MacDonald Center for Nutrition Education and Research (MCNER) Webinar Series for Health Professionals

VILLANOVA UNIVERSITY
M. Louise Fitzpatrick College of Nursing

VILLANOVA UNIVERSITY
M. LOUISE FITZPATRICK COLLEGE OF NURSING
MacDonald
CENTER FOR NUTRITION EDUCATION AND RESEARCH

Dietary Fiber: How Much, Why It Matters for Gut Health and How to Bridge the Gap

Wednesday, November 12, 2025

Moderator:
Lisa Diewald, MS, RDN, LDN
Associate Director
MacDonald Center for Nutrition Education and Research

Finding slides for today's webinar

VILLANOVA NURSING

- Slides are posted at villanova.edu/mcner
- From right menu→ Webinars
- Go to 11/12/25 webinar presented by Nicola McKeown, PhD

Today's Webinar Objectives

VILLANOVA NURSING

Review differences in fiber type and physiological health benefits

Provide an overview of the emerging role of fiber in promoting gut health.

Identify current dietary fiber recommendations for health vs. average U.S. adult intake.

Discuss practical and novel strategies for increasing dietary fiber intake to meet goals.

Continuing Professional Development Details

VILLANOVA NURSING

- This activity awards 1 CPEU in accordance with the Commission on Dietetic Registration's CPEU Prior Approval Program
  - Level 2 activity
  - Suggested CDR Performance Indicators: 7.2.3, 9.1.1, 9.1.5, 9.2.3
  - To receive CE credit, you must attend the entire program.
- Contact hours for nurses are not available for this webinar.

Note: If you are an RD or RDN and have any questions or concerns about this continuing education activity, you may contact CDR directly at QualityCPE@eatright.org.

The Q&A Box is Open!

VILLANOVA NURSING

- Questions are welcome!
- Please send through the Q&A Box during the presentation.
- Q&A session will follow the program.

Disclosures

Dr. McKeown is a scientific advisor and/or consultant with Whole Grains Council, Institute for the Advancement of Food and Nutrition Sciences, Grains for Health Foundation, American College of Lifestyle Medicine, the Soy Nutrition Institute Global and was a sponsored speaker by PepsiCo.

Rod Wallace, PhD and P.Stephen Baenziger, PhD have no disclosures to report.

Planners will review participant feedback to evaluate for real or perceived commercial bias in any activity.

VILLANOVA UNIVERSITY
M. LOUISE FITZPATRICK COLLEGE OF NURSING
MacDonald
CENTER FOR NUTRITION EDUCATION AND RESEARCH

Dietary Fiber: How Much, Why It Matters for Gut Health and How to Bridge the Gap

Nicola McKeown, PhD
Research Professor, Programs in Nutrition
Department of Health Sciences
Sargent College of Health & Rehabilitation Sciences
Boston University

Rodney Wallace, PhD

P. Stephen Baenziger, PhD

VILLANOVA UNIVERSITY
M. LOUISE FITZPATRICK COLLEGE OF NURSING
MacDonald
CENTER FOR NUTRITION EDUCATION AND RESEARCH

Dietary Fiber: How Much, Why It Matters for Gut Health and How to Bridge the Gap

Part 2: Innovation Overview

Dietary Fiber

How Much, Why It Matters for Gut Health, and How to Bridge the Gap

Dr. Nicola McKeown, PhD
Research Professor
Department of Nutrition Sargent College of Health and Rehabilitation Sciences
Boston University

BU Sargent College of Health & Rehabilitation Sciences
Diet Quality & Healthy Aging Lab

Photo credits: Iñigo De la Maza at Unsplash

Learning Goals

Review differences in fiber type and physiological health benefits.

Provide an overview of the emerging role of fiber in promoting gut health.

Identify current dietary fiber recommendations for health vs. average U.S. adult intake.

Discuss practical and novel strategies for increasing dietary fiber intake to meet goals.

Outline

- Understanding fiber definitions & physiological health benefits
- Falling short in meeting dietary fiber recommendations
- Fiber and our gut health
- Strategies to increase dietary fiber

Photo credits: Wsual Click at Unsplash

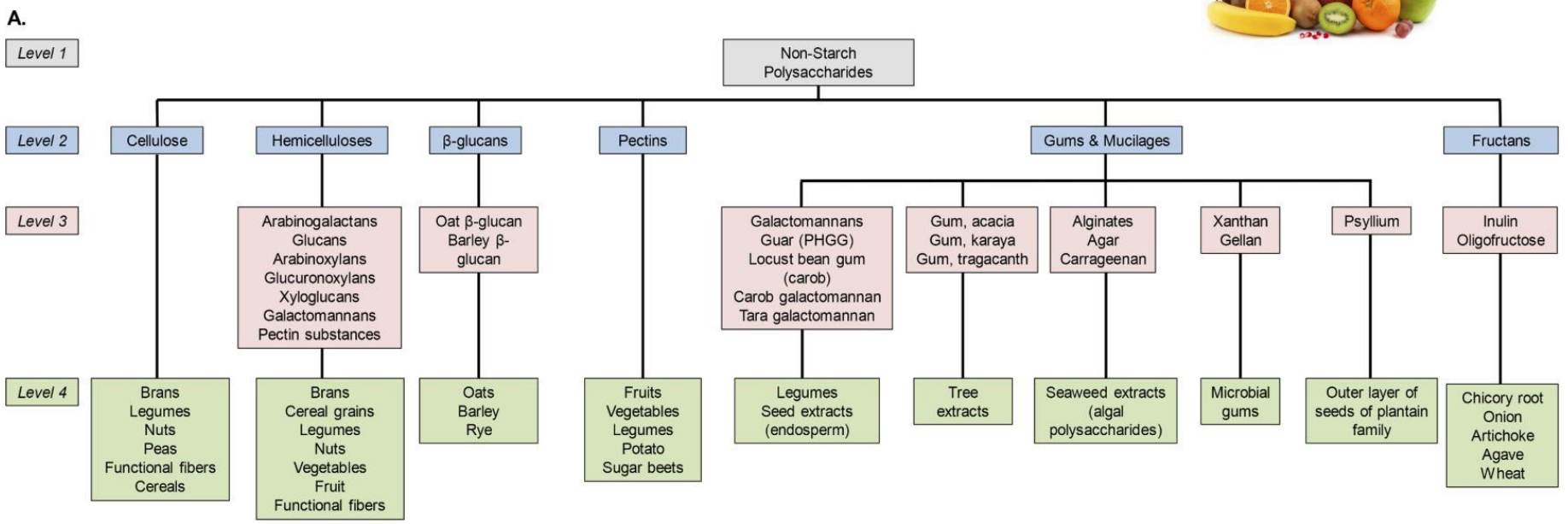
What is Fiber?

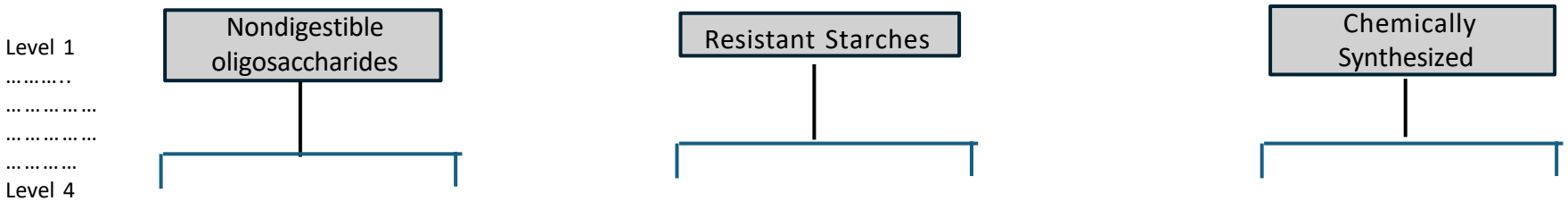
Dietary fiber consists of nondigestible carbohydrates and lignin that are intrinsic and intact in plants

Functional fiber is an isolated, nondigestible carbohydrate that confer beneficial physiological effects

(Institute of Medicine (IOM) 2002)

Fiber is Not a Single Entity





Livingston et al. (2016) doi:https://doi.org/10.1371/journal.pone.0156961.g001

Definition of Dietary Fiber

Codex Alimentarius Definition of Dietary Fiber (2009)		
Carbohydrate (CHO) polymers with ≥10 monomeric units* that are not digested (hydrolyzed) by the endogenous enzymes in the small intestine, categorized as		
Natural Plant Foods Edible CHO polymers are naturally occurring in the food as consumed.	Isolated CHO polymers obtained from food raw material by physical, enzymatic, or chemical means and show to have a physiological effect of benefit to health	Synthetic Synthetic CHO polymers which have been shown to have a physiological effect of benefit to health

*The decision to include carbohydrates of **3-9 monomeric** units should be left to national authorities

