Nourishing for Strength and Resilience: What Healthcare Professionals Need to Know about Sustainable Nutrition

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EXPLORE HEALTHCARE SUMMIT

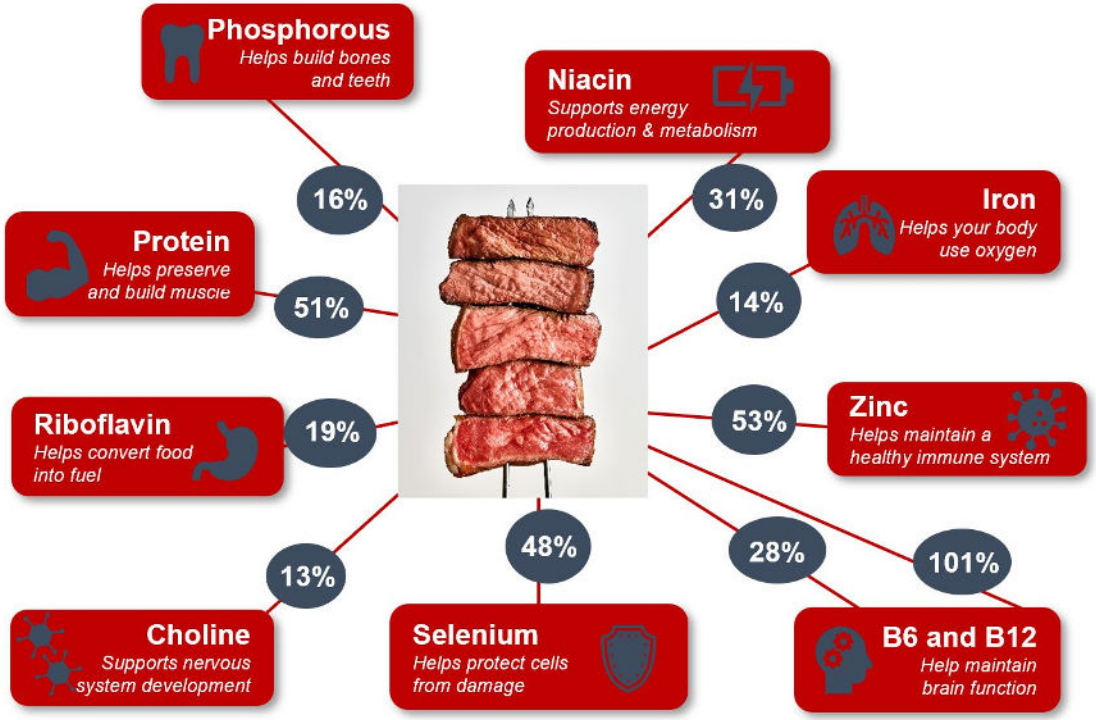
Funded by Beef Farmers and Ranchers

OKLAHOMA BEEF COUNCIL

Disclosures

Employee of the National Cattlemen's Beef Association, a contractor to the Beef Checkoff

Disclosure: Beef is my preferred nutrient-dense protein.



Source: U.S Department of Agriculture, Agricultural Research Service. FoodData Central SR# 13364 , 2019. fdc.nal.usda.gov.

Beef Nutrition Statement of Principles

Statement of Principles Regarding Nutrition and Health

As producers, processors, and marketers of the nation's beef supply, we are committed to providing a wholesome, nutritious food, and to communicating accurate information about beef's nutritional qualities and the role of beef in a healthful diet. We pledge to use the following principles to guide our actions and communications about beef in regard to nutrition and health.

1. We will provide factual, scientifically supported information about beef to help consumers make informed choices about what they eat.
2. We support the Dietary Guidelines for Americans recognizing that there are a variety of ways to achieve a healthy diet, and further, we believe that the overwhelming scientific evidence shows that dietary balance, variety, and moderation coupled with appropriate physical activity provides the foundation for a healthful life.
3. We are committed to conducting and participating in programs to actively disseminate accurate information about the nutritional advantages of beef in a healthful and balanced diet and lifestyle.
4. We recognize the important role of health professionals and nutrition educators in providing nutrition information and are committed to working with them and their professional organizations to communicate accurate information about nutrition and health.
5. We believe that dietary balance, variety, moderation, and physical activity are the keys to health, and we also encourage individuals with specific health concerns that require dietary modification to consult a physician followed by nutrition counseling from a Registered Dietitian/Nutritionist.
6. We support research on the nutritional qualities of beef and will accurately communicate research findings to help consumers make informed decisions about their diet.
7. We recognize that consumers want foods that are good tasting and convenient as well as nutritious and will support research to provide beef products that meet these consumer demands.

*The **Statement of Principles Regarding Nutrition and Health** was first adopted by the beef industry in 1984.*

"We believe that the overwhelming scientific evidence shows that dietary **balance, variety, and moderation**...provides the foundation for a healthful life."

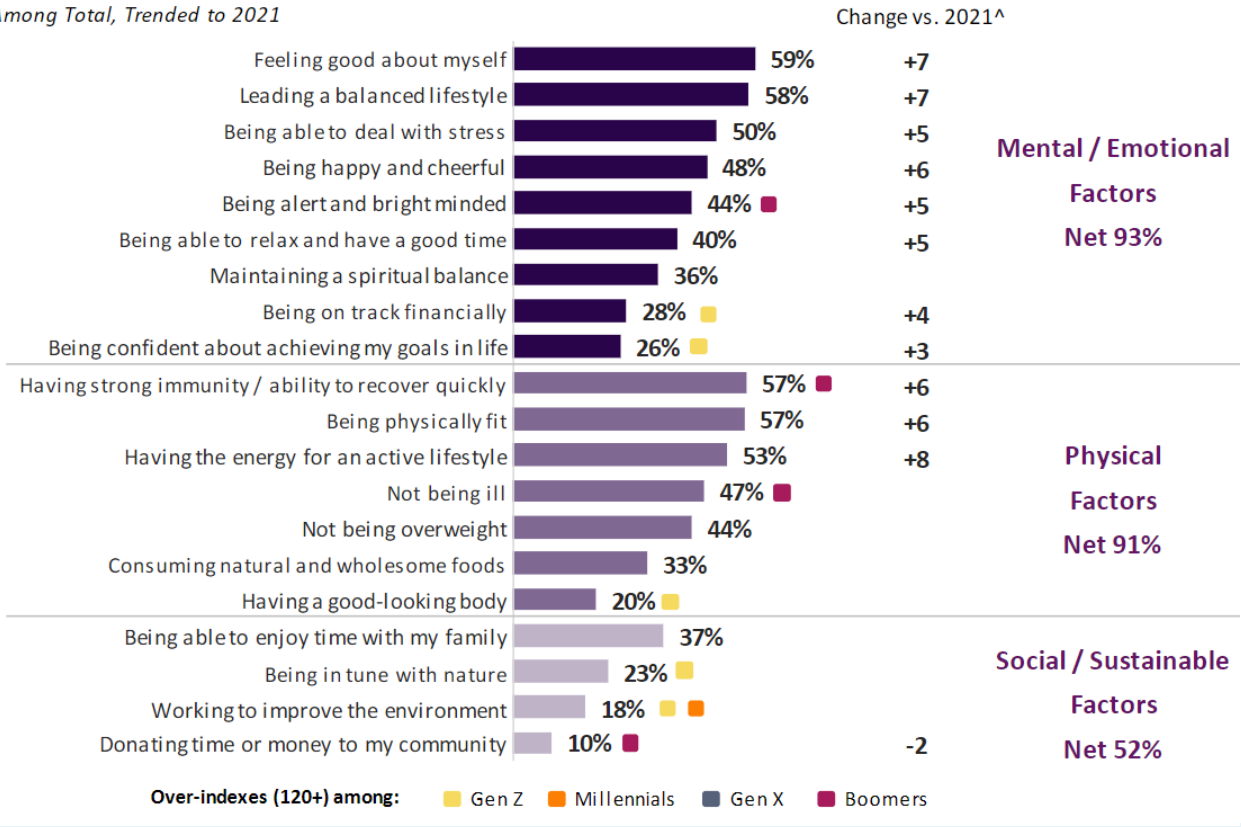
Learning Objectives

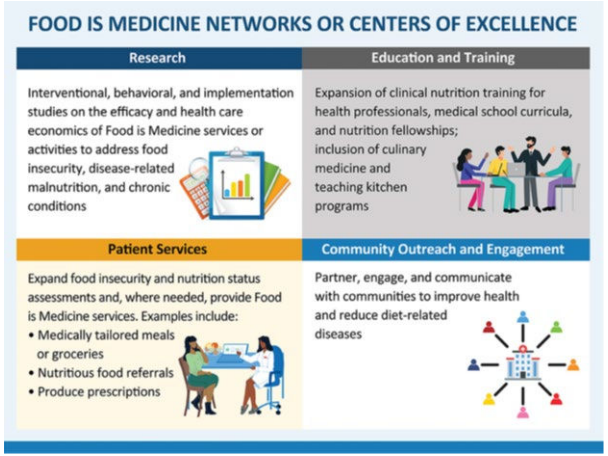
- Review current evidence on the state of the American diet.
- Explore opportunities in sustainable eating patterns.
- Gain a deeper understanding of complex food system.
- Leave with practical pieces to encourage and empower sustainable food choices.

