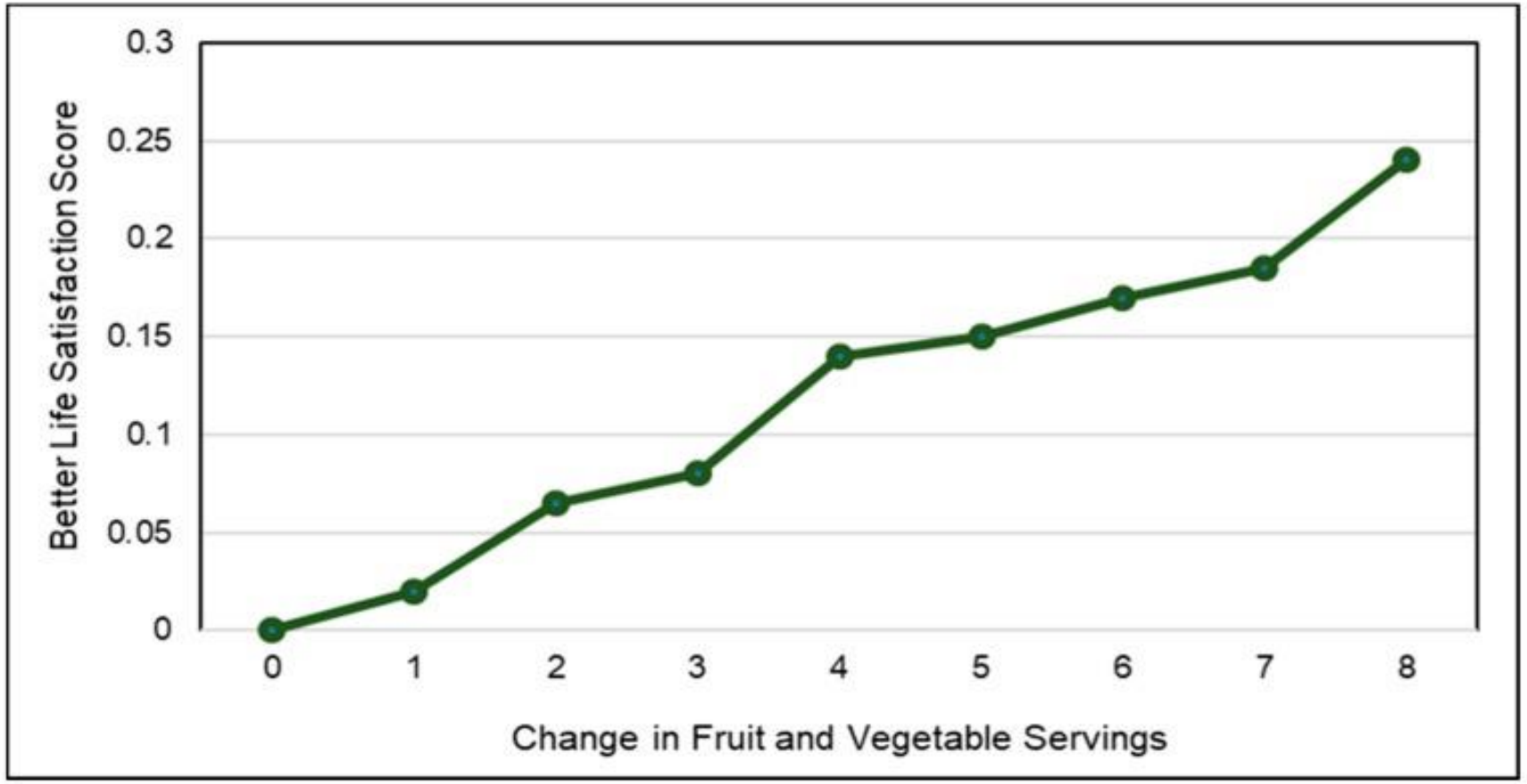
Colorful foods make for colorful moods!

Strategy #1:Color

Eating more fruits and vegetables has been associated with less psychological distress, better mood, greater happiness, flourishing, & well-being.

- Conner TS, Brookie KL, Carr AC, Mainvil LA, Vissers MC. Let them eat fruit! The effect of fruit and vegetable consumption on psychological well-being in young adults: A randomized controlled trial. PLoS One. 2017;12(2):e0171206. Published 2017 Feb 3. doi:10.1371/journal.pone.0171206
- Głąbska D, Guzek D, Groele B, Gutkowska K. Fruit and vegetables intake in adolescents and mental health: a systematic review. Rocz Panstw Zakl Hig. 2020;71(1):15-25. doi:10.32394/rpzh.2019.0097
- Holder MD. The Contribution of Food Consumption to Well-Being. Ann Nutr Metab. 2019;74 Suppl 2:44-52. doi:10.1159/000499147
- Mujcic R, Oswald AJ. Evolution of Well-Being and Happiness After Increases in Consumption of Fruit and Vegetables. Am J Public Health. 2016 Aug;106(8):1504-10. doi: 10.2105/AJPH.2016.303260.
- Nguyen B, Ding D, Mihrshahi S. Fruit and vegetable consumption and psychological distress: cross-sectional and longitudinal analyses based on a large Australian sample [published correction appears in BMJ Open. 2017 Apr 7;7(4):e014201corr1]. BMJ Open. 2017;7(3):e014201. Published 2017 Mar 15. doi:10.1136/bmjopen-2016-014201

Life Satisfaction and Fruit/Vegetable Servings



Why plant foods?

- High potassium and magnesium
- Micronutrients (vitamins, certain minerals)
- Fibers of all types
- Thousands of phytochemicals that play roles in insulin sensitivity, inflammation and stress response
- Absence of inflammatory precursors (unless laden in toxicants like pesticides)
- Will depend on how they are cooked/prepared

Houston M, Minich D, Sinatra ST, Kahn JK, Guarneri M. Recent science and clinical application of nutrition to coronary heart disease. *J Am Coll Nutr*. 2018 Mar-Apr;37(3):169-187. doi: 10.1080/07315724.2017.1381053. Epub 2018 Jan 9.