FAO/WHO Codex Alimentarius (2021); Gustafson & Rose 2022 doi: 10.3390/nu14112341

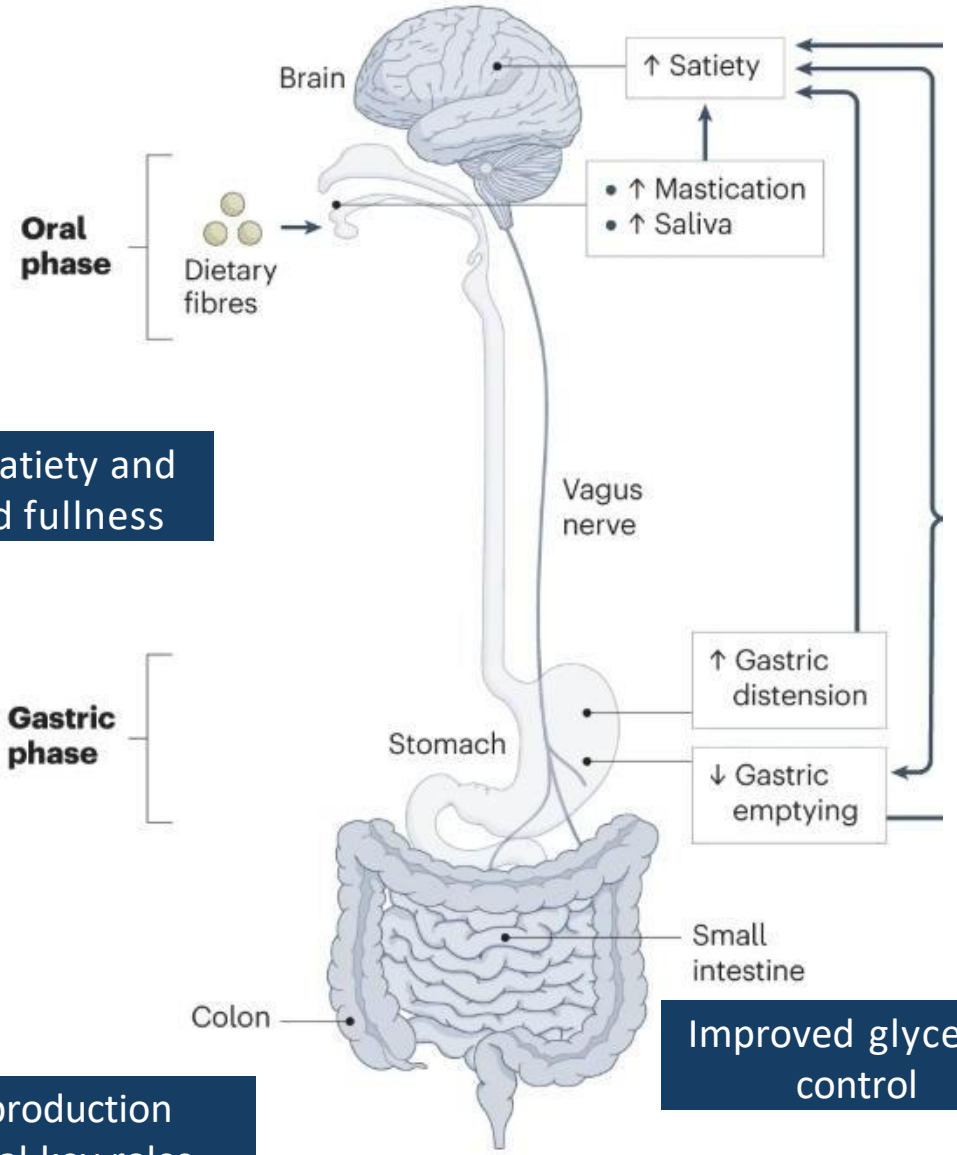
Fibers demonstrating a beneficial physiological effect

- Beta-Glucan
- Cellulose
- Guar Gum
- Hydroxypropylmethylcellulose
- Locust Bean Gum
- Pectin
- Psyllium Husk
- Arabinoxylan
- Alginate
- Galactooligosaccharides (GOS)
- High Amylose Starch (RS2)
- Inulin & Inulin-type Fructans
- Mixed Plant Cell Wall Fibers
- Polydextrose
- Resistant Maltodextrin/Dextrin

Health Benefits		
Lowers blood glucose or insulin, or post-prandial glucose or insulin levels	**Increases frequency of bowel movements (improved laxation)**	**Reduces energy intake (supports weight management)**
Lowers total cholesterol or LDL cholesterol levels	**Lowers blood pressure**	**Increases mineral absorption in intestinal tract**

https://www.fda.gov/food/hfp-constituent-updates/fda-releases-guidance-fiber-and-several-other-key-issues

Physiological effects of dietary fibers along the gastrointestinal tract



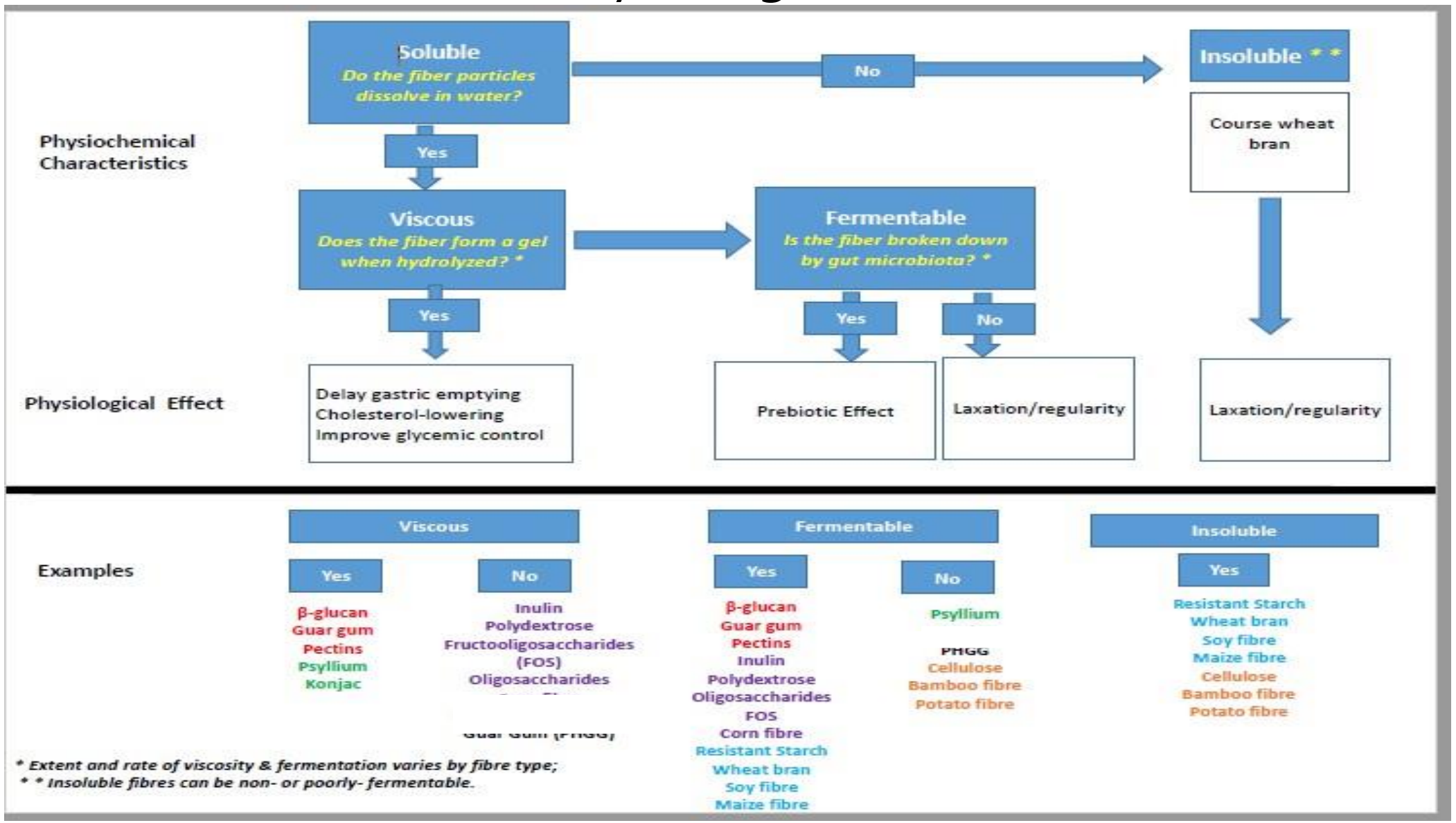
Greater satiety and sustained fullness

SCFA production
- Several key roles

Improved glycemic control

Adapted from Deehan et al. *Nat Rev Gastroenterol Hepatol* **21**, 301–318 (2024).

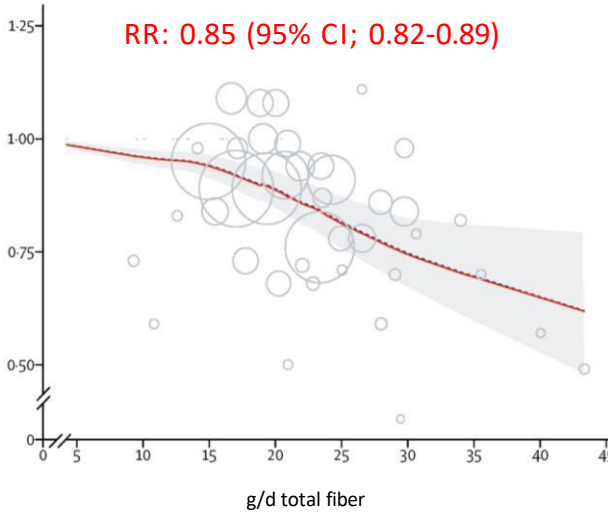
Physiochemical Characteristics of Fibers Drive Physiological Effects



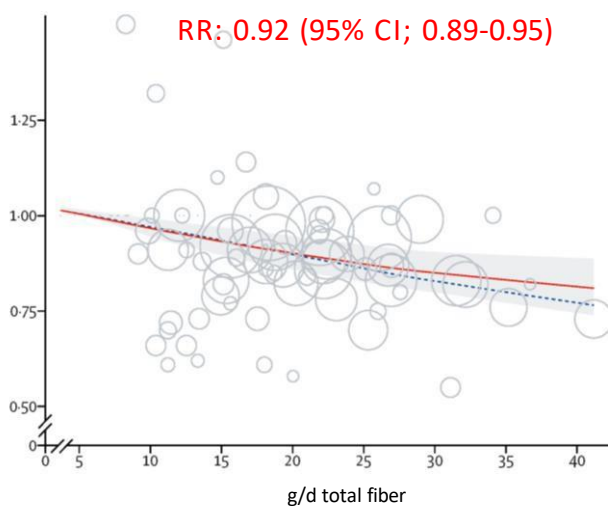
McKeown et al. BMJ 2022; McRorie & McKeown, JAND, volume 117 (2); 25-264

Inverse Association Between Dietary Fiber and Risk of Chronic Disease

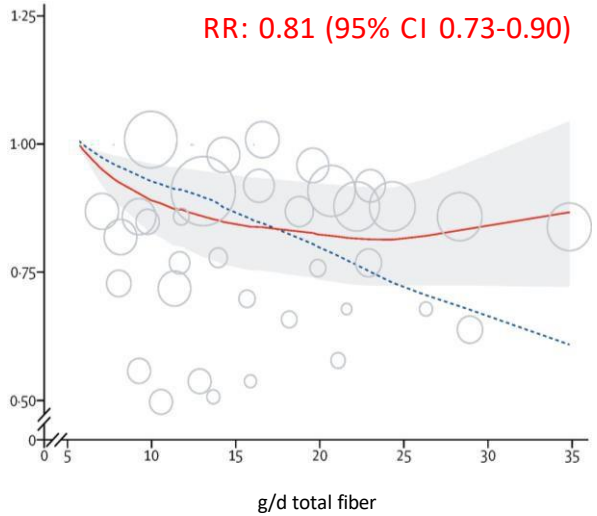
Type 2 Diabetes Incidence (17 Cohorts)



Colorectal Cancer Incidence (22 Cohorts)



Coronary Heart Disease Incidence (9 Cohorts)



For every additional 8 grams of dietary fiber consumed per day

15% reduced risk of T2D

8% reduced risk CRC

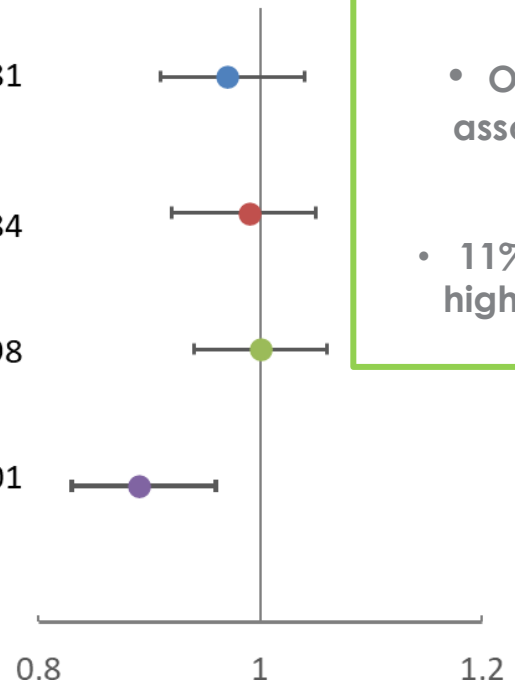
19% reduced risk of CHD

Reynolds et al. Lancet, 2019019;393(10170):434-445. DOI:10.1016/S0140-6736(18)31809-9.