Interest in our health and wellbeing at an all time high

Health & Wellness Dimensions

Among Total, Trended to 2021

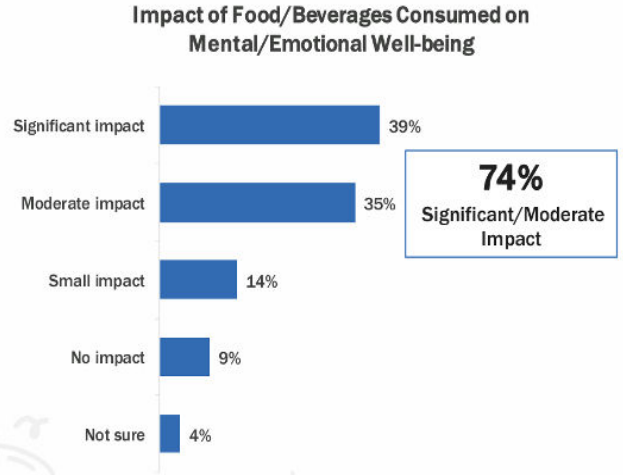


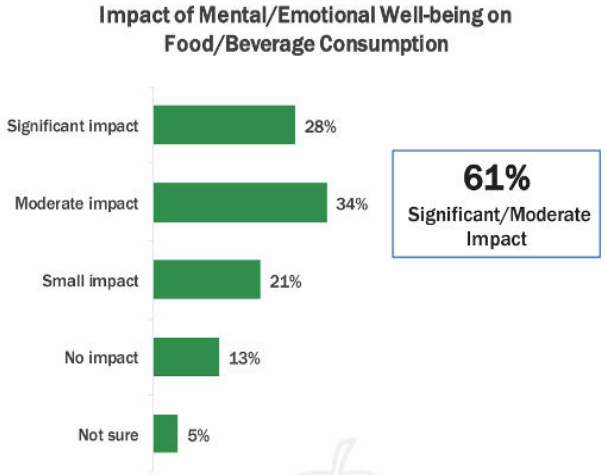


Food Mood Connections

Three in four say food consumption impacts their mental or emotional well-being

In comparison, only six in ten say the reverse is true: that well-being impacts food choices.





Q12a. To what degree do you believe that the food and beverages you consume has an impact on your overall mental/emotional well-being? (n=1,022)/ 12b. Now consider the reverse: to what degree does the state of your mental/emotional well-being impact the type of food and beverages you choose to consume? (n=1,022)

International Food Information Council

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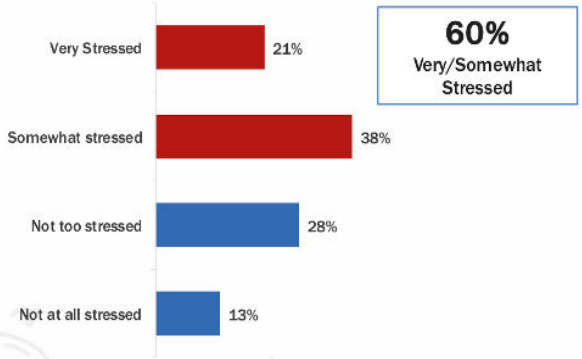
Source: International Food Information Council. 2023 Food & Health Survey. 23 May 2023. [https://foodinsight.org/2023-food-health-survey/]

Stress Derails Healthy Eating

Six in ten self-report being "somewhat" or "very" stressed

Gen Z and Millennials are more likely to be stressed than older generations. Of those who say they are stressed, just over half say it has influenced them to make less-healthy choices.

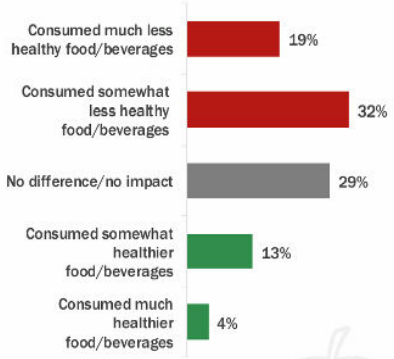
Self-Reported Stress



60% Very/Somewhat Stressed

Impact of Stress on Healthfulness of Food/Beverage Consumption

(If At Least Somewhat Stressed)



51% Somewhat/Much Less-Healthy Consumption

No significant change vs. 2022

[TREND] Q13 How stressed have you been? (n=1,022) / Q14 What impact did your stress level over the past six months have on the healthfulness of the foods/beverages you consumed? Filter: Very/Somewhat stressed over the past six months (n=603) Note: "Not sure" is not shown; Response text abridged on each item

International Food Information Council

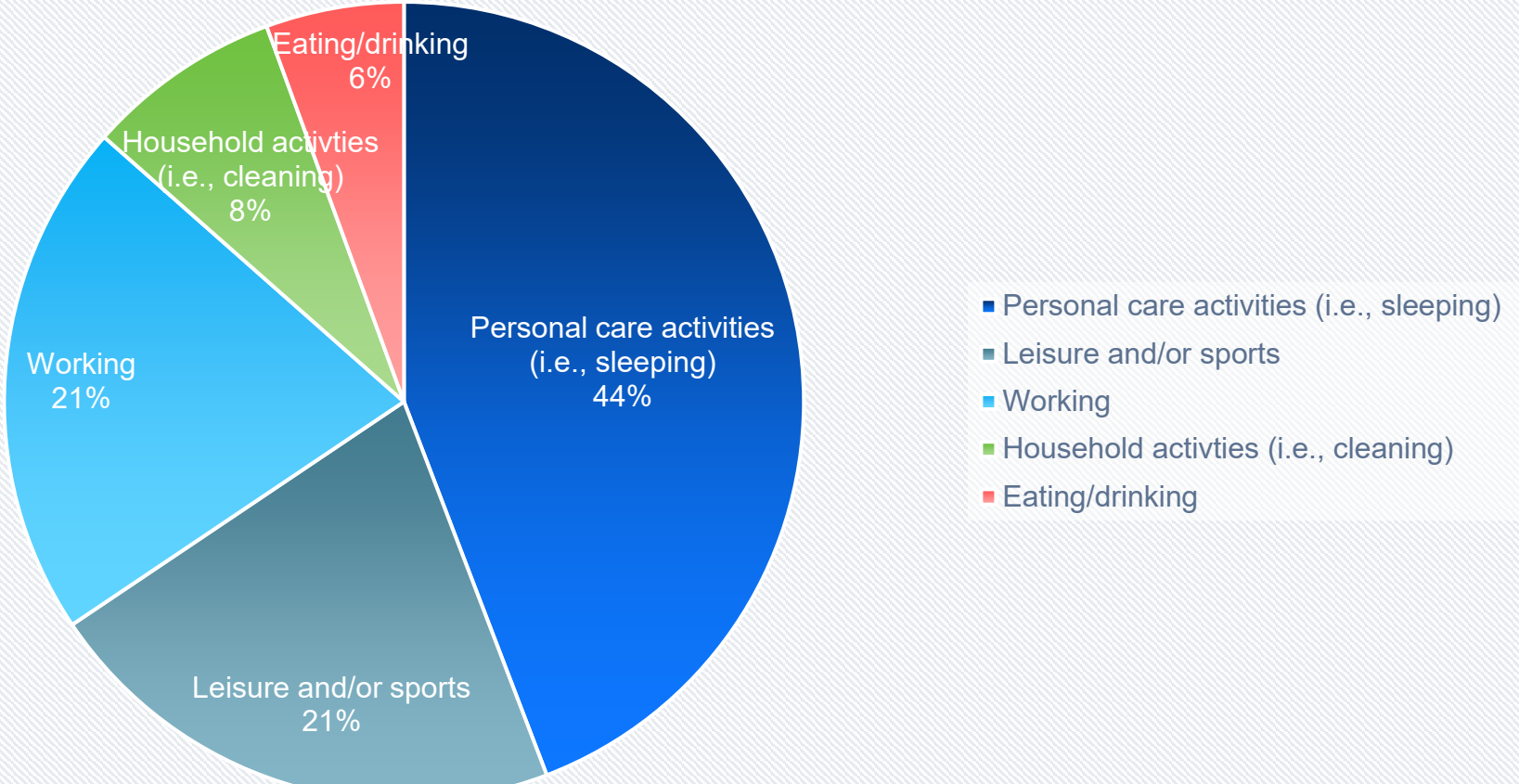
14

Adobe Stock | #569502134

Source: International Food Information Council. 2023 Food & Health Survey. 23 May 2023. [https://foodinsight.org/2023-food-health-survey/]

Time Spent Fueling Ourselves is Limited

American's Top 5 Daily Activities



Our Cooking IQ is a Little Low… But Confidence is Growing!