How many servings of fruits and vegetables are required?

- Fruit & vegetable intake > 5 servings/d is associated with the lowest risk of CVD
- Highest risk with an intake <3 servings/d.

Flock MR, Kris-Etherton PM. Dietary Guidelines for Americans 2010: Implications for cardiovascular disease. *Curr Atheroscler Rep*. 2011 Dec;13(6):499-507. doi: 10.1007/s11883-011-0205-0.

The Science of the “Rainbow” of Foods

Minich DM. *J Nutr Metab.* 2019;2019:2125070.

Hindawi
Journal of Nutrition and Metabolism
Volume 2019, Article ID 2125070, 19 pages
https://doi.org/10.1155/2019/2125070

Hindawi

Review Article

A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”

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Received 27 September 2018; Revised 27 March 2019; Accepted 17 April 2019; Published 2 June 2

Academic Editor: Stan Kubow

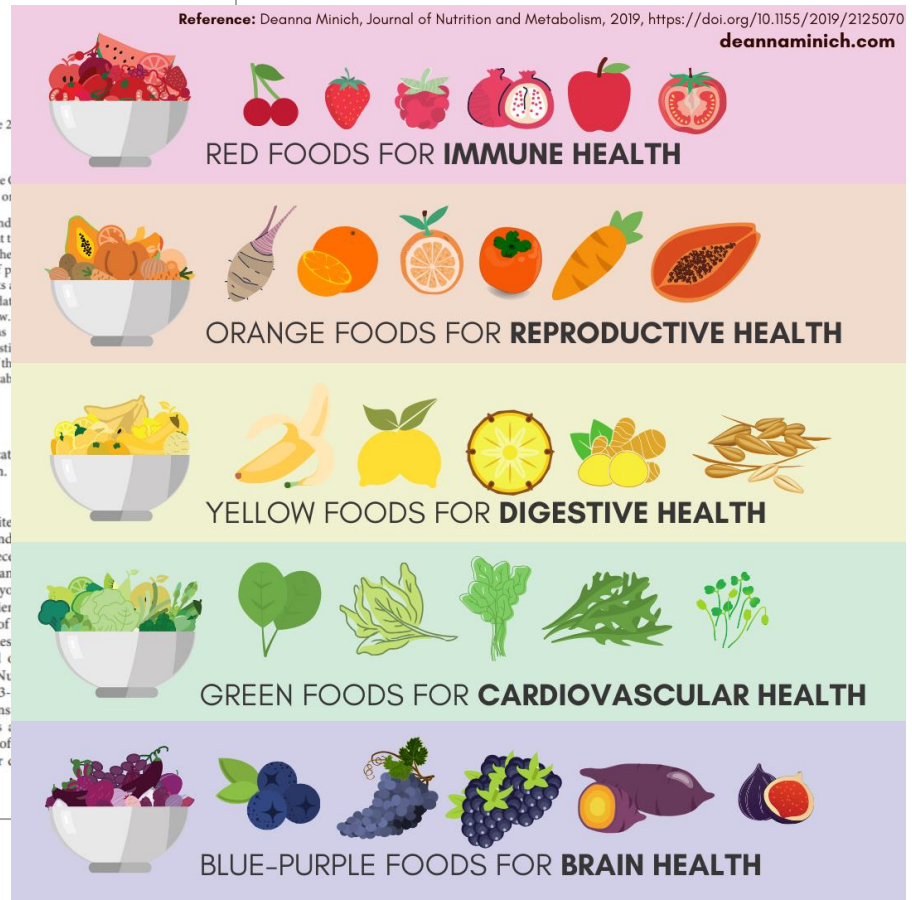
Over the past decades, thousands of published studies have amassed supporting recommend
vegetables for physiological and psychological health. Newer research has emerged to suggest that t
a plethora of not only vitamins and minerals, but perhaps, most importantly, phytonutrients. The
pleiotropic effects on cellular structure and function, ultimately resulting in the modulation of p
epigenetic modification in a manner that leads to improved outcomes. Even though eating fruits
feature of a healthy dietary pattern, population intakes continue to be below federal recommendat
to include fruits and vegetables into their diet, an “eat by color” approach is proposed in this review.
may have numerous effects based on its constituents, the goal of this simplified approach was
benefits based on the preponderance of scientific data and known mechanisms of food-based consti
a consumer-oriented categorization of these plant-based foods may lead to greater recognition of th
throughout the lifespan. Other adjunctive strategies to heighten awareness of fruits and vegetab

1. Introduction

While there continues to be debate about the inclusion of meat, dairy, grains, and legumes in a healthy diet, there would seem to be little disagreement in the scientific community that eating fruits and vegetables is beneficial for one's health. Eating plant-based foods is part of many diverse dietary patterns, including the well-studied Mediterranean diet [1], vegan and vegetarian approaches, the hunter-gatherer (Paleolithic) diet [2], and even the less well-studied, ketogenic diet [3]. The quantity and quality of in vitro, animal, and clinical data over several decades suggest that intake of fruits and vegetables is associated with reducing chronic disease risk, such as cardiovascular disease, diabetes, cataracts, cancer, dementia, obesity, and others [4–7].

The search strategy for this review article was to start with a scientific literature review of the health benefits of fruits and vegetables, along with the predominant issues surrounding deficiencies in intake. Secondly, the goal was to organize the findings into a cat
understanding and application.

1.1. Phytonutrient Gap. Despite
benefits of consuming fruits and
historically consistent, with rec
havioral Risk Factor Surveillan
most adults (particularly men, yo
in poverty) consume insufficie
percent and twelve percent of
recommendations for vegetables
Moreover, a report [9] based
from the National Health and Nu
(NHANES) conducted in 2003-
that eight out of ten Americans
phytonutrients (referred to as
pecially in the color category of
people neglected to meet their



First:
Make the case for why, what, how, and where to eat more plant-based foods.

EAT THE RAINBOW OF PLANT FOODS

WHY?

- TO REDUCE RISK OF CHRONIC DISEASE
- TO HELP WITH BETTER MOOD
- TO OPTIMIZE HEALTH AND FUNCTION

WHAT?