Source of Dietary Fiber and Risk of Colorectal Cancer

NIH-AARP Diet and Health Study cohort (n=478,994 US adults, aged 50–71 y)

Fiber Source	g/ 1000kcal/d	HR Q5 vs Q1 (95% CI)	P-trend
Fruit	4.8 (vs 0.5)	0.97 (0.91, 1.04)	0.81
Vegetables	6.0 (vs 1.7)	0.99 (0.92, 1.05)	0.84
Legume	2.3 (vs 0.2)	1.0 (0.94, 1.06)	0.98
Grain	5.7 (vs 1.7)	0.89 (0.83, 0.96)	<0.001



- Only fiber from grains was associated with a reduction in CRC
- 11% lower risk of CRC among highest vs lowest intake of fiber from grains

Adapted from Hullings et al. 2020 AJCN PMID: 32619213

Dietary Component (Nutrient) of Public Health Concern

(Scientific Report of the 2025 Dietary Guidelines Advisory Committee, HHS & USDA, July 2025)

A Dietary Fiber Gap Exists in Our Diets

Adequate Fiber Intake (g/d) by Sex and Life Stage

Life Stage Group	Male (g/day) U.S. National Academies	Female (g/day) /Institute of Medicine, 2002)
1–3 years	19	19
4–8 years	25	25
9–13 years	31	26
14–18 years	38	26
19–30 years	38	25
31–50 years	38	25
51–70 years	30	21
Over 70 years	30	21
Pregnancy	–	28
Lactation	–	29

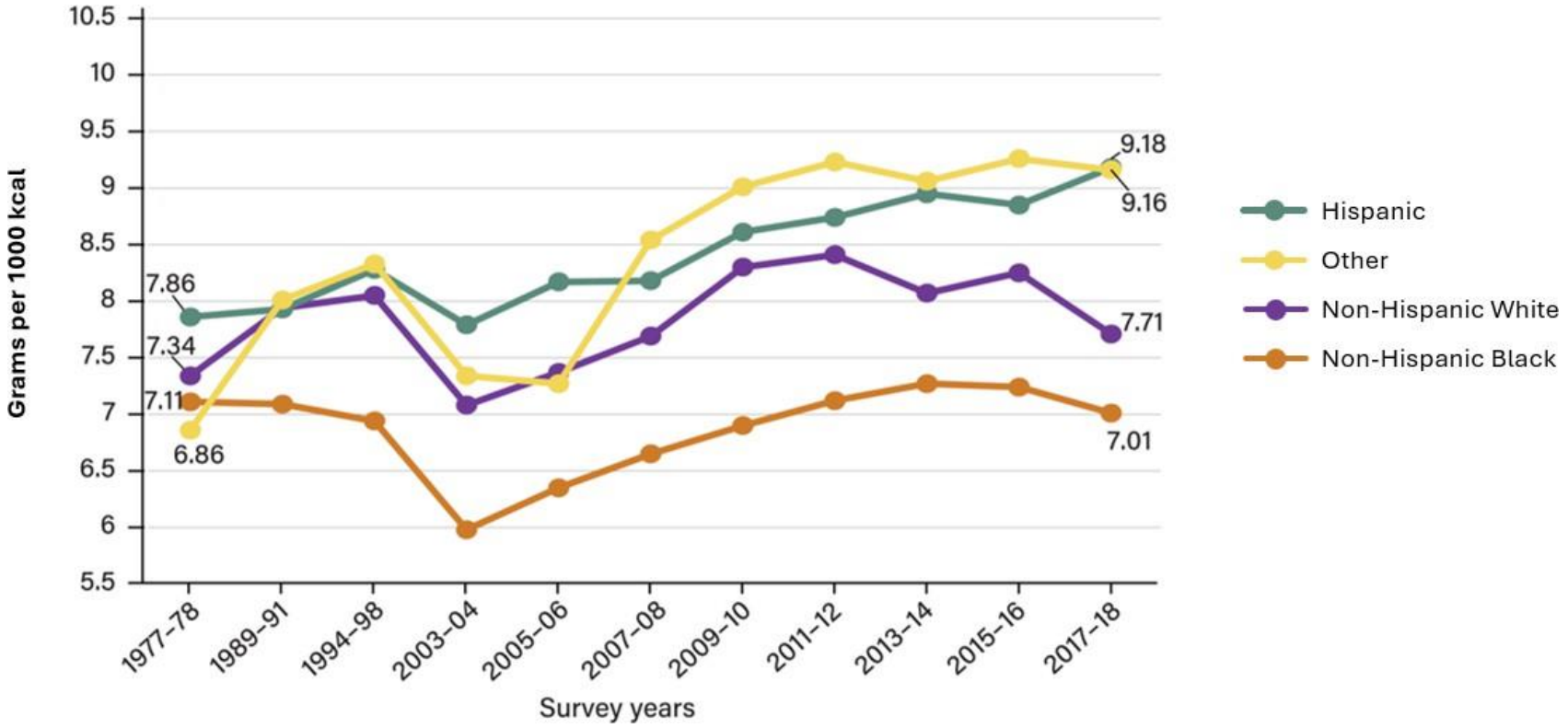
13 .6 g/d

16 g/d

Adequate Intake for dietary fiber is
14 grams per 1000 kcal

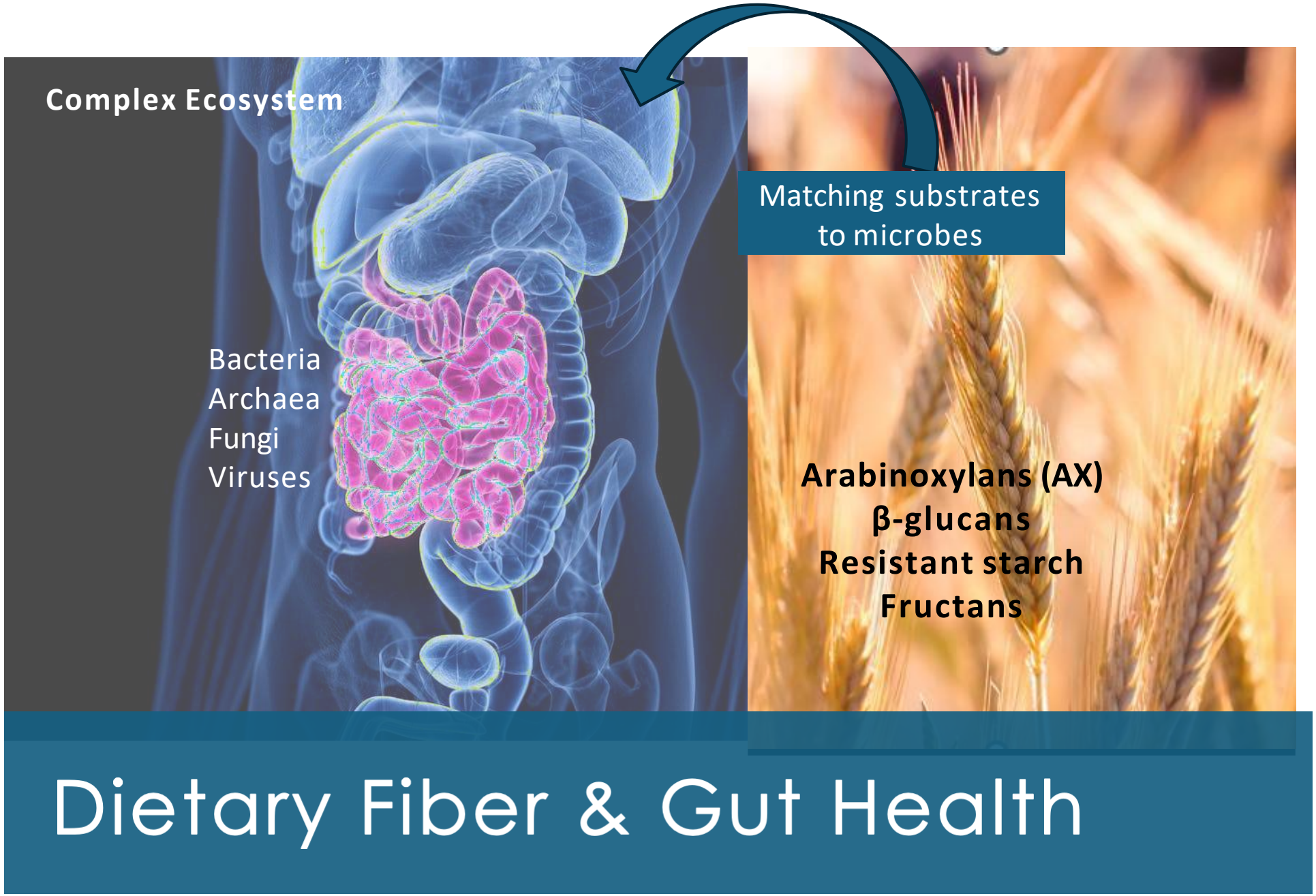
Finn et al (2019) *BMC Pediatrics*, Nicklas et al. (1995) *J Am Diet Assoc*, Lin & Guthrie (2023) *USDA ;* Prokopidis et al. (2022) *AJM*, Miketinas et al (2022) *JAND*

Dietary Fiber Intake Has Remained Low Across All Racial and Ethic Groups in the US