THE NEW CORONAVIRUS PANDEMIC HAS DRIVEN AMERICANS INTO THEIR HOMES AND INTO THEIR KITCHENS. ACCORDING TO AN ONLINE SURVEY CONDUCTED BY HUNTER:

COOKING AND BAKING ON THE RISE

54% COOKING MORE

46% BAKING MORE

COOKING CONFIDENCE SOARS*

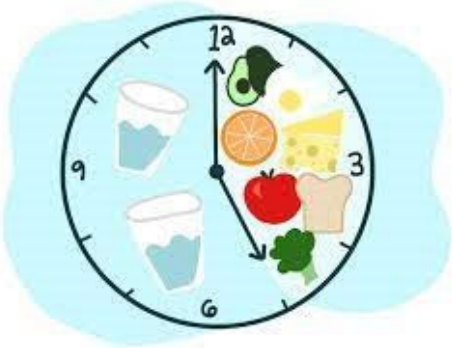
50% MORE CONFIDENT IN THE KITCHEN

26% LEARNING MORE

Images: https://www.hunterpr.com/foodstudy_coronavirus/ ; https://studyfinds.org/bad-cooking-easy-meals-pancakes-pasta/

So much advice and so many “solutions”

WHOLE 30®
let us change your life



PALEO

Images: https://www.foodbusinessnews.net/articles/11838-ific-survey-36-of-americans-follow-a-specific-diet

We Aren’t Even Sure What Healthy Looks Like

Our considerations around healthy food/healthy diets are expanding….

Nutrients

Foods

Dietary Patterns

Food Systems

There are no magic bullets in nutrition.

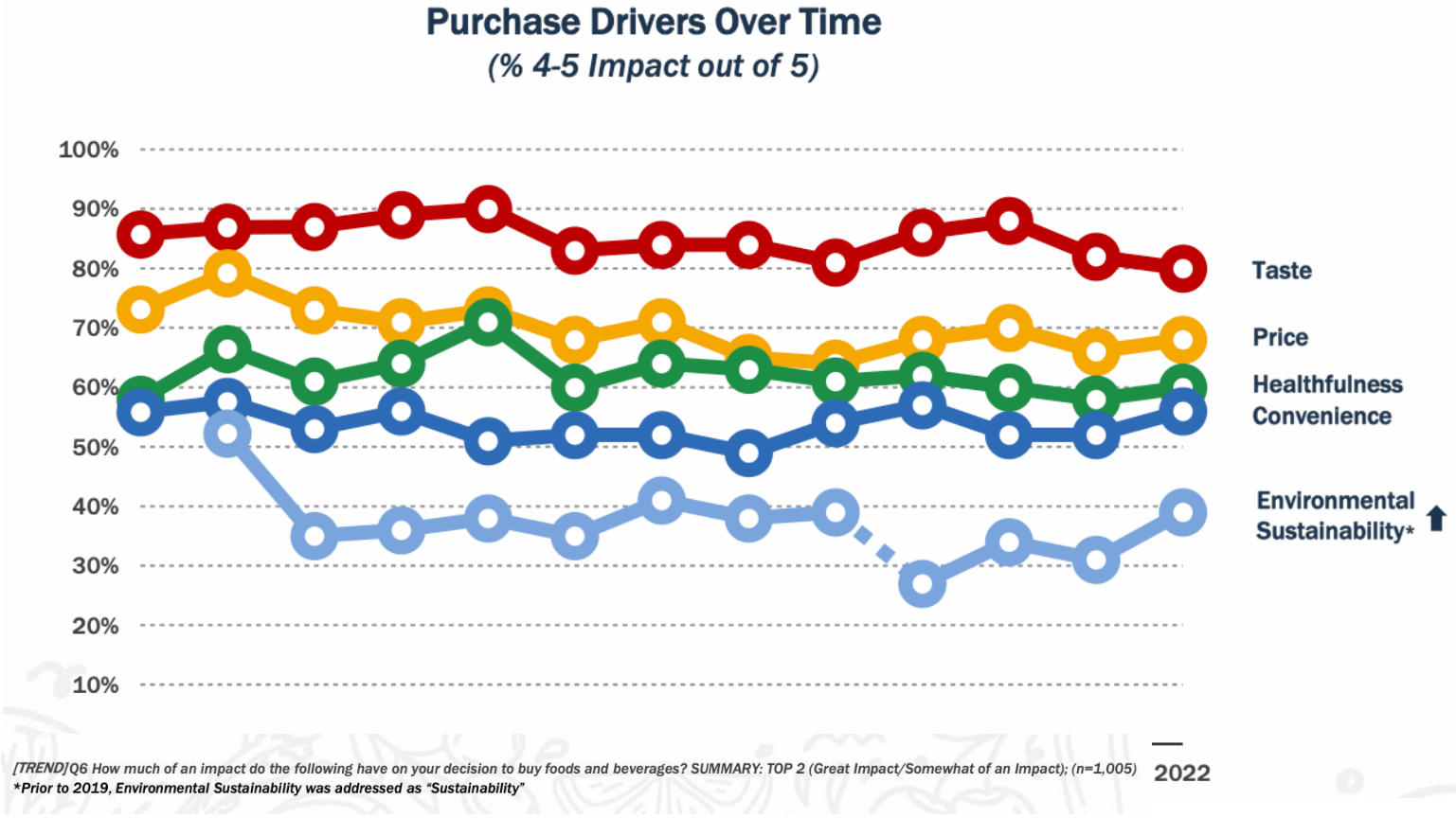
“There are no miracles in agricultural production”

- Norman Borlaug

Source: https://borlaug.tamu.edu/

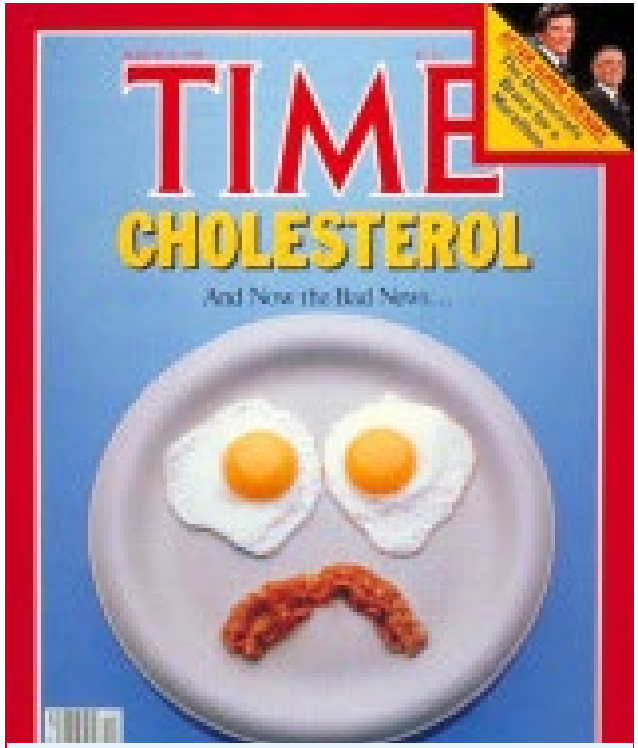
Food nourishes our hearts, minds and souls.

Why do we eat what we eat?

