Fiber-Bound Polyphenols and the Gut Microbiome

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Today, we'll be talking about fiber in a new way.

NOT your grandparents' fiber

NOT common purified / isolated fibers

NOT just for digestion/laxation

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Brendan's Academic Bio

Past

- B.S. - Exercise Science
- M.H.A. - Health Administration
- M.S. - Nutrition Science

Current

- PhD candidate in Human Nutrition at The Rowett Institute at University of Aberdeen.
- Postgraduate Researcher in Obesity Research Unit.

Research Journey

- Thesis Research – Fruit / Vegetable Consumption and Health Outcomes.
- PhD Research – Exploring the role of fiber-bound polyphenols in human health with a major focus on the gut microbiome and obesity.

UNIVERSITY OF ABERDEEN
The Rowett Institute

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Intro to the Dietary Guidelines for Americans (2020-2025)

- Publishes every 5 years from USDA & HHS.
- Provides an evidence-based summary of what we should eat, what we actually eat, and where the gaps are.
- Translates into food programs, education initiatives, and food policy.

Reference: U.S. Department of Agriculture and U.S. Department of Health and Human Services. (2020). *Dietary Guidelines for Americans*, 2020-2025. 9th Edition.

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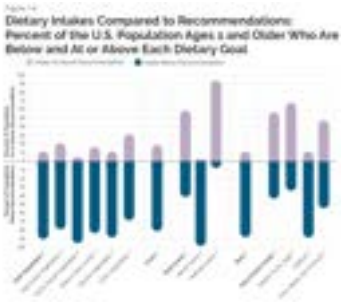
Lifecycle Adherence to the Dietary Guidelines

- Drastic under-consumption of the three key fiber-rich food categories: vegetables, fruits, and grains.
  - Gaps in all vegetable sub-categories.
  - Fruit notably includes 100% fruit juice.
  - Deficiency in whole grains.
- Despite missing key food groups, total caloric consumption remains high.
  - 40% of children and 74% of adults are overweight or obese.



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Nutrition in the United States through the Life Cycle

Primary theme of the 2020-2025 USDA Dietary Guidelines is America's need to prioritize **Nutrient Density:** *Make Every Bite Count*

of Americans are not consuming enough vegetables

of Americans are not consuming enough fruit

of Americans are not consuming enough whole grains

Nutrients of Public Health Concern: Dietary Fiber, Vitamin D, Calcium, and Potassium

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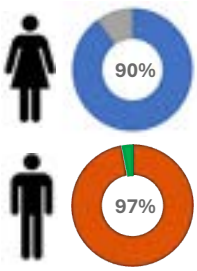
Fiber Gap in the Standard American Diet

- The health benefits of dietary fiber are well-established, yet in the United States **more than 90% of women and 97% of men do not consume the Adequate Intake (AI) for fiber daily.**
- The root cause of the fiber deficiency is under consumption of fiber-rich fruits, vegetables, and whole grains.
- Globally, these numbers improve; however, to the best of my knowledge all countries with established fiber guidelines and a national dietary survey has shown fiber to be a critical gap.

Fiber Gap in the U.S.



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Known Functions of Fiber in the Body

Viscous / Gel-Forming Fibers
- Gastric distension
- Longer intestinal transit time
- Reduced nutrient digestion / absorption

→ Reduced Cholesterol / Blood Sugar & Satiety

Non or Less Fermentable Fibers
- Increased water holding
- Greater frequency of defecation

→ Laxation

Fermentable Fibers
- Growth of bacterial populations
- Increased fecal mass
- Short-chain fatty acids (SCFA)

→ Microbiome Health and Metabolite Production

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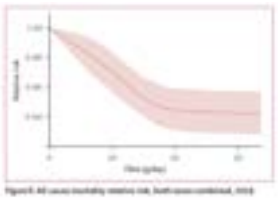
Growing Health Benefits Associated with Fiber

From ***The Lancet*** *(publication on Global Burden of Disease study)* – "Our findings show that suboptimal diet is responsible for more deaths than any other risks globally, including tobacco smoking" (Afshin, 2019).