U.S. Department of Agriculture, Economic Research Service (ERS).
Dietary Fiber Density of the U.S. Diet, 1977–2018. Updated 2023.
Available at: https://www.ers.usda.gov/data-products/charts-of-note/chart-detail?chartId=106189

Slide created by A. Alonso Gomez, MS



Dietary Fiber & Gut Health

Feeding the Microbiome: How Dietary Fiber Supports Gut and Whole-Body Health

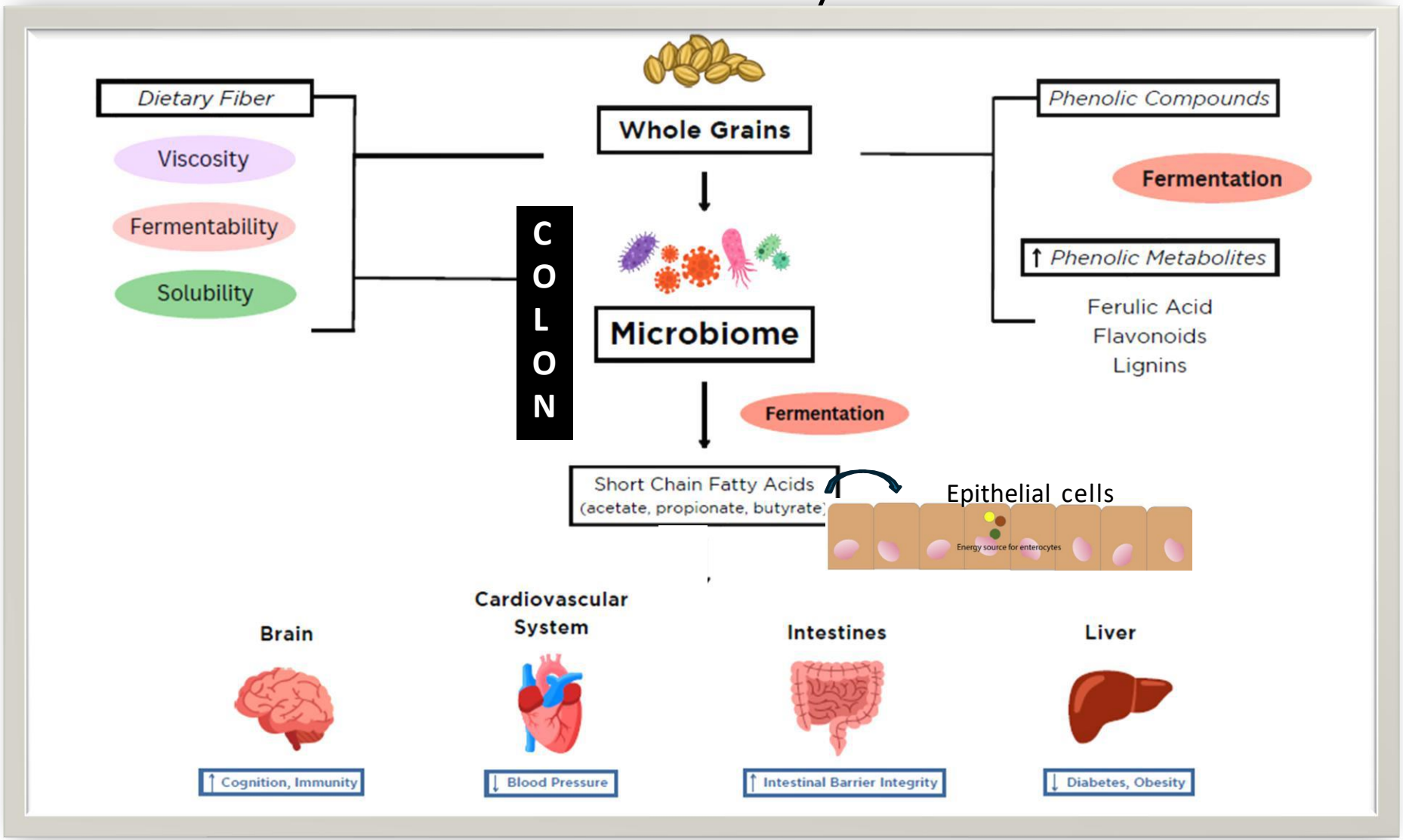
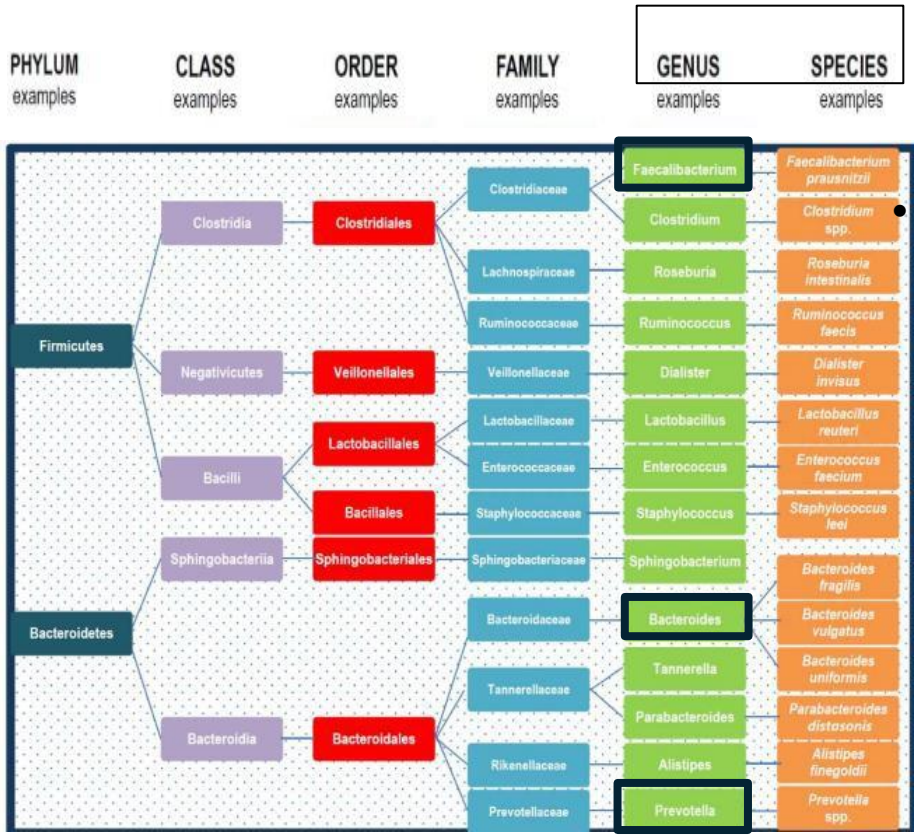


Figure created by Bella Scherer, MS, 2024

Taxonomic Structure of Human Gut Microbiome: (From Phyla to Species)



- Firmicutes and Bacteroidetes — make up about 90% of the gut microbiota

  - *Bacteroides – wide range of plants*
  - *Prevotella – fibers from whole-grains; AXOS*
  - *Faecalibacterium – breakdown products*

Rinninella et al. (2019) Microorganisms. 10;7(1):14.

Different Fibers Feed Different Microbes

Fiber	Fermenting genera	Derived metabolites & health benefits

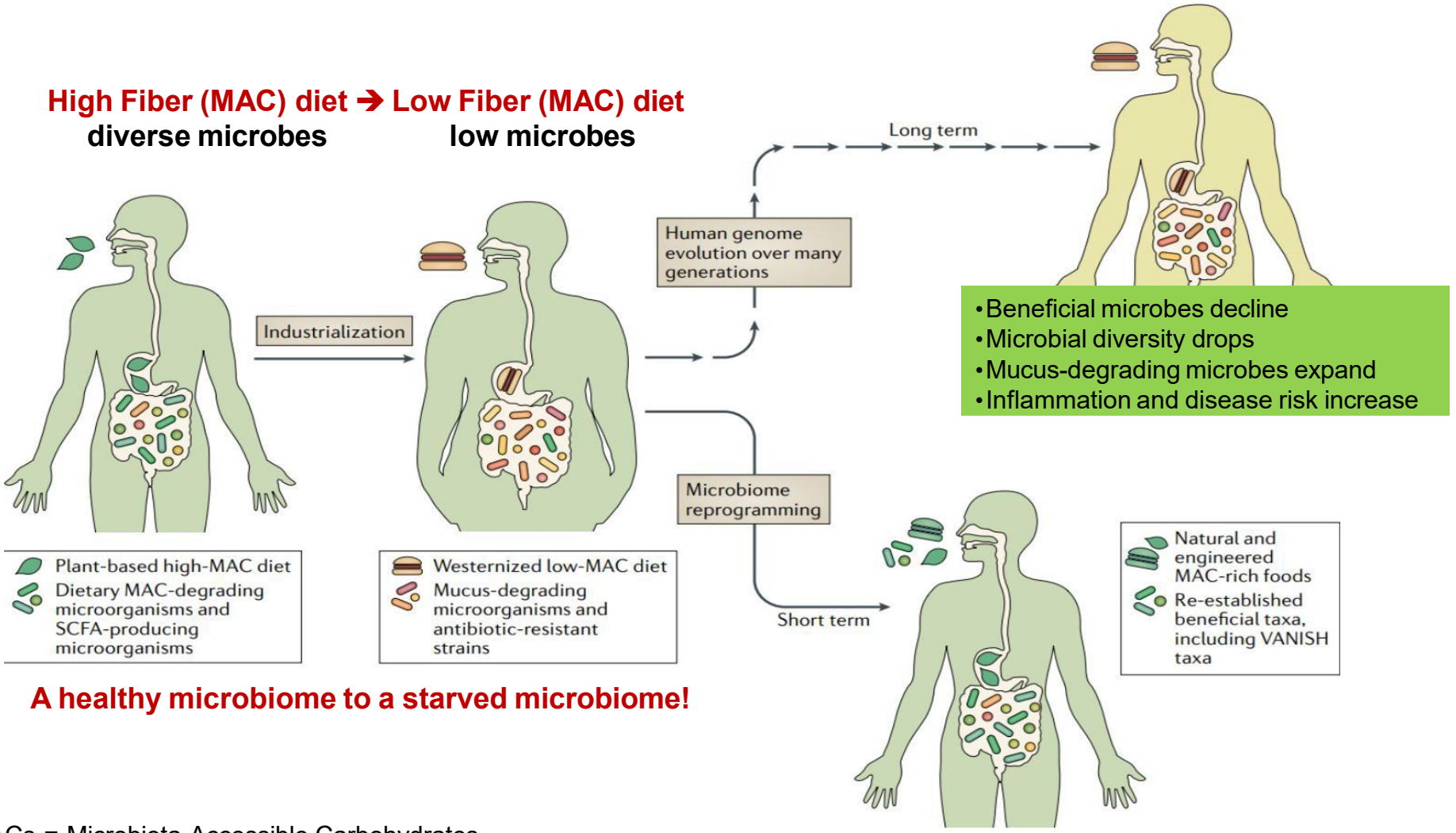
Not all fiber feeds the gut in the same way

Different bacterial species have different enzyme systems — so the types of fiber we eat determine *which microbes grow* and *what beneficial compounds they produce!*

Adapted form Dalile, B *et al.* . *Nat Rev Gastroenterol Hepatol* **16**, 461–478 (2019).