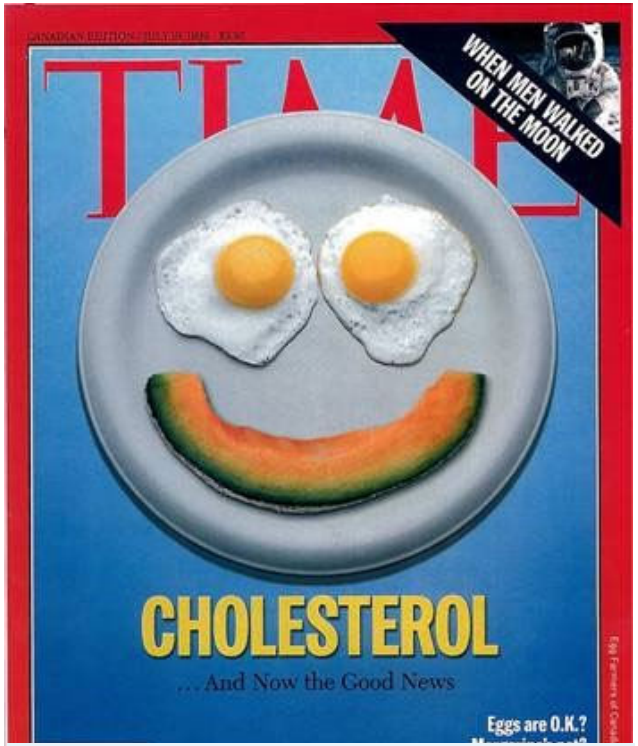


Source: International Food Information Council. 2023 Food & Health Survey. 23 May 2023. [https://foodinsight.org/2023-food-health-survey/]

Nutrition Science is Evolutionary, not Revolutionary



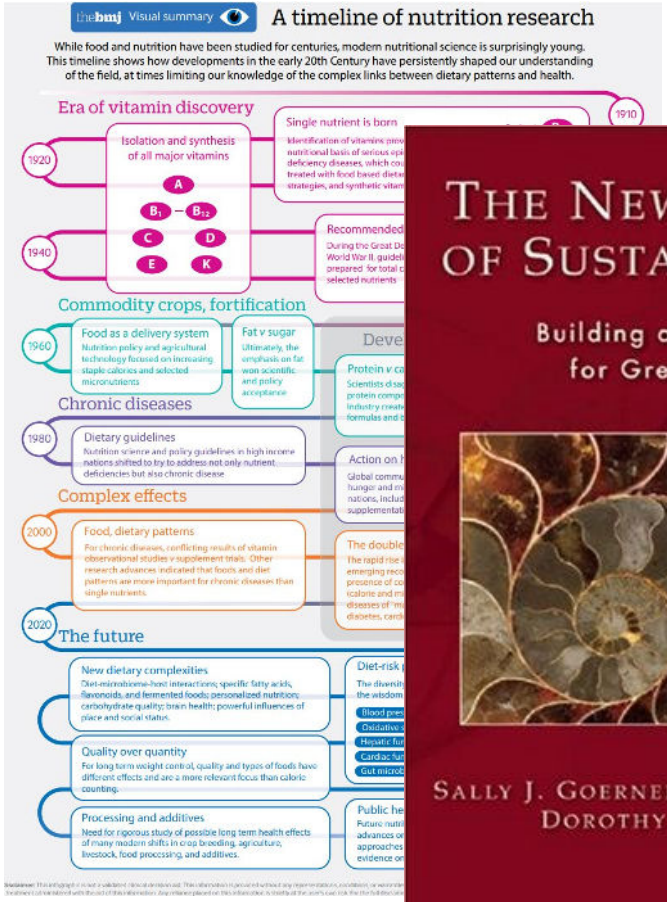
1984

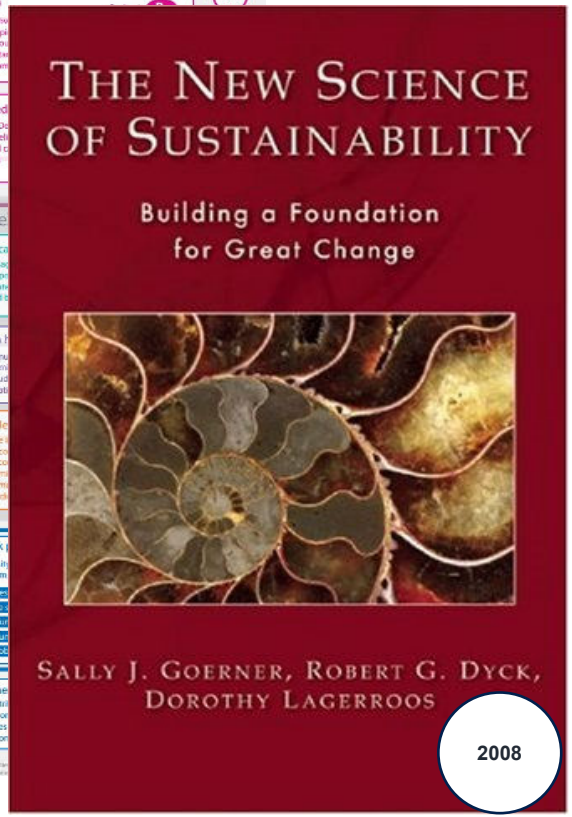


1999

2014

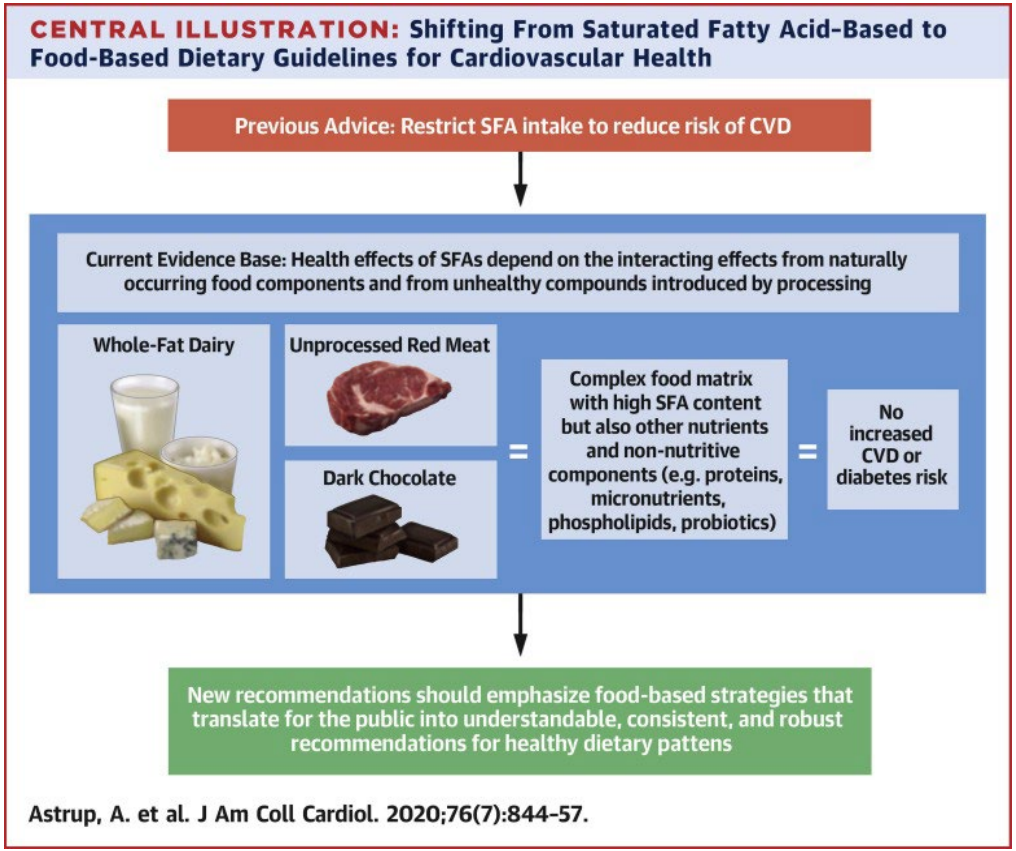
Modern nutrition science is young, but sustainability science is even younger.





Source: https://www.bmj.com/content/bmj/361/bmj.k2392.full.pdf; https://www.amazon.com/New-Science-Sustainability-Building-Foundation/dp/0979868319

New Science on Saturated Fat

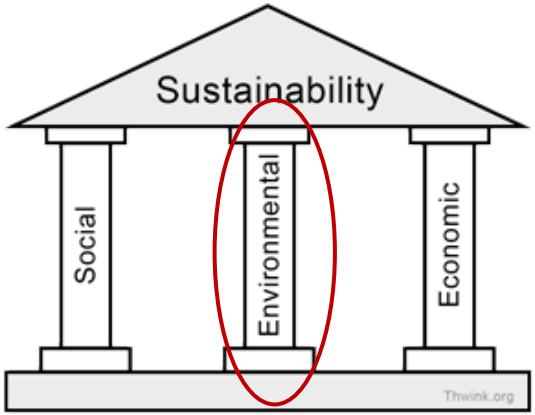


"Whole-fat dairy, unprocessed meat, and dark chocolate are SFA-rich foods with a complex matrix that are not associated with increased risk of CVD. The totality of available evidence does not support further limiting the intake of such foods."