- FRUITS
- HERBS AND SPICES
- JUICES (100% JUICE)
- LEGUMES
- NUTS AND SEEDS
- SALADS
- SMOOTHIES
- TEAS
- VEGETABLES
- WHOLE GRAINS

HOW?

- INCLUDE IN EVERY MEAL
- VARY YOUR CHOICES
- AIM FOR A MINIMUM OF 5 SERVINGS DAILY
- TRY A NEW FOOD EVERY WEEK
- BUY COLORFUL PRODUCE AT THE MARKET

WHERE?

- HAVE FROZEN AND FRESH FOODS AT HOME
- ASK FOR SUBSTITUTIONS WHEN EATING OUT
- BRING WHOLESOME SNACKS WITH YOU WHEN TRAVELING

Second, provide a tool to track intake

EAT THE RAINBOW FOOD TRACKER

Name:

AIM FOR 7 COLORS EVERY DAY OF THE WEEK AND GET TO THE RAINBOW!

RED ORANGE YELLOW GREEN PURPLE BROWN WHITE

You can use this weekly tracker in at least two ways:

- Put an X in the circle when you have had one serving of the food.
- If you want to eat multiple servings of a color, put the total number of foods eaten in the circle.

Specifics on how and what to count as your servings:

- **All plant-based foods count.** This category includes beverages (herbal teas, unsweetened juices, smoothies, coconut water), condiments (mustard, soy sauce, vinegar, hot sauce), fruits, herbs and spices, legumes, vegetables, nuts and nut butters, seeds and seed butters, and whole grains. Frozen, fresh, and canned varieties are all options, with an emphasis on fresh when available.
- **The color of a food corresponds to its inner and outer color.** Some foods will have multiple colors, such as the red skin and white flesh of an apple. So, for an apple, you will count both the *red* skin and the *white* inner flesh on the Tracker. If you have a cucumber slice, it will simply count as green since both the skin and the flesh are green, as would an apricot as both the skin and the flesh are orange.
- **Quality matters.** The goal of this tracker is to emphasize the quality of plant-based foods rather than than to focus on serving sizes. Look at your plate of food and observe the colors rather than analyzing the quantity.
- **Get variety.** Remember that many grains and legumes come in a variety of colors such as black or brown rice, green or red lentils, and red, black, or white beans.

Third:
Encourage with new ideas and input on foods.