Low-Fiber Diets Lead to Loss in Microbial Diversity

High Fiber (MAC) diet ➔ Low Fiber (MAC) diet
diverse microbes **low microbes**



- Beneficial microbes decline
- Microbial diversity drops
- Mucus-degrading microbes expand
- Inflammation and disease risk increase

A healthy microbiome to a starved microbiome!

MACs = Microbiota-Accessible Carbohydrates

Sonnenburg E. et al. *Nature* (2016)
Sonnenburg E, et al *Nature Reviews Microbiology* (2019)

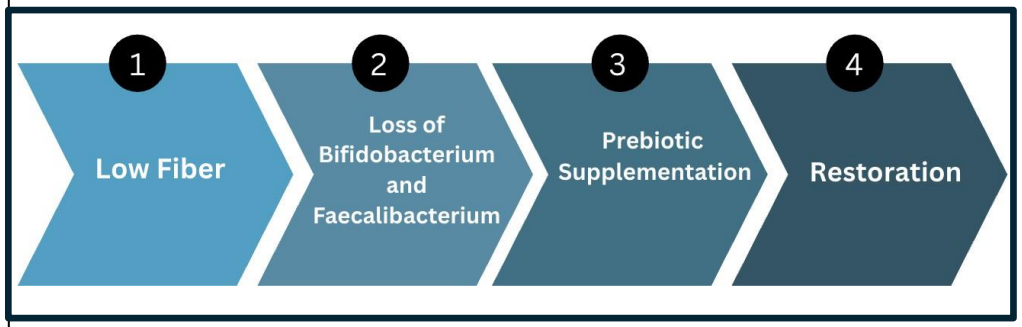
Image credits: Adapted from Sonnenburg E (2019)

Prebiotic Fibers

A substrate selectively utilized by host microorganisms conferring a health benefit (International Scientific Association for Probiotics and Prebiotics, 2021)

Established
Fructo-oligosaccharides (FOS)
Galacto-oligosaccharides (GOS)
Inulin
Resistant starch type 2 (RS2)

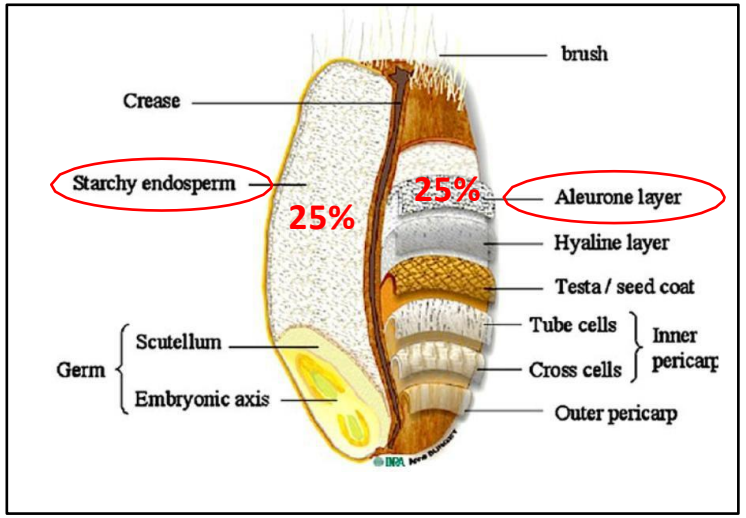
Emerging
Arabinoxylo-oligosaccharides (AXOS)
Resistant Starch 4 (RS4)*



*Functional ingredient in high-fiber “white” breads, tortillas, and low-carb products.

Gibson, G. et al. *Nat Rev Gastroenterol Hepatol* **14**, 491–502 (2017).
https://doi.org/10.1038/nrgastro.2017.75

Case Example: Arabinoxylans (AX)-Oligosaccharides (AXOS)



AX: Non-starch polysaccharide (hemicellulose) in cereal grains (wheat, rye, barley, oats, rice, sorghum) and in legumes.

AXOS: Hydrolyzed product of AX, soluble, fermentable form

Summary of Evidence from Randomized Controlled Trials

	Short-term Studies (3–6 weeks) (n=6)	Acute Studies (≤24 hours) (n=6)
AXOS Dose	8-17 g/day	3.5–15 g single dose
Health Impact	↓fasting glucose and insulin ↓postprandial glycemia ↑insulin sensitivity ↓triglycerides	↓postprandial glucose and insulin ↑SCFA production ↑postprandial GLP- production

Histological structure of wheat grain.
Adapted from Surget and Barron (2005).

Delzenne & Neyrinck (2019) 2019;32(1):23-35.
doi:10.1017/S0954422418000231

Comparative Effects of Arabinoxylan Oligosaccharides (AXOS) on Gut Microbiota: Insights from Diverse Populations

Study	Population (Sample Size)	AXOS Dose /Duration	Focus	Bifidobacteria & Butyrate Response	Other Key Findings
Kjolbaek et al. (2020)	Overweight adults (n ≈ 27)	10.4 g/d for 12 weeks	AXOS vs n3 PUFA in metabolic syndrome	↑Bifidobacteria (↑butyrate producers	AXOS affected microbiota composition, but no changes in clinical/metabolic outcomes.
Chung et al. (2020)	Older adults (n = 21)	6 g/d for 4 weeks	Baseline Prevotella determines response	↑Bifidobacterium, variable butyrate effect	The microbiota's baseline structure (enterotype, especially Prevotella) shaped individual AXOS response in the elderly

Chung et al. BMC Microbiology (2020) https://doi.org/10.1186/s12866-020-01968-4; *Kjølbæk et al. (2020). https://doi.org/10.1016/j.clnu.2019.01.012**.

iafns

Home | About | Spotlight | Science and Research | Events & Education | Publications

https://iafns.org/fiberdb/

Diet-Related Fibers And Human Health Outcomes Database

RESEARCH ARTICLE

Development of a Publicly Available, Comprehensive Database of Fiber and Health Outcomes: Rationale and Methods

Kara A. Livingston[1], Mei Chung[2], Caleigh M. Sawicki[1], Barbara J. Lyle[3], Ding Ding Wang[2], Susan B. Roberts[1], Nicola M. McKeown[1,4]*

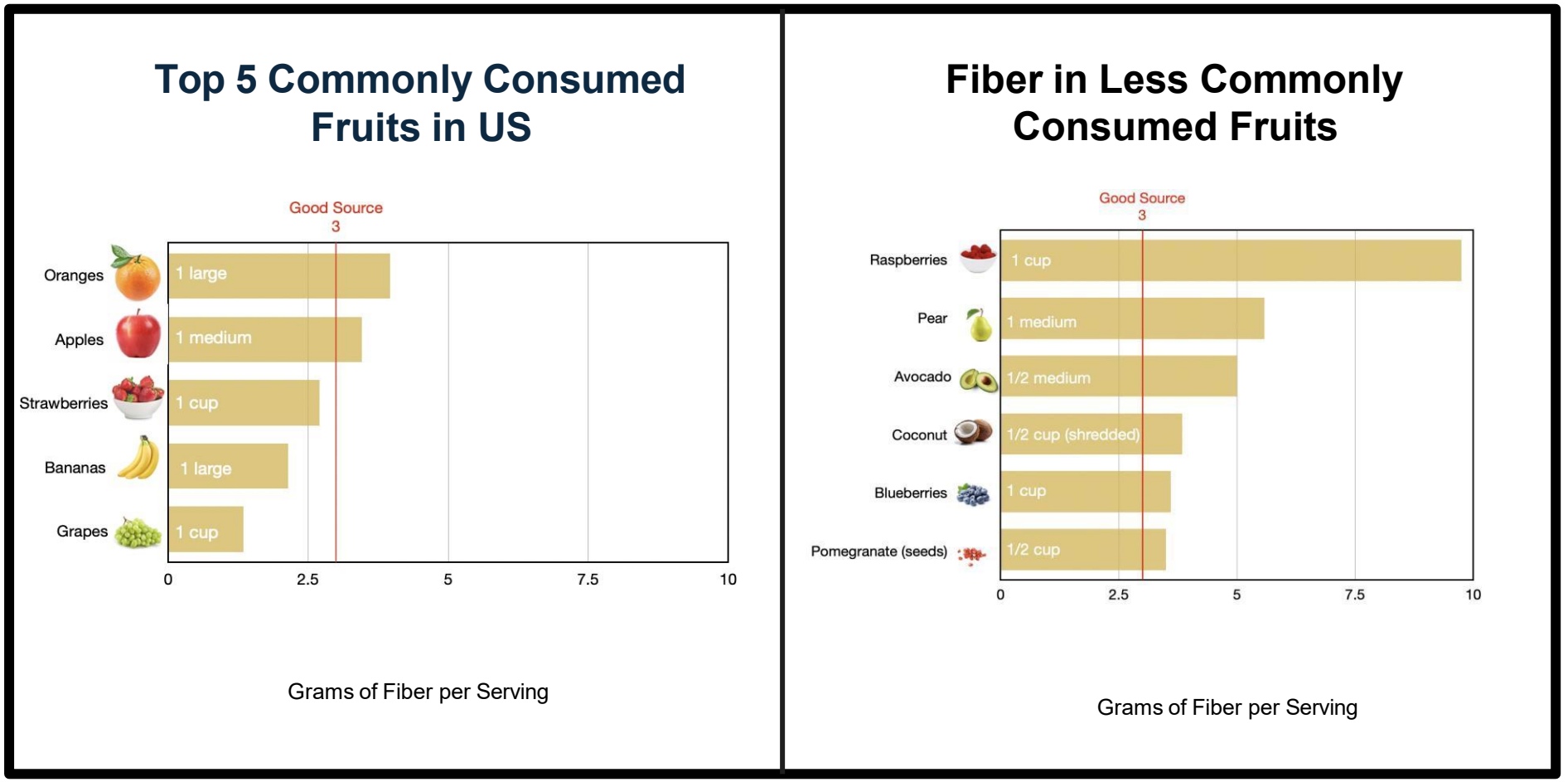
Diet-Related Fibers and Human Health Outcomes Database - IAFNS

Livingston et al. 2016 *PLoS ONE*, vol. 11, no. 6, 2016.