Source: https://www.sciencedirect.com/science/article/pii/S0735109720356874?via%3Dihub

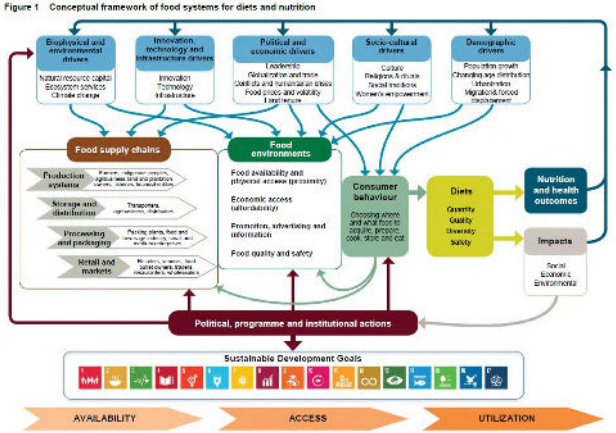
Diets for Planetary Health: Frameworks help us make sense of it all, but they are increasingly complex

Sustainability



Sustainable Diets

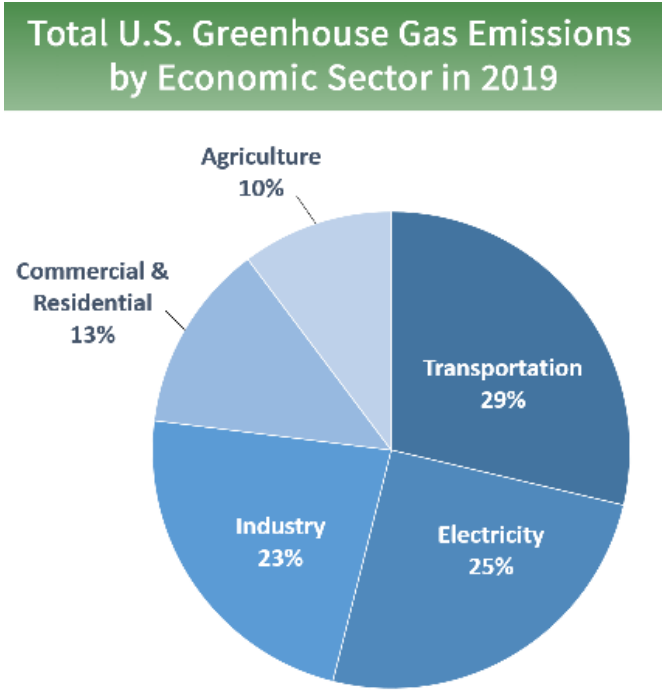
Sustainable Food Systems



Beware of Mental Shortcuts

For every complex problem, there is a solution that is simple, neat, and wrong.

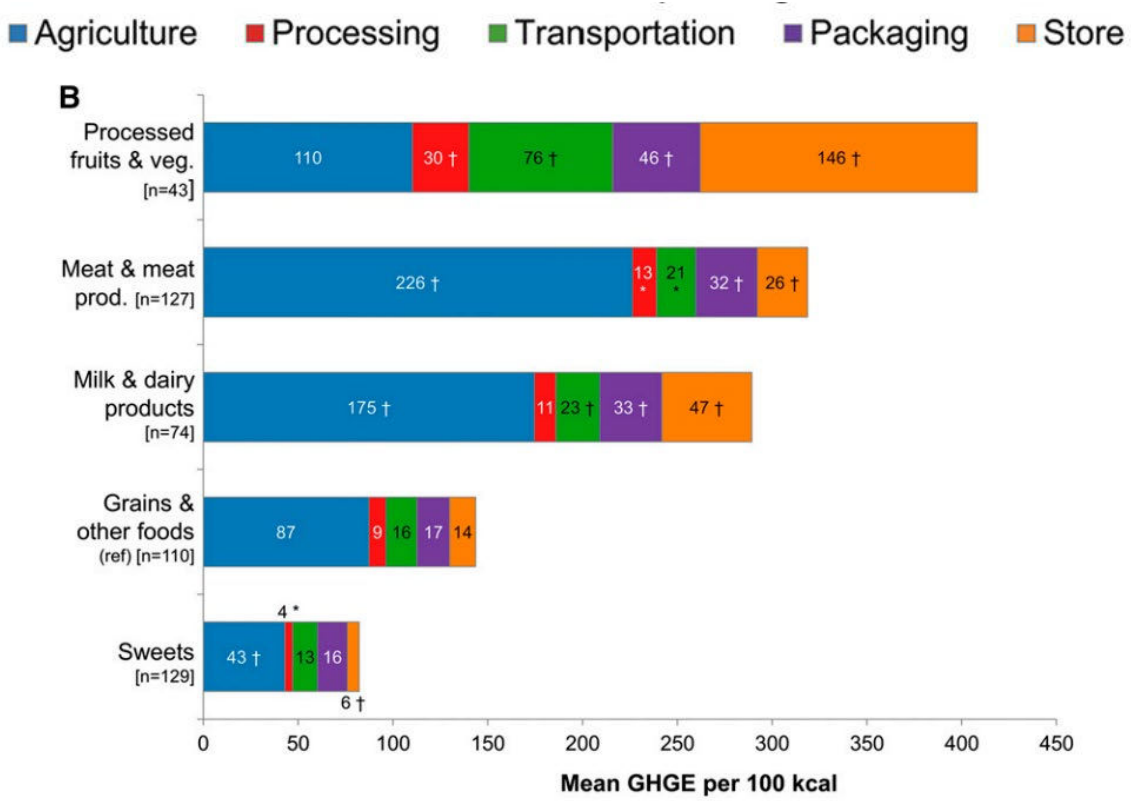
H.L. Menken



U.S. Environmental Protection Agency (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019

Food Choices Come with Trade-Offs

"Grains and sweets had lowest GHGEs (per 100 g and 100 kcal) but had high energy density and a low nutrient content"



Source: Drewnowski et al, Am J Clin Nutr 2015;101:184–91


1/3 people wait for next paycheck to buy groceries
Purdue, Consumer Food Insights, 2022

Animal-sourced foods are required for minimum-cost nutritionally adequate food patterns for the United States

"A dietary pattern containing no animal-based food items became economically optimal only after an increase in the price of milk by eight times, eggs by 11.5 times, fish by 6.5 times, mayonnaise and animal-based salad dressings by five times, bread rolls and buns (which included milk and eggs) by 4.5 times, beef by 5.5 times, chicken by five times, sausages by three times, turkey by three times, cheese by three times, pork by 2.5 times, cold cuts and cured meats by twice, cooked egg noodles by twice, ice cream by twice, yogurt by 2.5 times and mashed potatoes by twice their original costs, respectively. This resulted in a relatively expensive least-cost modelled food pattern with a daily cost of US$3.61, and containing 14 foods (Fig. 1)."

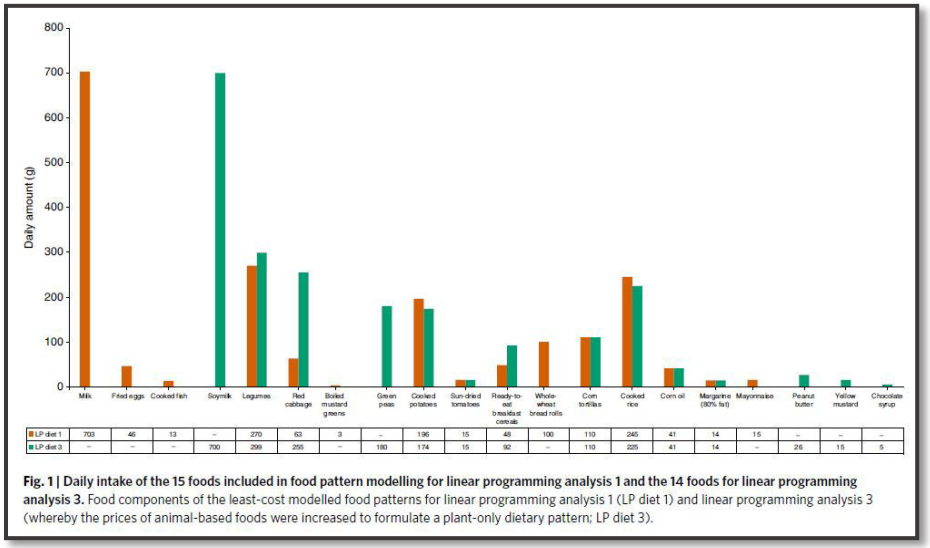
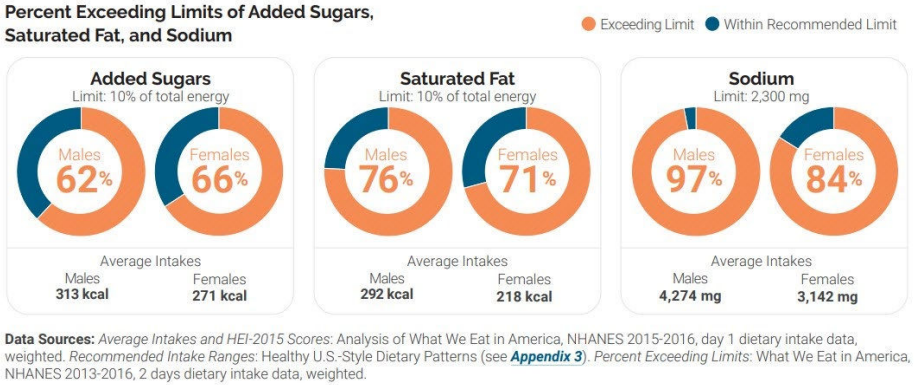