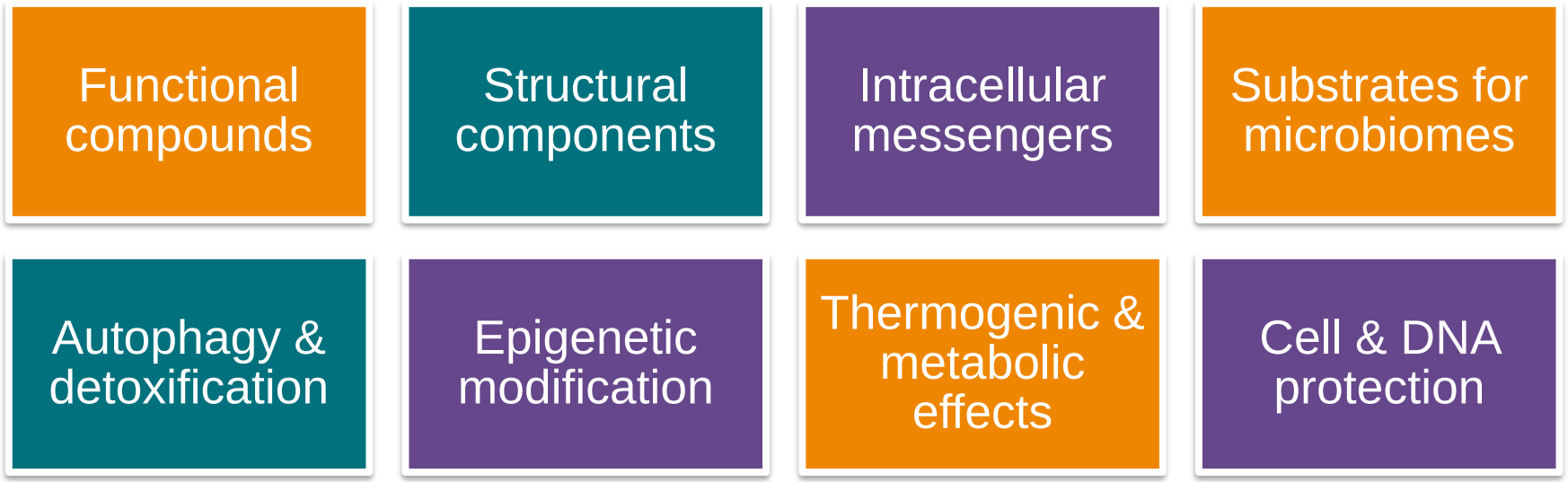
EAT THE RAINBOW SHOPPING LIST

RED	ORANGE	YELLOW	GREEN	PURPLE BLACK	BROWN TAN	WHITE
Adzuki beans	Apricots	Apples	Artichokes	Acai berries	Almonds	Apples
Apples	Cantaloupe	Asian pears	Arugula	Aronia berries	Barley	Applesauce
Beets	Carrots	Bananas	Asparagus	Asparagus*	Brazil nuts	Cauliflower
Blood oranges	Kumquat	Chamomile tea	Avocado	Beans*	Brown lentils	Coconut
Cherries	Mandarins	Chickpeas	Bamboo shoots	Black beans	Brown rice	Coconut water
Cranberries	Mangoes	Corn (hominy, kernels, on cob, popcorn)	Beet greens	Black lentils	Buckwheat	Daikon radish
Currants	Nectarines		Bell peppers	Black pepper	Cacao nibs	Garlic
Goji berries	Orange bell peppers	Endive	Bok choy	Black quinoa	Cacao powder	Hearts of palm
Guava	Orange lentils	Ginger root	Broccoflower	Black rice	Carob	Horseradish
Kidney beans	Oranges	Ginger spice	Broccoli	Black tea	Cashews	Jicama
Lingonberries	Papaya	Ginger tea	Brussels sprouts	Blackberries	Chai tea	Kohlrabi
Peppers	Passionfruit	Golden beets	Celery	Blueberries	Cocoa powder	Mushrooms
Pink grapefruit	Peaches	Golden flaxseed	Chard	Boysenberries	Coffee	Parsnips
Pomegranate	Persimmons	Golden raisins	Cilantro	Cabbage*	Dates	Pear (flesh)
Radicchio	Pumpkin	Lemons	Collards	Carrots*	Flaxseeds	Pumpkin seeds (outer)
Radishes	Sweet potato	Millet	Cucumbers	Cauliflower*	Hemp seeds	Rutabaga
Raspberries	Tangerines	Mustard (Dijon, spice, yellow)	Fennel bulbs	Eggplant	Millet	Sauerkraut
Red beans	Turmeric root	Pineapples	Green apples	Figs	Mushroom teas	Sesame seeds
Red cabbage	Turmeric spice	Plantains	Green beans	Grapes*	Mushrooms	Shallots
Red carrots	Yams	Quinoa	Green cabbage	Huckleberries	Nuts	Tofu
Red chard		Squash	Green grapes	Kale*	Nut butters	Turnips
Red grapes		Starfruit	Green lentils	Marionberries	Oats	White potatoes
Red lentils		Yellow bell peppers	Green olives	Olives	Peanuts	White carrots
Red onions			Green onions	Onions*	Pecans	White onions
Red pears		Yellow carrots	Green pears	Oolong tea	Pili nuts	White pepper
Red plums		Yellow cauliflower	Green peas	Peppers	Pumpkin seeds	White rice
Red potatoes		Yellow lentils	Green tea	Plums	Quinoa	White tea
Red quinoa		Yellow onions	Herbs	Potatoes*	Rye	
Rhubarb		Yukon potatoes	Kale	Prunes	Seed butters	
Rooibos tea			Kiwis	Raisins	Seeds	
Strawberries			Leeks	Rice*	Sesame seeds	
Tomato			Lettuces	Sweet potato*	Soy sauce	
Tomato paste			Limes		Spelt	
Tomato sauce			Mung beans		Sunflower seeds	
Watermelon			Mustard greens	*Purple variety	Tamari sauce	
			Okra		Taro root	
			Olives		Teff	
			Parsley		Tempeh	
			Peppers		Triticale	
			Pickles		Walnuts	
			Snow peas		Wheat	
			Soybeans			
			Spinach			
			Sprouts			
			Thyme			
			Turnip greens			
			Watercress			
			Zucchini			

“Eat a Rainbow” Tool Kit

1 — 2 — 3

Select Functions of Phytochemicals: Modulation of the gut-brain axis



- Lamming DW, Wood JG, Sinclair DA. Small molecules that regulate lifespan: evidence for xenohormesis. Mol Microbiol. 2004 Aug;53(4):1003-9. doi: 10.1111/j.1365-2958.2004.04209.x. PMID: 15306006.
- Banudevi S, Swaminathan S, Maheswari KU. Pleiotropic Role of Dietary Phytochemicals in Cancer: Emerging Perspectives for Combinational Therapy. Nutr Cancer. 2015;67(7):1021-48. doi: 10.1080/01635581.2015.1073762. Epub 2015 Sep 11. PMID: 26359767.

Color-code for RED: Inflammation, prostate

The Color Code of Red Foods

- High in antioxidants and red-food carotenoids (e.g., astaxanthin, lycopene)
- Anti-inflammatory properties
- Immune system modulation:
  - Red-colored foods such as acerola cherry, rosehips, red bell pepper and tomatoes are some of the highest vitamin C-containing foods
  - Cell, animal, and human studies have shown that red-colored foods and/or their compounds may assist with reducing inflammation and helping immune status: watermelon, apples, cherries, cranberries, pomegranate, raspberries

Minich DM, A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”, *Journal of Nutrition and Metabolism*, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

Color-code for ORANGE: Fertility, reproductive health, protection

The Color Code of Orange Foods

- Abundant in carotenoids, especially beta-carotene and beta-cryptoxanthin
- Fat-soluble antioxidants, storage in adipose tissue, skin, breast, ovaries, brain
- Endocrine-regulating activities such as ovulation; may play role in reducing risk for insulin resistance
- Role in fertility through association with hormone levels (in animals) and reducing oxidative stress
  - Supplementation with beta-carotene and other antioxidants in women has shown reduced time to pregnancy
  - Important for viability of sperm; levels of beta-carotene associated with sperm concentration

Minich DM, A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”, *Journal of Nutrition and Metabolism*, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

Color-code for YELLOW: Digestion, energy, metabolism

The Color Code of Yellow Foods

- Bioflavonoids for healthy microorganisms and metabolic detoxification
- Rich in fibers to support a complex microbiome and for sustained release of simple carbohydrates to modify glycemic impact
- Assist in maintaining gastrointestinal health through gastric motility and/or digestive secretions

Minich DM, A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”, *Journal of Nutrition and Metabolism*, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

Color-code for GREEN: Circulation, cardiovascular

The Color Code of Green Foods

- High in a variety of nutrients for cardiovascular health such as vitamin K (phylloquinone), folate, magnesium, potassium, and dietary nitrates
- Flavonoid antioxidants like vitexin (found in green leafy vegetables) may have cardioprotective benefit.
- Blood-vessel expanding
- Relaxing due to vasodilatory properties
- Binding and clearing

Minich DM, A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”, *Journal of Nutrition and Metabolism*, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

Color-code for BLUE-PURPLE: Brain, cognition, memory

Blue-purple foods for brain health

- Polyphenol-rich
- Flavonoids have an anti-anxiety effect due to their ability to bind GABA-A receptors.
- Blueberries and grapes most well studied
- Assist with learning, memory, and mood
- Contain mood- and brain-modulating flavonoids:
  - Procyanidins (monomeric and oligomeric form)
  - Flavonols (i.e., kaempferol, quercetin, myricetin)
  - Phenolic acids (hydroxycinnamic acids & derivatives of stilbenes)