Strategies to Increase Fiber in Our Diets

McKeown et al (2022) BMJ 2022;378:e054370 http://dx.doi.org/10.1136/bmj-2020-054370

Eat a Variety of Fruits to Meet Recommendations

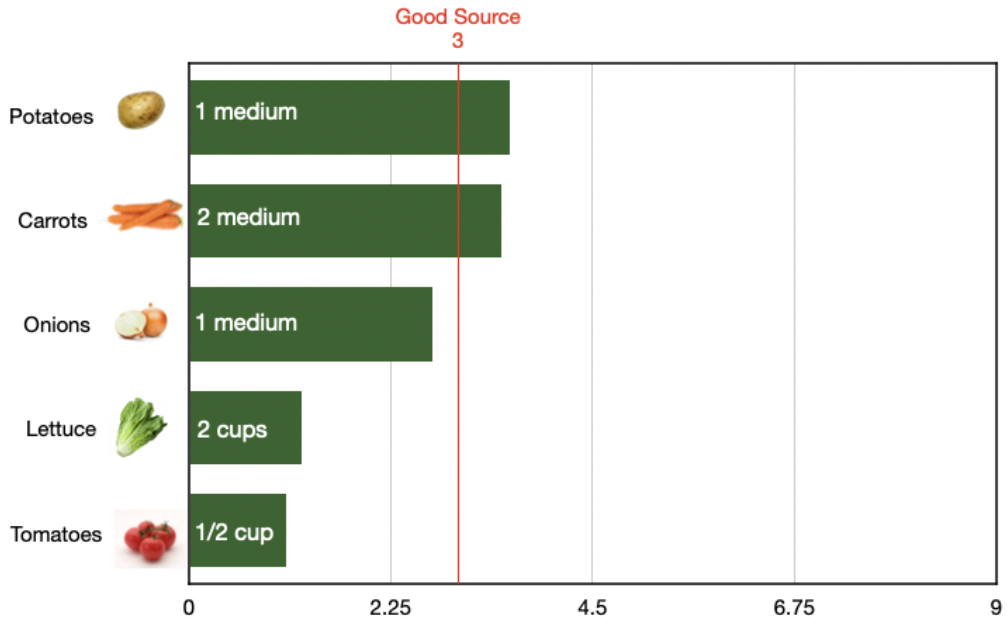


USDA (2023) https://www.ers.usda.gov/data-products/chart-gallery/chart-detail?chartId=58322

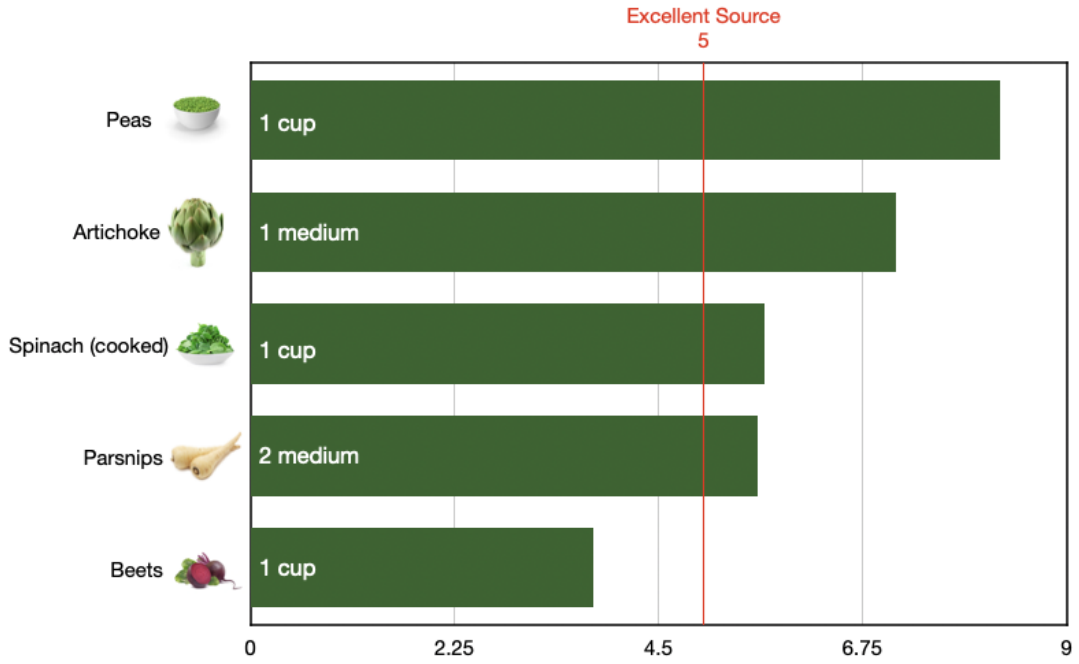
Figure created by Mariana Gianulis, MS, 2026

Eat a Variety of Vegetables to Meet Recommendations

Top 5 Commonly Consumed Vegetables in the US



Fiber in Less Commonly Consumed Vegetables



USDA (2020) https://www.ers.usda.gov/data-products/chart-gallery/chart-detail?chartId=58340

Figure created by Mariana Gianulis, MS, 2026

Incorporate beans, peas, lentils daily!

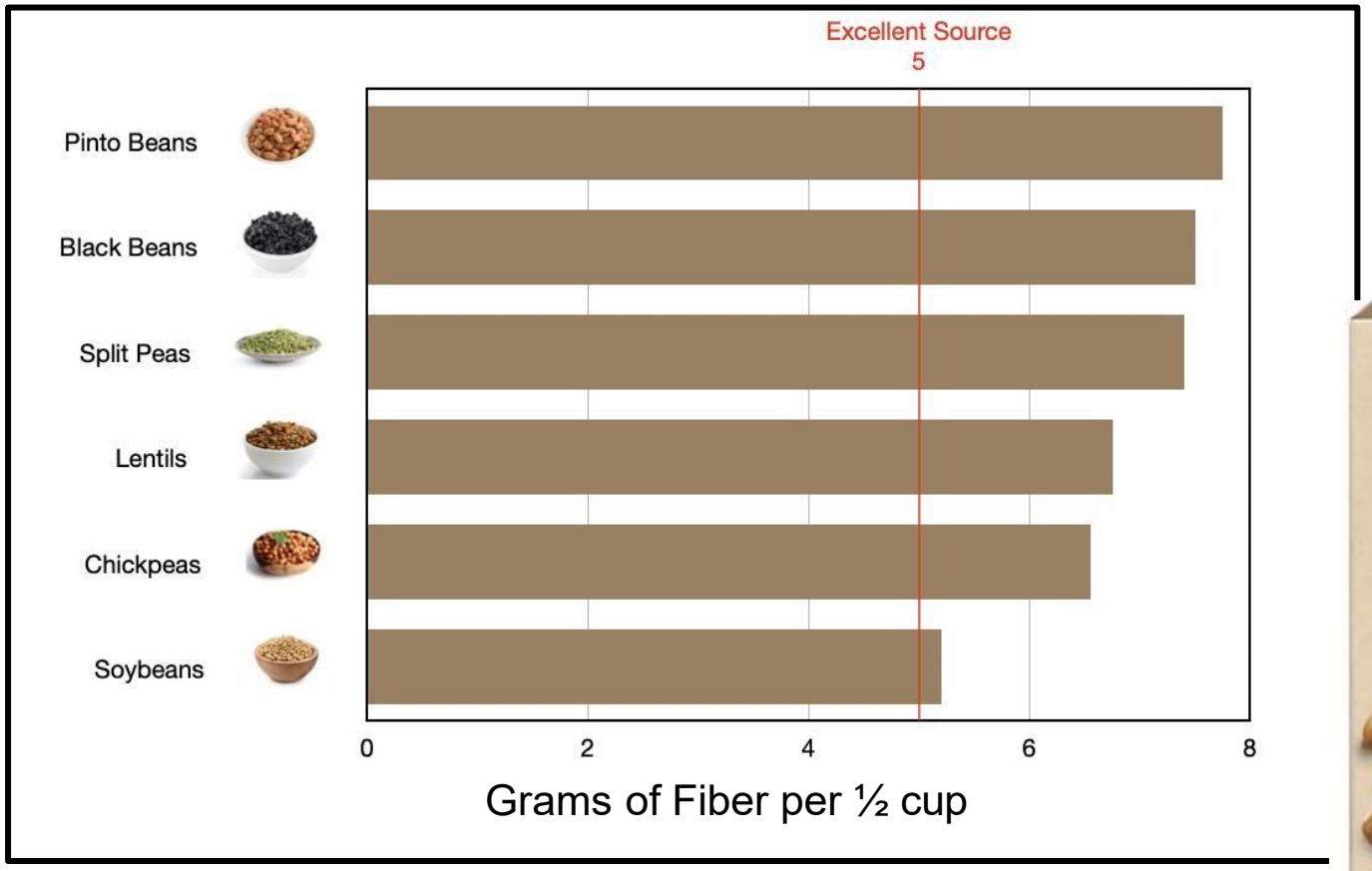
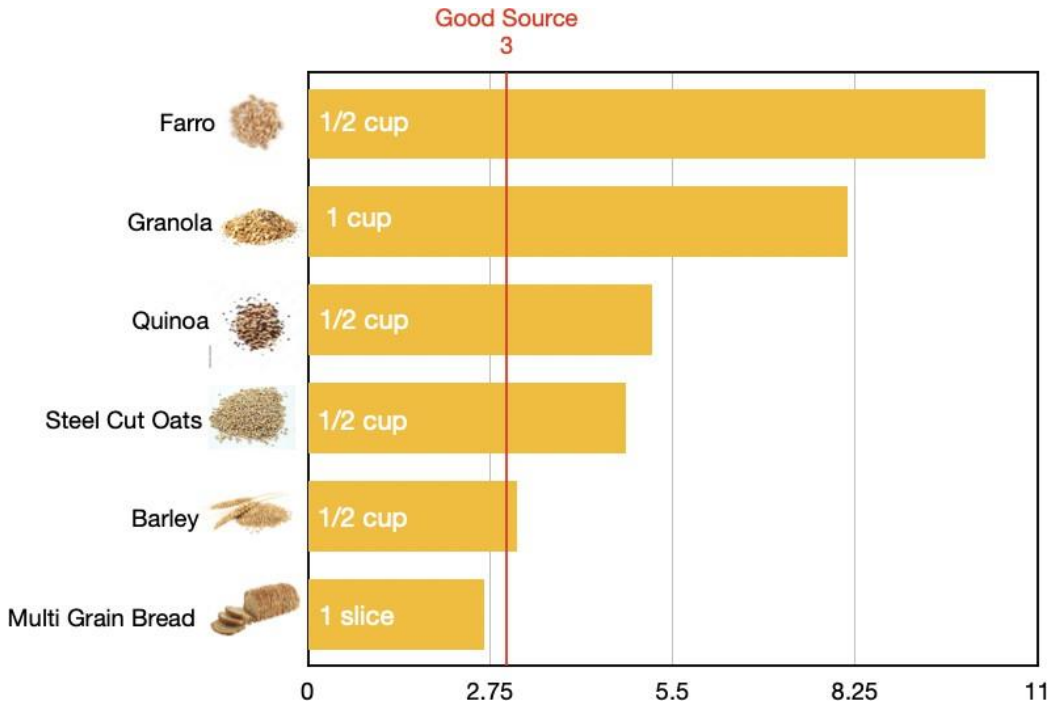