Fig. 1 | Daily intake of the 15 foods included in food pattern modelling for linear programming analysis 1 and the 14 foods for linear programming analysis 3. Food components of the least-cost modelled food patterns for linear programming analysis 1 (LP diet 1) and linear programming analysis 3 (whereby the prices of animal-based foods were increased to formulate a plant-only dietary pattern; LP diet 3).

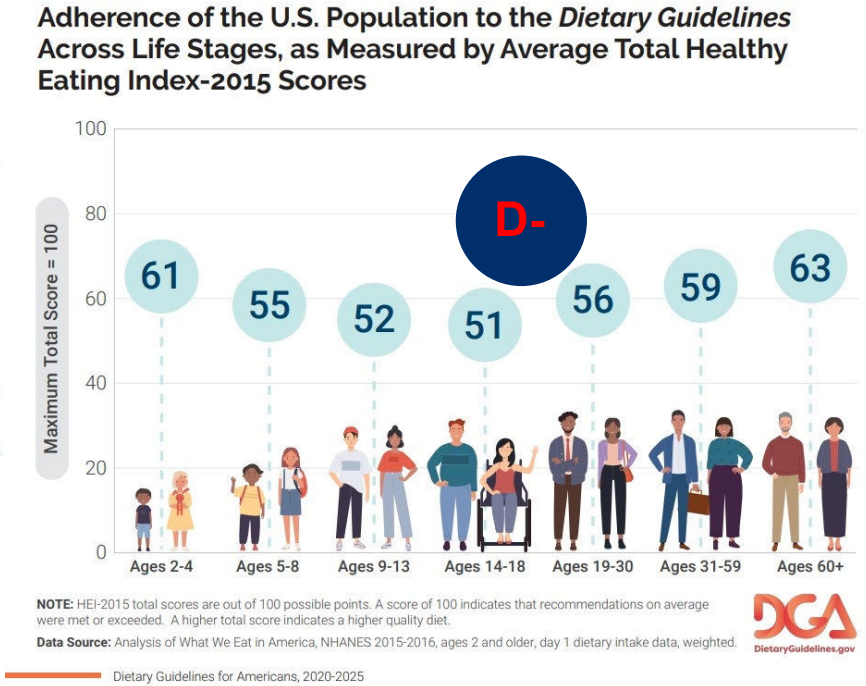
Source: https://doi.org/10.1038/s43016-020-0096-8

What does sustainability mean to you?

Overall…There is Room for Improvement in Dietary Patterns



Data Sources: *Average Intakes and HEI-2015 Scores*: Analysis of What We Eat in America, NHANES 2015-2016, day 1 dietary intake data, weighted. *Recommended Intake Ranges*: Healthy U.S.-Style Dietary Patterns (see ***Appendix 3***). *Percent Exceeding Limits*: What We Eat in America, NHANES 2013-2016, 2 days dietary intake data, weighted.

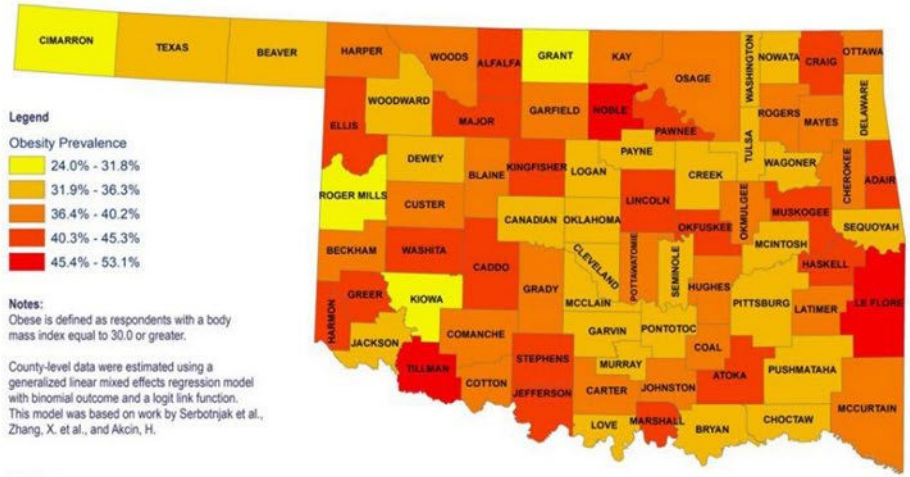


Source: Menichetti, G., Ravandi, B., Mozaffarian, D. *et al.* Machine learning prediction of the degree of food processing. *Nat Commun* **14**, 2312 (2023). https://doi.org/10.1038/s41467-023-37457-1
U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020-2025. 9th Edition.

Obesity/Overweight in Oklahoma

36% of adults are obese/overweight, placing Oklahoma in the top ten states for prevalence of obesity

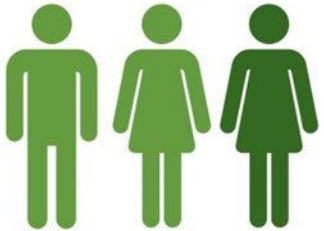
32% of children in Oklahoma are overweight/obese