Minich DM. “A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”,” Journal of Nutrition and Metabolism, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

The Family of Phytochemicals: A spotlight on polyphenols

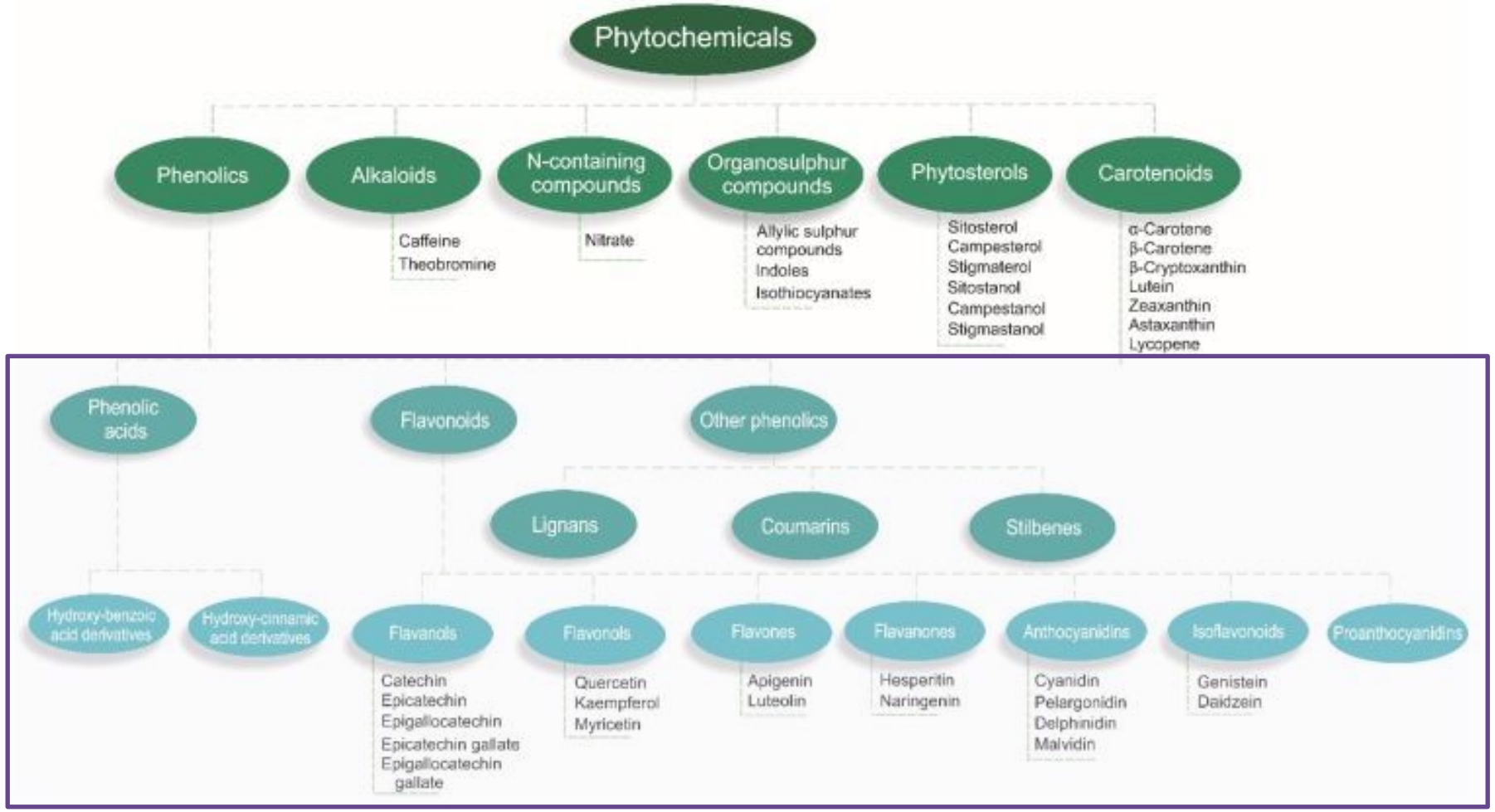
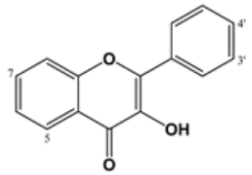


Image Credit: Blekkenhorst LC, Sim M, Bondonno CP, et al. Cardiovascular health benefits of specific vegetable types: A narrative review. *Nutrients*. 2018 May 11;10(5). pii: E595. doi: 10.3390/nu10050595. No changes made. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license CC BY 4.0.

Mood modulation by flavonols: GABA-a agonist activity

Table 1. Flavonols with relevant GABAergic effects.



Flavonol

Compound	Properties	Reference
Quercetin (5,7,3′ ,4′-tetrahydroxy)	Quercetin acts as a negative allosteric $GABA_AR$ modulator with antipsychotic activity. These results justify further therapeutic development of the excitatory-inhibitory imbalance disorders.	[69]
	Quercetin antagonistic actions on $GABA_A\rho_1Rs$ are mediated through a redox-independent allosteric mechanism.	[70]
	$GABA_A\alpha_5R$ could be a mechanism for reducing seizure severity (at anticonvulsive doses) or even be used a marker of seizure severity.	[71]
	Quercetin and its glycosides (rutin and isoquercitrin) are partially responsible for the anxiolytic and sedative-like effect of *Tilia americana* var. *mexicana* through the GABA/BZD and serotoninergic 5-HT_{1A} receptors.	[72]
Fisetin (7,3′,4′-trihydroxy)	Treatment with fisentin can delay or correct neuropathic hyperalgesia and allodynia in mice with type 1 diabetes. The analgesia caused by fisetin may be linked with its antioxidant activity. Spinal $GABA_ARs$ are likely rendered as downstream targets.	[73]
Myricetin (3,5,7,3′,4′,5′ -pentahydroxy)	Myricetin enhances $GABA_AR$ activity via the calcium channel/Ca^{2+}/calmodulin-dependent protein kinase II dependent mechanism, which is distinctively different from that of most existing BZD-binding site agonists of $GABA_AR$.	[74]
Viscosine (5,7,4′-trihydroxy-3,6-dimethoxy)	The anxiolytic and anticonvulsant actions of viscosine are likely mediated via its positive allosteric modulatory action at different $GABA_AR$ subtypes.	[75]
	Glycosides	
Rutin (quercetin 3-*O*-rutinoside)	The anxiolytic-like effect involves GABAergic neurotransmission without implication of BZD receptors.	[76]
Rutin (quercetin 3-*O*-rutinoside) Isoquercitrin (quercetin-3-*O*-glucoside)	Leaves of *Tilia americana* var. *mexicana* have anxiolytic and sedative-like effects and its flavonoids, quercetin, rutin and isoquercitrin, are partially responsible due to the involvement of GABA/BZD and serotoninergic 5-HT_{1A} receptors.	[72]