Figure created by Mariana Gianulis, MS, 2026

Grains are a Good Source of Fiber



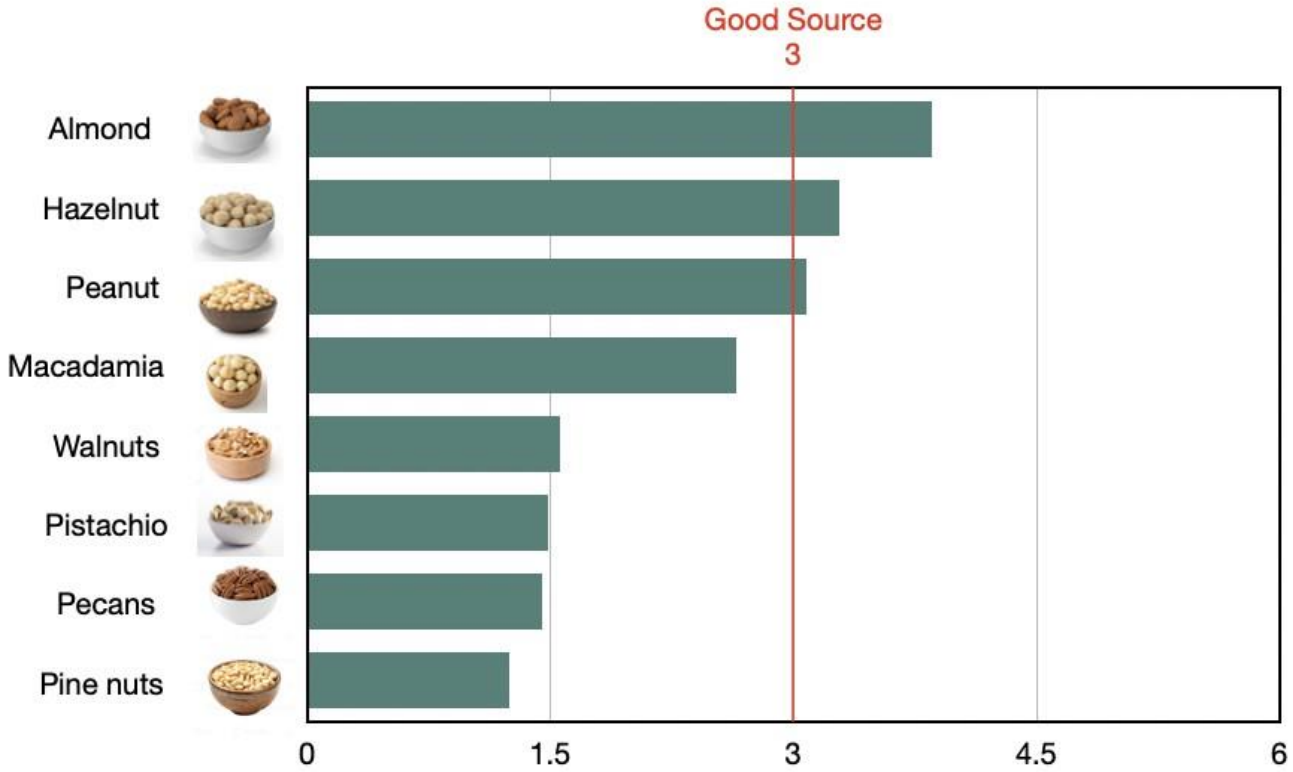
Wheat Bran

By adding **2 tbsp** of wheat bran to your cereal, you can increase your fiber intake by **3.22 g**!

10% of daily reference value per serving can be named a "good source of fiber."

Figure created by Mariana Gianulis, MS, 2026

Let's not forget about nuts or seeds…



Flax Seeds

2.4 gram/tbsp

Chia Seeds

3.61 grams/tbsp

Figure created by Mariana Gianulis, MS, 2026

Emerging Flour Alternatives

Refined Wheat Flour

High Arabinoxylan Enhanced Refined Flour

Whole Wheat Flour

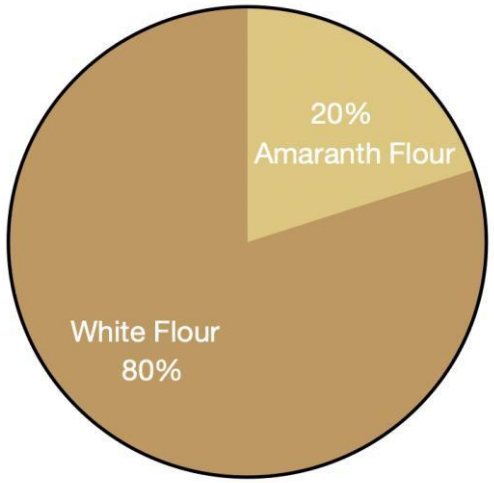
Other flours in marketplace -**amaranth, barley, coconut, chestnut, maize, millet, teff, oats, rye, sorghum, soy, rice, and legumes**

Siddiqui et al. 2022 Sep;46(9) PMID: 35441405.

Figure created by Eliana Wong, MS, 2026

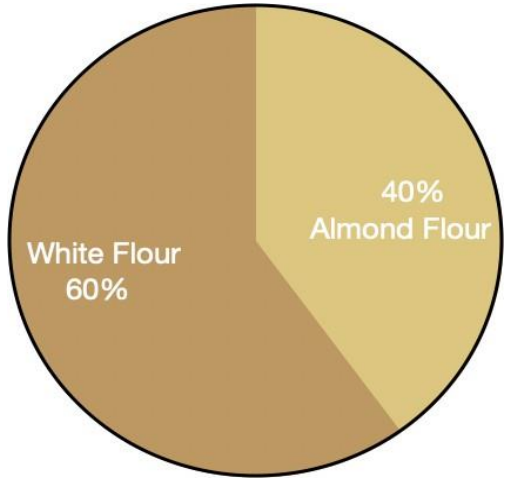
Incorporate Non-Wheat Flour Alternatives in Baking

(Partial Substitution and Composite Blends)



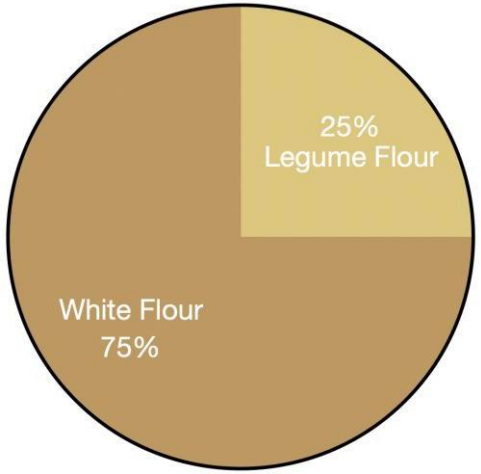
Amaranth
(7.2 g fiber per 100g)

20% substitution in bread



Almond
(9.3 g fiber per 100g)

40% substitution in muffins



Legume (chickpea/lentil)
(10-12g fiber per 100g)

20-25% substitution in baked goods

Siddiqui et al. 2022 Sep;46(9). PMID: 35441405.

Figure created by Eliana Wong, MS, 2026

Key Take Aways

- Fiber is not a single entity.
- Fiber **quality** and **diversity** are equally crucial to quantity.
- Fiber **type** and **physicochemical structure** determine how microbes use fiber.
- Fiber-degrading microbes differ in people, leading to different metabolic effects.
- Low-fiber diets lead to a **loss in fiber-degrading microbes** and loss in a broad range of SCFA needed for gut health.
- A **variety of fibers** in the diet nurtures a diverse and resilient microbiota.
- Intakes remain **suboptimal** and thus multiple dietary strategies to increase fiber intake in populations are warranted.
- **Substituting** refined flour with whole-wheat or higher-fiber alternatives (for gluten free options) is a feasible and impactful nutrition strategy — provided taste is good!
- Closing the fiber gap is an **actionable step** to health!

Photo credits: Tom Brunberg at Unsplash

More than 95% of Americans are not meeting fiber recommendations!

Increasing fiber intake will **improve overall population health**

Quagliani D & Felt-Gunderson P. *Closing America's Fiber Intake Gap: Communication Strategies From a Food & Fiber Summit.* **Am J Lifestyle Med.** 2016 Jul;11(1):80-85