APPROXIMATELY

1 MILLION

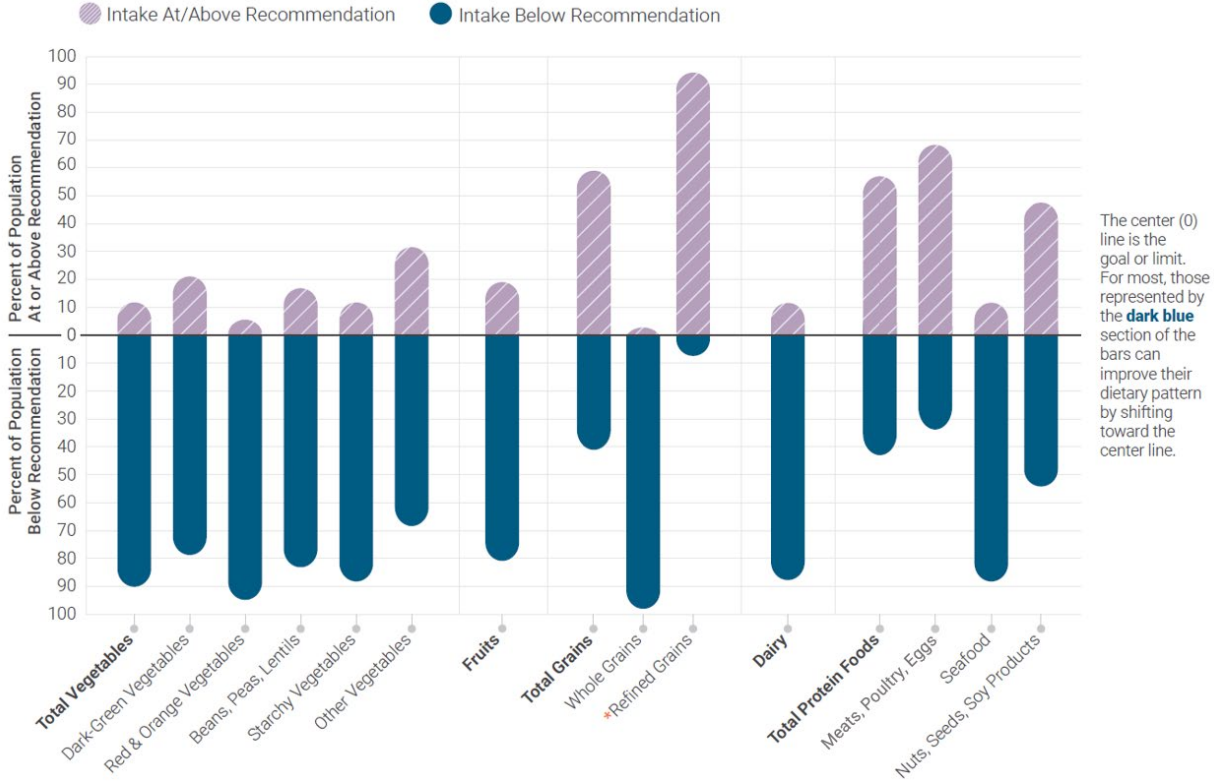
OKLAHOMA ADULTS WERE OBESE IN 2019

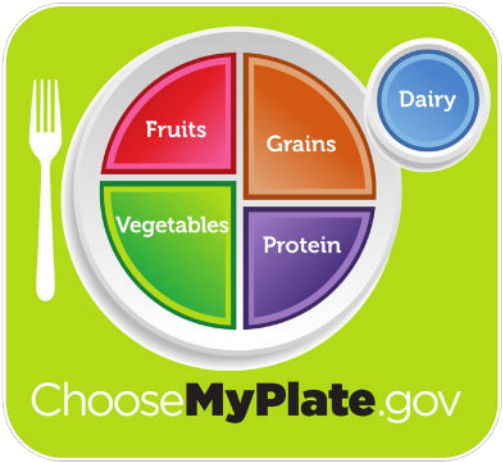


That's about 1 out of every 3 adults.

Source: Oklahoma State Department of Health. Health For A Lifetime, State of Oklahoma Obesity Prevention Plan. 2022.

Dietary Intakes Compared to Recommendations



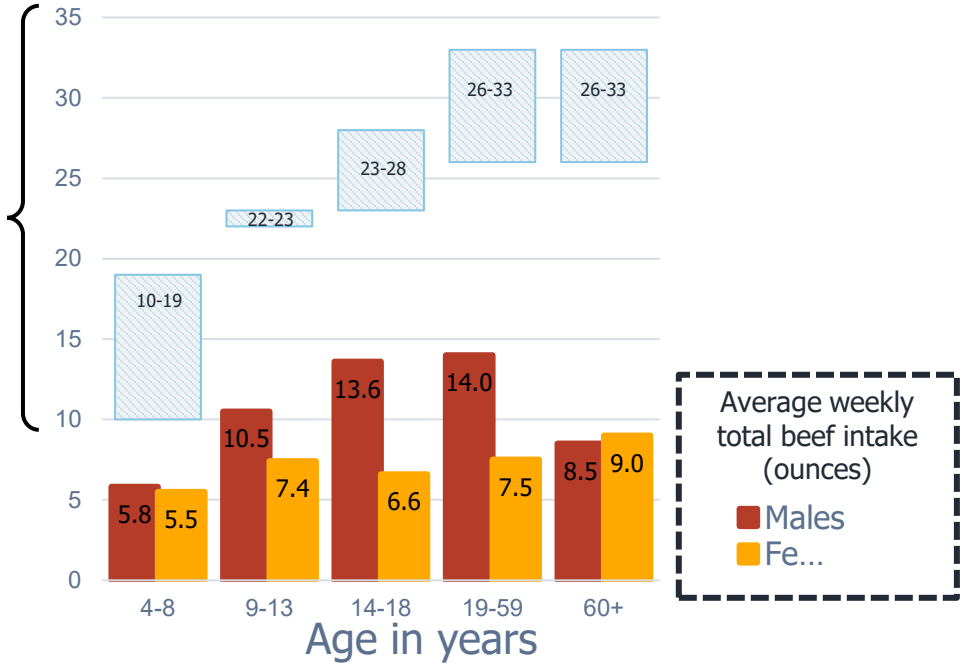


NOTE: Recommended daily intake of whole grains is to be at least half of total grain consumption, and the limit for refined grains is to be no more than half of total grain consumption.

Data Source: Analysis of What We Eat in America, NHANES 2013-2016, ages 1 and older, 2 days dietary intake data, weighted. Recommended Intake Ranges: Healthy U.S.-Style Dietary Patterns

Beef Consumption is within Dietary Guidelines Suggested Healthy Dietary Patterns

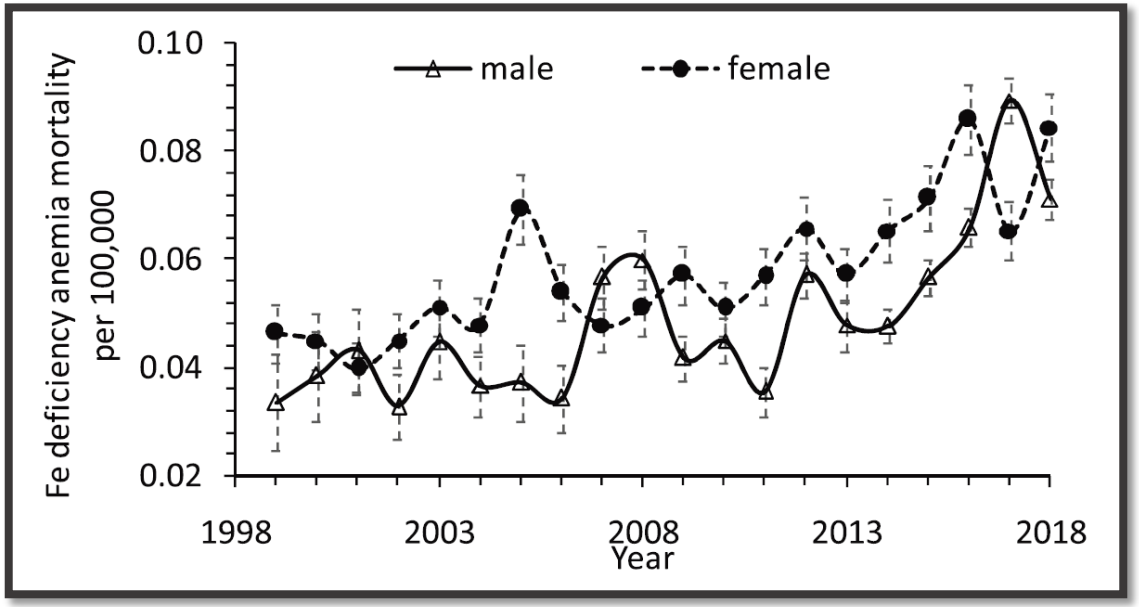
Recommended meats, poultry, eggs (ounces/week)



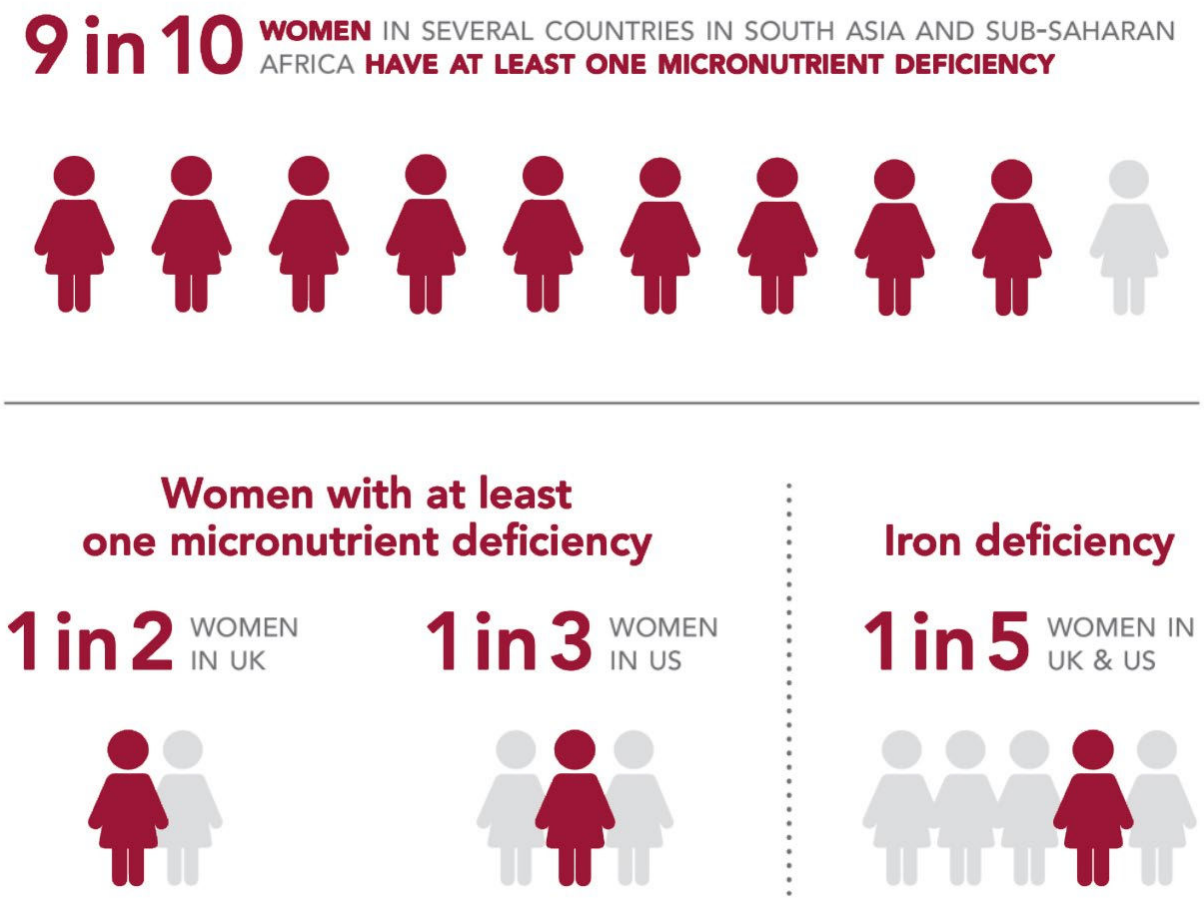
Note: DGA = Dietary Guidelines for Americans
Source: 2020-2025 Dietary Guidelines for Americans; WWEIA, NHANES 2013-2016, Day 1, Exponent, Beef Checkoff Analysis, unpublished