Apple, apricot, black tea, broccoli, green bean, green tea, kale, leek, onion, red wine, tomato

Ríos JL, Schinella GR, Moragrega I. Phenolics as $GABA_A$ Receptor Ligands: An Updated Review. Molecules. 2022 Mar 8;27(6):1770. doi: 10.3390/molecules27061770. PMID: 35335130; PMCID: PMC8953830.

Blue-purple fruits & vegetables, select phytochemicals & physiological effects

Color	Fruits	Vegetables	Select Phytochemicals	Physiological Effects
Blue-purple	Blackberries Blueberries Boysenberries Figs Huckleberries Plums Prunes Purple grapes Raisins	Eggplant Purple bell peppers Purple cabbage Purple carrots Purple cauliflower Purple kale Purple potatoes	Anthocyanidins Flavonoids Phenolic acids Proanthocyanidins Pterostilbene Resveratrol Stilbenes	Antioxidant Cognitive support Healthy mood balance Neuronal health

Minich DM. “A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”,” Journal of Nutrition and Metabolism, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070.

Purple is precious:

Choose blue-purple varieties whenever possible for added neuroprotective polyphenols

Concord grape juice (Resveratrol)

- Daily intake over 3-4 months shown to improve memory in adults with mild cognitive impairment.
- Can help with other parameters of cognition including reactive time on an attention measure and increased calm ratings
- An animal study suggests it may modulate BDNF, a neuronal growth factor.
- Grape polyphenols like resveratrol have been shown to have anti-inflammatory effects.

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Blueberries

- May help with cognition
  - Regular blueberry intake can prevent cognitive decline in those at risk.
  - Clinical trials shown to help cognition in older adults, such as delayed word recognition or recall.
- May help with mood
  - In addition to cognitive markers, may help with mood, as shown in children and young adults.
- May affect hippocampal BDNF mRNA expression (shown in rats)
- Frozen blueberries preserves antioxidant effects and anthocyanin levels.
  - Drying the fruit, however, will reduce total anthocyanin level by 41%, and dehydrating will reduce levels by 49%.

Miller MG, Hamilton DA, Joseph JA, Shukitt-Hale B. Dietary blueberry improves cognition among older adults in a randomized, double-blind, placebo-controlled trial. Eur J Nutr. 2018 Apr;57(3):1169-1180. doi: 10.1007/s00394-017-1400-8. Epub 2017 Mar 10. PMID: 28283823. Krikorian R, Skelton MR, Summer SS, Shidler MD, Sullivan PG. Blueberry Supplementation in Midlife for Dementia Risk Reduction. Nutrients. 2022 Apr 13;14(8):1619. doi: 10.3390/nu14081619. PMID: 35458181; PMCID: PMC9031005.Minich DM, A Review of the Science of Colorful, Plant-Based Food and Practical Strategies for “Eating the Rainbow”, *Journal of Nutrition and Metabolism*, vol. 2019, Article ID 2125070, 19 pages, 2019. https://doi.org/10.1155/2019/2125070. Lohachoompol V, Srzednicki G, Craske J. The Change of Total Anthocyanins in Blueberries and Their Antioxidant Effect After Drying and Freezing. J Biomed Biotechnol. 2004;2004(5):248-252. doi: 10.1155/S1110724304406123. PMID: 15577185; PMCID: PMC1082901.

Select mechanisms of how blueberries support mood & cognition

- Involved in inflammation and cell survival; enhance neuroplasticity, neurotransmission
- Reduce glycation
- Reduce DNA damage
- Improves spatial memory, increases rate of learning, elevates BDNF (animals)
- Improves cognition in older adults and in children
- Improved positive affect/mood in children/young adults

Khalid S, Barfoot KL, May G, et al. Effects of acute blueberry flavonoids on mood in children and young adults. *Nutrients*. 2017;9(2):158. Published 2017 Feb 20. doi:10.3390/nu9020158.; Barfoot KL, May G, Lamport DJ, Ricketts J, Riddell PM, Williams CM. The effects of acute wild blueberry supplementation on the cognition of 7-10-year-old schoolchildren. *Eur J Nutr*. 2019;58(7):2911–2920. doi:10.1007/s00394-018-1843-6.; Fragua V, Lepoudère A, Leray V, et al. Effects of dietary supplementation with a mixed blueberry and grape extract on working memory in aged beagle dogs. *J Nutr Sci*. 2017;6:e35. Published 2017 Jul 12. doi:10.1017/jns.2017.33.; Rendeiro C, Vauzour D, Rattray M, et al. Dietary levels of pure flavonoids improve spatial memory performance and increase hippocampal brain-derived neurotrophic factor. *PLoS One*. 2013;8(5):e63535. Published 2013 May 28. doi:10.1371/journal.pone.0063535

Strategy #2: Creativity

- Creativity enables for better expression of oneself[1,2]
- Reduces burnout and emotional stress[3,4]
- Cultivates resilience[3,4]
- Greater sense of purpose and meaning[5]
- Food cravings may be related to need for less boredom and more creativity.[6]