Enhancing Nutrition in Foods People Already Love

Increasing Population Fiber Intake

Making Choices About How We Produce and Process Food

- Traditional plant breeding for increasing fiber in commodity wheat varieties

- Processing fruit / vegetable peels

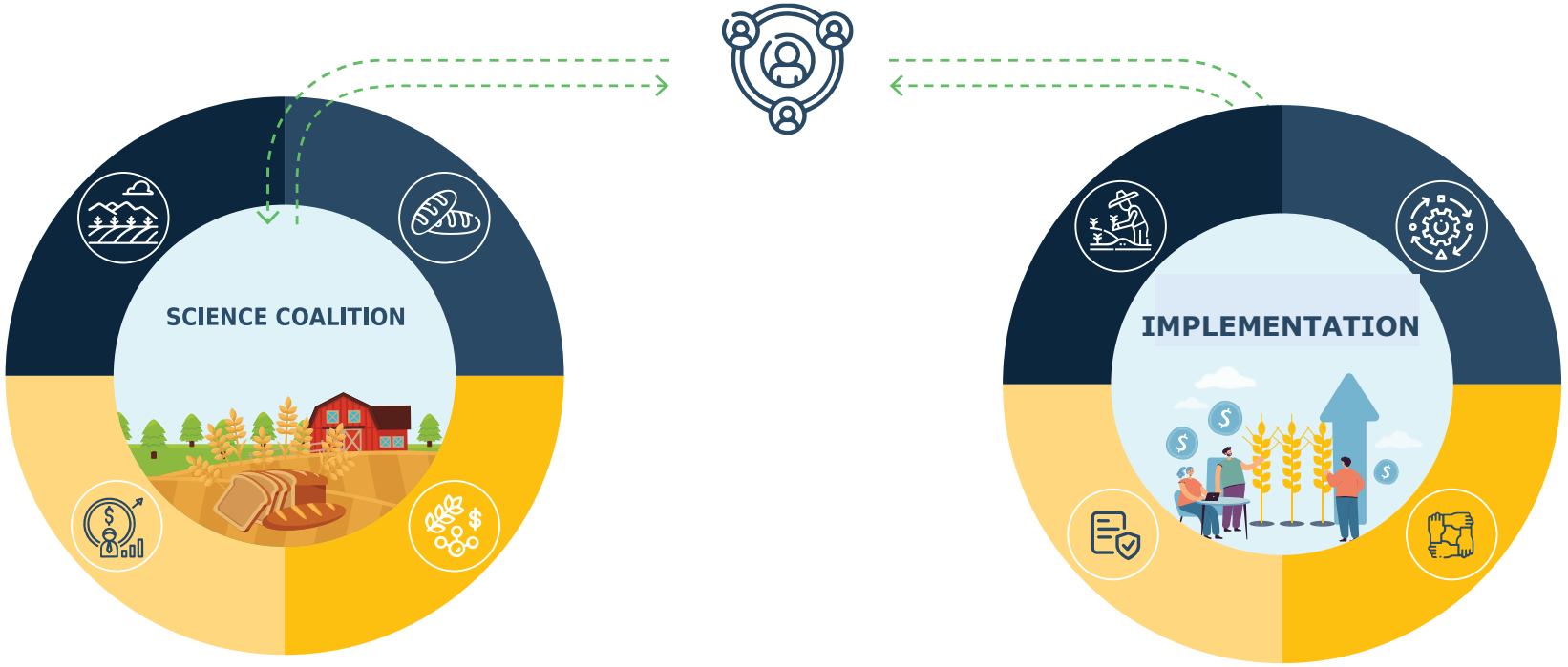
- Cook then cool carbohydrates to increase resistant starch, which acts as a dietary fiber (rice, wheat, corn, potatoes)

Better Food and Health. Market Smart. Within Reach.

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

We bring evidence-based, high-impact nutrition solutions within reach by aligning science, markets, and public policy.

"Hinge"



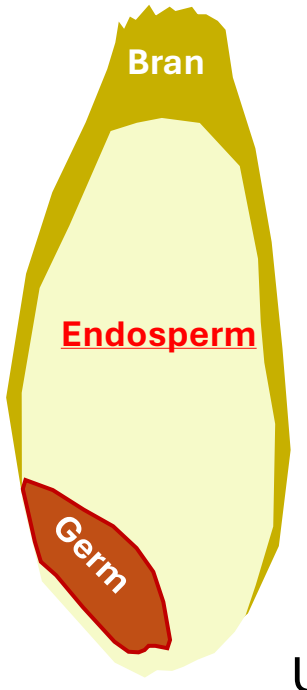
Our science team develops low-cost, scalable improvements to everyday foods, designed to prevent chronic disease and improve health outcomes at population scale.

Our outreach professionals build coalitions across sectors — shaping policy, engaging food producers, and supporting communities — so that nutritious food becomes the default, not the exception.

Commodity Pipeline

Increasing Arabinoxylan Fiber in Wheat Through Breeding

- Clean label
- In intact food



Target: fiber in endosperm cell walls

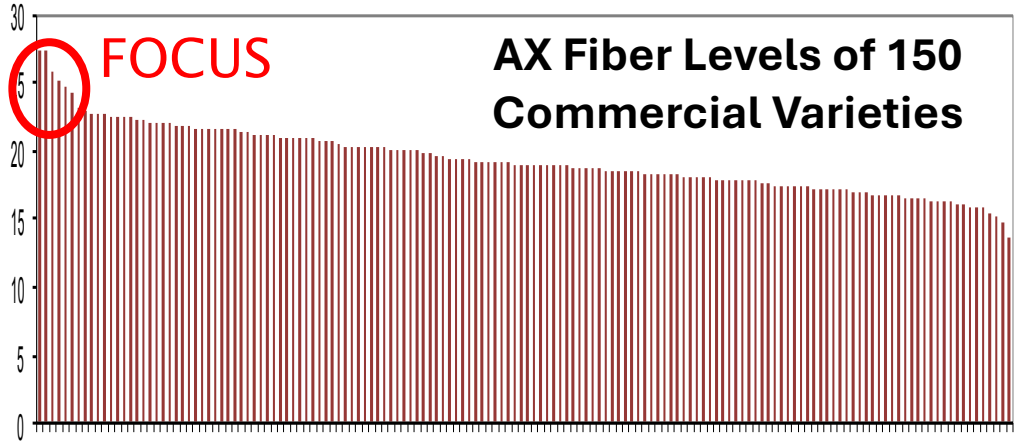
US Wheat Crop (non-GMO): $13BB ← 60 x
Annual US Cost CVD+ DB2: $800BB

Wheat: 15-20% of US and global diet
Already 30% of fiber intake; 20% protein
Fortified (white flour) is in Guidelines

To be featured in national forum hosted by publisher of Science Magazine (AAAS)

Doable
For Farms and Bakeries

- **Fiber content naturally varies in commercial wheat (a non-GMO crop)**



Shewry, et al, 2015.

- No yield loss
- Royalty free
- Within commercial variation

- 19 years of research

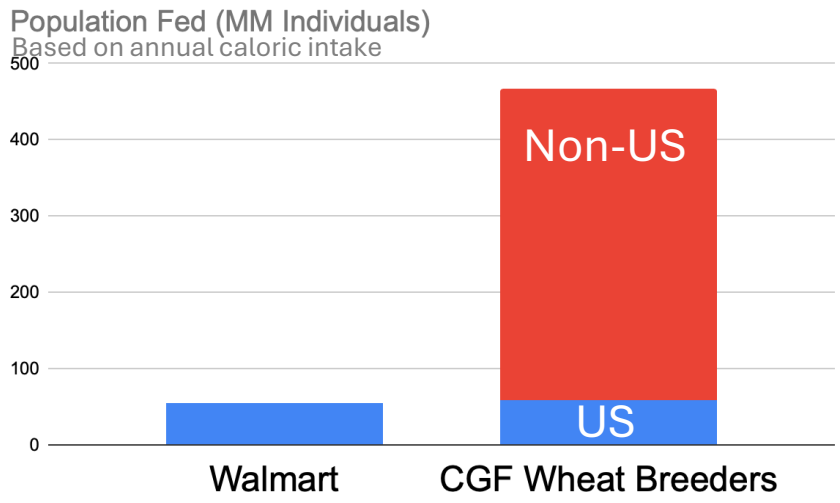
- Completed in vitro tests of gut microbiota

Driving Population Change

High-Impact Supply Points we Can Influence at Low Cost

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

Major 1st Step: Pay Wheat Breeders



Wheat breeders already developing varieties.
Retailers and brands support.

Step 2, Scale: Reimburse Farmers for Seed

1 Farm (2,000 acres)

Year's Supply of Baked Goods for 30,000+ people

Several times a day

Step 3: Repeat

Top 7 Foods

70% Global Diet

Driving Community Change

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

One Community Foodservice System

Delaware State University
- 7,000 faculty, staff, students
- 4-5,000 cases CVD and (pre)DB2
  - 400 w/ diabetes type 2
  - 100 very high-risk heart attack or stroke

500 at very high risk

Reformulate favorite foods to increase fiber at low cost:

- Better outcomes cut healthcare cost
- Community prevention message
- Nutrition and Dietitian expertise critical for highest impact

How Much Impact

Foods People Already Love (2.5 g/ population / day)

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

- **Any fiber increase in intact foods responds to what the US Department of Agriculture calls a "substantial public health concern for the general US population."**

  - Projected risk reduction, conditions with especially clear relationships with fiber:
    - 1-3%** less cardiovascular disease (1)
    - 3-4.5%** less Type 2 diabetes (1, 2)
    - 1-3.5%** less colorectal cancer (3)

    - Also improves disease outcomes (4)

- Estimates are best available information, based on peer-reviewed scientific literature supported by evaluation of esteemed scientific bodies. These should be evaluated as rationale to support in-depth evaluation. It is preliminary to view this data as a healthcare savings forecast.

1. Carene-Adams, et al, Br J Nutr, 128 (9), 2022
2. Inter-Act Consortium, Diabetologia 58(7), 2015
3. Institute for Advancement of Food and Nutrition Sciences
4. Reynolds, et a., BMC Medicine, 20, 2022.
5. Agency for Healthcare Research and Quality, 2025.

Follow-Up

FOUNDATION FOR INNOVATION IN HEALTHY FOOD

Stay informed!

Upcoming : Fiber + CVD, Type 2 DM

Connect: Rod.Wallace@FIHF.org

Pstephen.Baenziger@gmail.com

- Help us learn and share
  - Share your questions!
  - Invite us to participate
  - Help us connect
  - Explore opportunities in your community
- We need your support

Max 1-2 updates a month

To Receive Your CE Certificate

VILLANOVA NURSING

- A link to an evaluation will be sent within a day or two.
- RD/RDNs: Although completing an evaluation is not required, we truly appreciate your feedback.

  If you do not see the evaluation, look in your spam folder.
- CE certificates for RDs/RDNs/DTRs will be emailed within 2 business days after the program.

Upcoming MCNER Health Professional Webinars

VILLANOVA NURSING

January 21, 2026/12- 1 PM ET
Mahima Gulati, MD, MSc
Lifestyle Interventions for Treatment and Remission of Type 2 Diabetes and Prediabetes in Adults

February 4, 2026/12-1 PM ET
Carl (Chip) Lavie, Jr., MD, FACC, FACP, FCCP
Omega 3-Fatty Acids and Cardiovascular Disease Primary and Secondary Prevention

To Register:
Villanova.edu/mcner

1 free CPEU RDs/DTRs
1 free CH for RNs/NPs

Q&A

Moderator:
Lisa Diewald, MS, RDN, LDN
mcner@villanova.edu

If you are an RD or RDN and have any questions or concerns about this continuing education activity, you may contact CDR directly at QualityCPE@eatright.org.

VILLANOVA UNIVERSITY
M. LOUISE FITZPATRICK COLLEGE OF NURSING
MacDonald
CENTER FOR NUTRITION EDUCATION AND RESEARCH