Images Used from: https://www.thelancet.com/pb-assets/Lancet/gbd/summaries/risks/diet-fibre.pdf

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Growing Health Benefits Associated with Fiber

In 2020, ***Nutrients*** published an updated review of dietary fiber literature and found consumption of dietary fiber led to positive health outcomes for:

- Gut Motility
- Metabolism
- Chronic Inflammation
- Colon Cancer
- Weight / Adiposity
- Gut Microflora
- Depression
- Longevity
- Insulin Sensitivity
- Gut Metabolites
- Cardiovascular Disease

"Over recent decades, there has been a transformation in our understanding of the health benefits of dietary fiber" (Barber et. al, 2020).

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Fiber-Bound Polyphenols - is there more to dietary fiber?

- An often-overlooked component of dietary fiber is its antioxidant capacity exerted through its bound phenolic compounds.
- Often thought of separately, dietary fiber and many antioxidant compounds have synergistic effects inside the G.I. tract.
- The most abundant antioxidants found in nature are polyphenols, corresponding to about 90% of dietary antioxidant intake.

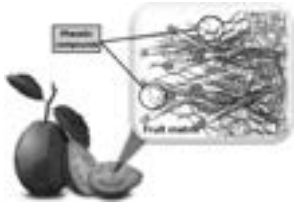

Image: (Quirós-Sauceda et al., 2014)

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Polyphenols

- Powerful phytochemicals produced by plants: often responsible for a plant's aroma, color, and antioxidant properties.
- Widely available in plant foods such as fruits, vegetables, and seeds.
- The most abundant antioxidants available in the human diet.
- Key classes of polyphenols include flavonoids (most common), phenolic acids, coumarins, stilbenes, and lignans.
- Epidemiological studies consistently associate consumption of polyphenols with reduced risk of chronic disease. E.g., Mediterranean Diet.
- An estimated 50% of dietary polyphenols are associated with dietary fiber.

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Polyphenols in Food

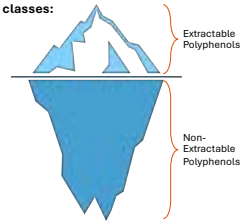
Polyphenols associated with food are broken down into two classes:

Extractable

- Easily separated from food
- Primarily accessible in the small intestine

Non-Extractable

- Not easily separated from food
- Not significantly released by chewing, stomach acid, or digestive enzymes
- Becomes a fermentable substrate in the colon



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Polyphenol Types in a Spanish Mediterranean Diet

Non-Extractable Polyphenols (NEPP) are the major form of polyphenols available in whole foods.

A recent study of the Spanish Mediterranean Diet analyzed the type of polyphenols consumed per capita per day:

NEPP = 942mg (78.5%)
EPP = 258mg (21.5%)

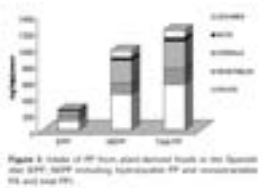

Image from (Arranz et al., 2010)

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Fiber and Bound Polyphenols - Synergies

Bound Polyphenols and Fiber work in synergy to reach the colon primarily in-tact where they:

- Provide fermentable substrates to the microbiome
- Create local antioxidant environment
- Produce biologically active metabolites
- Create prolonged circulation of metabolites via fermentation

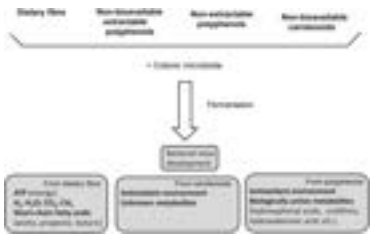

Image: (Saura-Calixto & Perez-Jimenez, 2018)

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Summary of Key Points

- True dietary fiber, as found in fruits, vegetables, and whole grains, is often accompanied by powerful antioxidants known as polyphenols.
- Non-extractable polyphenols (NEPP), which make up the largest % of dietary polyphenols, are a unique class of polyphenols largely missed by current research.
- Non-extractable polyphenols (NEPP) are capable of reaching the colon primarily in-tact.
- Once inside the colon, non-extractable polyphenols interact with the gut microbiome and are capable of:
  - Being utilized as antioxidants.
  - Promoting homeostasis of the colon.
  - Positively modulating the gut microbiome (prebiotic effect).
  - Being transformed into beneficial metabolites (postbiotics).
- Fiber and bound polyphenols work synergistically in the colon where they increase fermentation activity and create a slow, sustained release of beneficial compounds.

❖ **The science of fiber-bound polyphenols is emergent with so much left to learn and discover!**

Thank You!

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