1. Jackson L. T. (1991). Creative movement promotes health, self-expression. Provider (Washington, D.C.), 17(7), 35. PMID: 10114257; 2. Stuckey HL, Nobel J. The connection between art, healing, and public health: a review of current literature. Am J Public Health. 2010 Feb;100(2):254-63. doi: 10.2105/AJPH.2008.156497. Epub 2009 Dec 17. PMID: 20019311; PMCID: PMC2804629. 3. Reynolds, S. S., & Sova, C. (2022). Memes and poetry: A descriptive analysis on creative arts therapy to reduce health care worker burnout. Journal of Nursing Care Quality, 37(3), 245–248. https://doi.org/10.1097/NCQ.0000000000000618 PMID: 35142729; 4. Ho AHY, Tan-Ho G, Ngo TA, Ong G, Chong PH, Dignadice D, Potash J. A Novel Mindful-Compassion Art-Based Therapy for Reducing Burnout and Promoting Resilience Among Healthcare Workers: Findings From a Waitlist Randomized Control Trial. Front Psychol. 2021 Oct 21;12:744443. doi: 10.3389/fpsyg.2021.744443. PMID: 34744918; PMCID: PMC8566679; 5. Liddle, J. L., Parkinson, L., & Sibbritt, D. W. (2013). Purpose and pleasure in late life: Conceptualising older women's participation in art and craft activities. Journal of Aging Studies, 27(4), 330–338. https://doi.org/10.1016/j.jaging.2013.08.002 PMID: 24300053; 6. Hill, A. J., Weaver, C. F., & Blundell, J. E. (1991). Food craving, dietary restraint and mood. Appetite, 17(3), 187–197. https://doi.org/10.1016/0195-6663(91)90021-j PMID: 1799281

Strategy #2: Creativity

- Food preparation
- Plays, acting, drama
- Designing (interior, graphic, fashion)
- Thinking strategically
- Physical movement
- Being in nature
- Playing or listening to music
- Journaling
- Crafts of various types
- Painting, drawing, coloring books

Mental creativity can help one move out of restrained eating ruts

- Mindfulness meditation may help reduce binge eating and emotional eating[1,2]
- Relaxation response to modulate stress eating episodes[3]

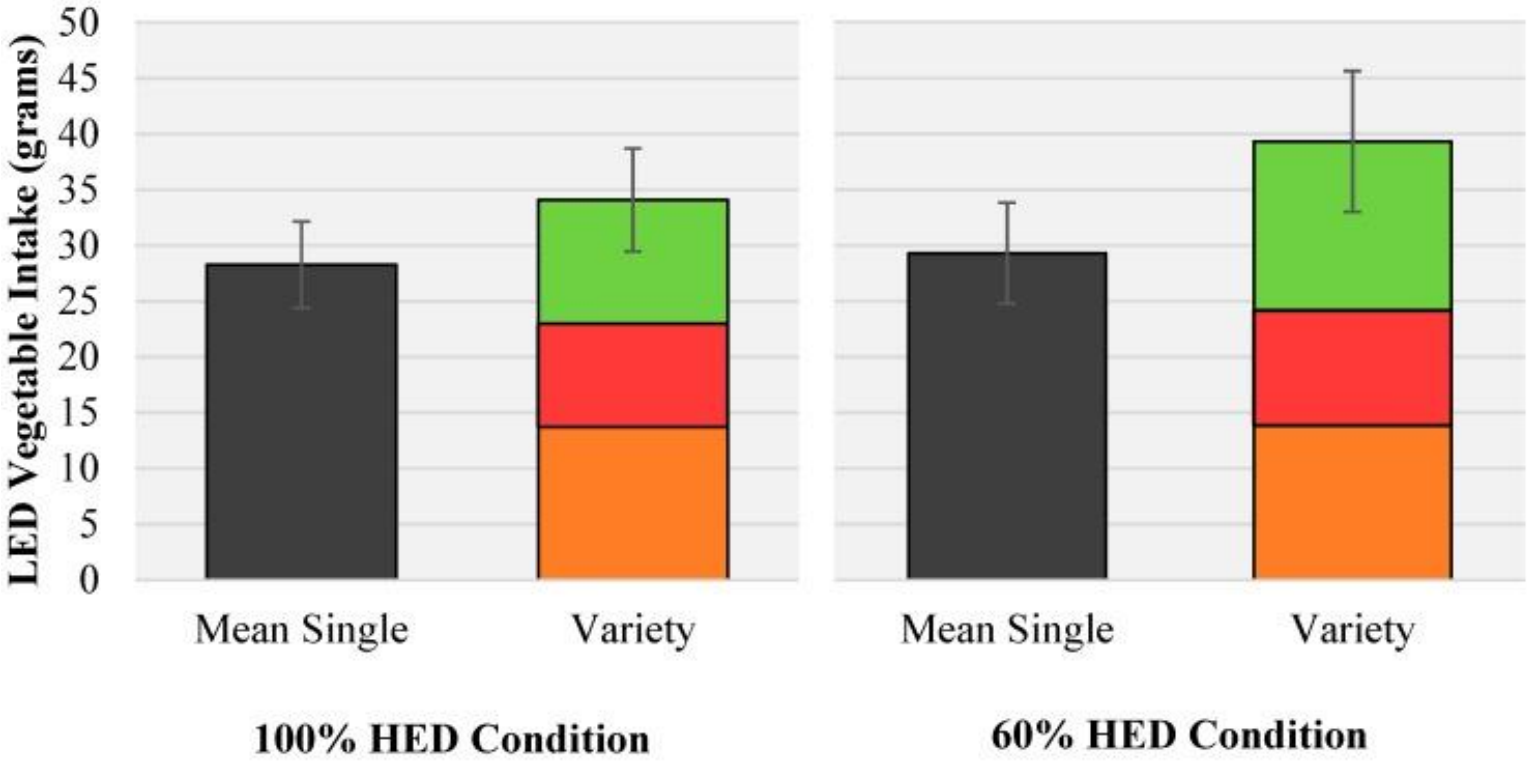
1. Katterman, S. N., et al. (2014). Mindfulness meditation as an intervention for binge eating, emotional eating, and weight loss: A systematic review. Eating Behaviors, 15(2), 197–204. https://doi.org/10.1016/j.eatbeh.2014.01.005 PMID: 24854804; 2. Warren, J. M., et al. (2017). A structured literature review on the role of mindfulness, mindful eating and intuitive eating in changing eating behaviours: Effectiveness and associated potential mechanisms. Nutrition Research Reviews, 30(2), 272–283. https://doi.org/10.1017/S0954422417000154 PMID: 28718396; 3. Masih, T., et al. (2017). Stress-induced eating and the relaxation response as a potential antidote: A review and hypothesis. Appetite, 118, 136–143. https://doi.org/10.1016/j.appet.2017.08.005 PMID: 28789869

Strategy #3: Variety

- Greater variety of fruits and vegetables was associated with a higher MMSE and cognitive domains such as executive function, memory, and attention in adults[1]
- Children with less dietary diversity and dietary adequacy have greater anxiety[2]
- Women with lower dietary diversity had greater associations with anxiety[3] and depression[4].
    - A one-unit increase in the Dietary Diversity Score was associated with a 39% reduced risk of depression

1. Ye, X., Bhupathiraju, S. N., & Tucker, K. L. (2013). Variety in fruit and vegetable intake and cognitive function in middle-aged and older Puerto Rican adults. The British Journal of Nutrition, 109(3), 503–510. https://doi.org/10.1017/S0007114512001183 PMID: 22717056; 2. McMartin, S. E., et al. (2013). Diet quality and feelings of worry, sadness or unhappiness in Canadian children. Canadian Journal of Public Health = Revue canadienne de sante publique, 104(4), e322–e326. https://doi.org/10.17269/cjph.104.3845 PMID: 24044473; 3. Poorrezaeian, M., et al. (2015). Association of dietary diversity score with anxiety in women. Psychiatry Research, 230(2), 622–627. https://doi.org/10.1016/j.psychres.2015.10.016 PMID: 26506017; 4. Poorrezaeian, et al. (2017). Depression is related to dietary diversity score in women: A cross-sectional study from a developing country. Annals of General Psychiatry, 16, 39. https://doi.org/10.1186/s12991-017-0162-2 PMID: 29176995

More variety of vegetables results in greater intake in children



Mean (± SEM) intakes of LED vegetables at a lunch meal across both HED portion sizes by vegetable condition. A significant main effect of vegetable condition was observed at $p < 0.05$. Within each variety condition the mean consumption of each individual vegetable type (carrot (orange), cherry tomato (red) and cucumber (green) has been shown.

Clinical Tool: Variety Tracker

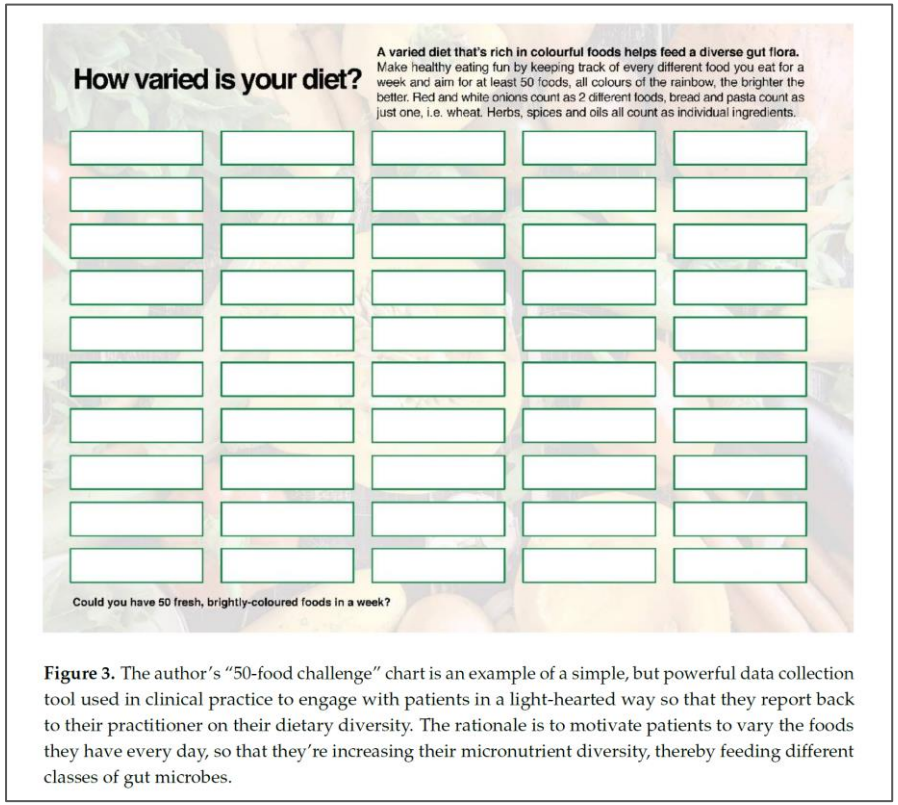


Figure 3. The author's "50-food challenge" chart is an example of a simple, but powerful data collection tool used in clinical practice to engage with patients in a light-hearted way so that they report back to their practitioner on their dietary diversity. The rationale is to motivate patients to vary the foods they have every day, so that they're increasing their micronutrient diversity, thereby feeding different classes of gut microbes.

"Increasing the diversity of brightly-coloured plant foods, even in small amounts, can have a dramatic effect on SCFA production."

Toribio-Mateas, M. Harnessing the Power of Microbiome Assessment Tools as Part of Neuroprotective Nutrition and Lifestyle Medicine Interventions. *Microorganisms* 2018, *6*, 35. https://doi.org/10.3390/microorganisms6020035

Putting it all together

- Focus on physiological reasons for mood issues by dealing with inflammation, the gut microbiome and nutrient imbalances
- Aim for more color, creativity, and diversity as general principles to engage healthy, happy eating
- Use tracking metrics and assessments to put people in touch with emotions & food intake
- Ensure nutrient sufficiency and eating foods that are known to be dense in those nutrients
- Food & mood are interconnected: physically, emotionally, and mentally.

Thank You!

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