Lower Iron Intake in the US, Rising Anemia Related Mortality

- ~20% females fell below the EAR of Fe intake
- Rising trends of Fe intake deficits in both males and females between 1999 and 2018

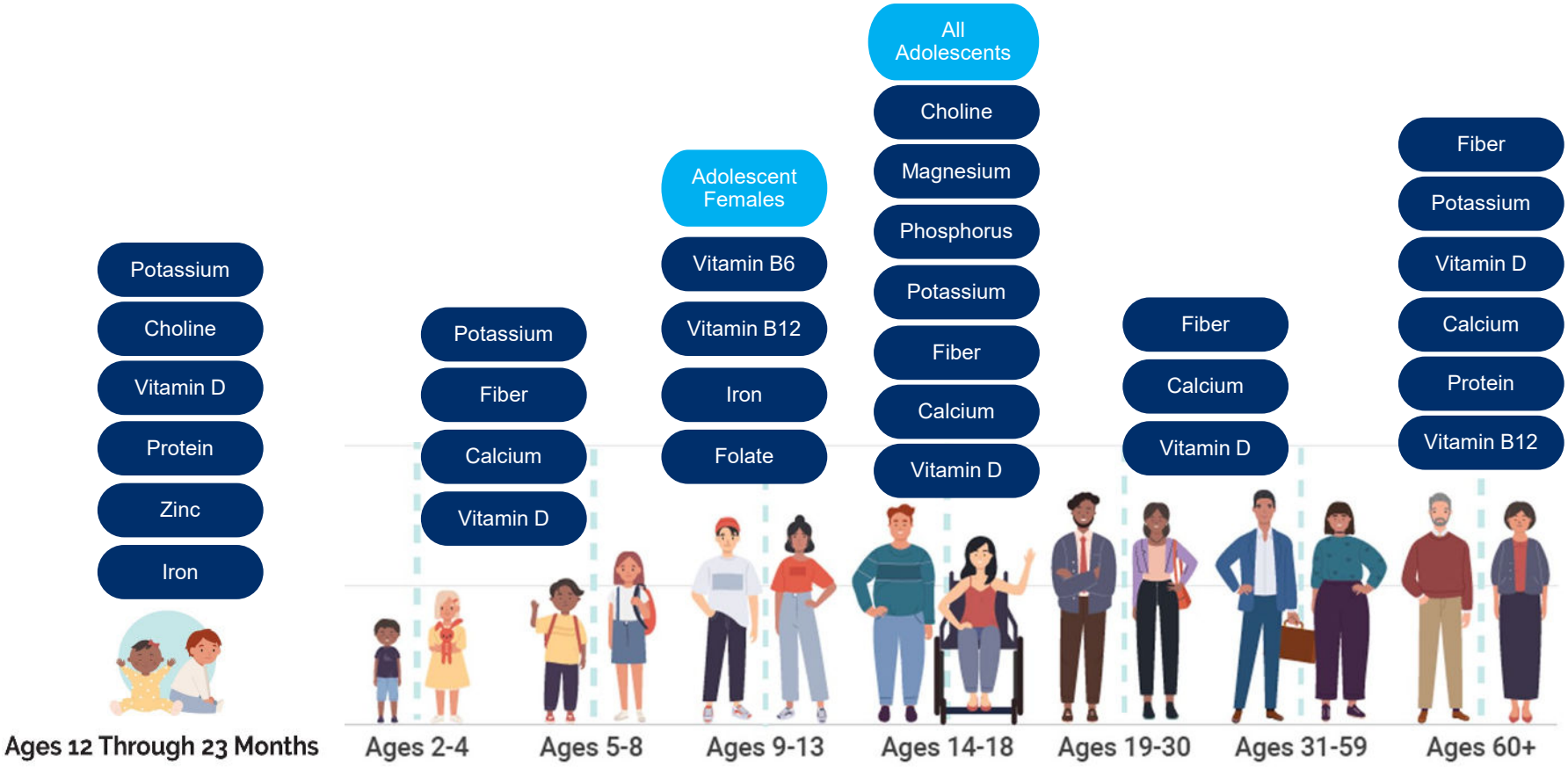


Sun H, Weaver CM. Decreased Iron Intake Parallels Rising Iron Deficiency Anemia and Related Mortality Rates in the US Population. *J Nutr*. 2021;151(7):1947-1955. doi:10.1093/jn/nxab064



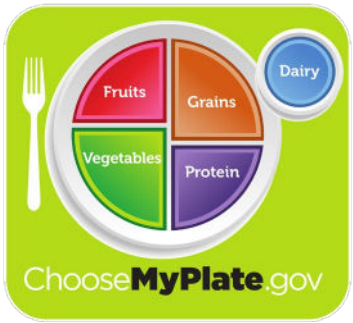
Source: Stevens and Beal et al. (2022). Micronutrient deficiencies among preschool-aged children and women of reproductive age worldwide. *Lancet Global Health*.

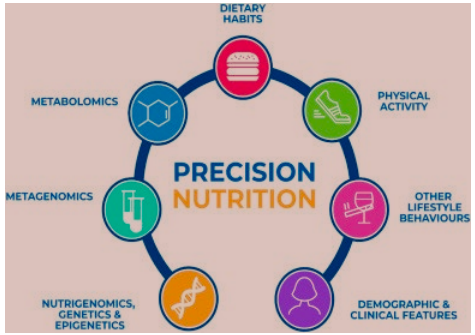
Nutrients of Public Health Concern Across the Life Stages



Source: 2020-2025 Dietary Guidelines for Americans/Dietary Guidelines Scientific Advisory Report

Moving from Population to Personalization





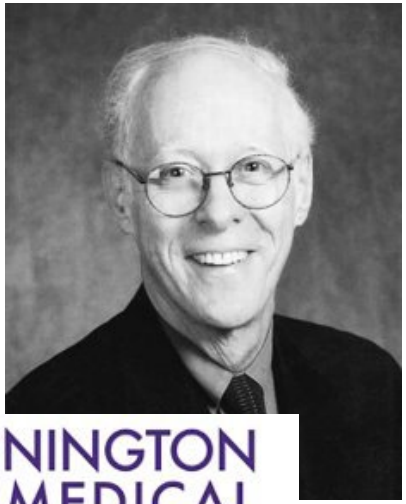
No One Size Fits All Diet

"Diets to treat obesity have been in existence since Hippocrates treated obesity some 2500 years ago. There are currently a wide variety of diets and a common misconception that a single magical diet can cure overweight and obesity. Systematic reviews and meta-analyses indicate that

all diets work when adhered to

and that initial weight loss can predict the amount of weight lost and maintained for up to 4 years. Individual preferences are thus key in selecting a diet. There are emerging data pinpointing genetic variability in the metabolic responses to variation in macronutrient intake."

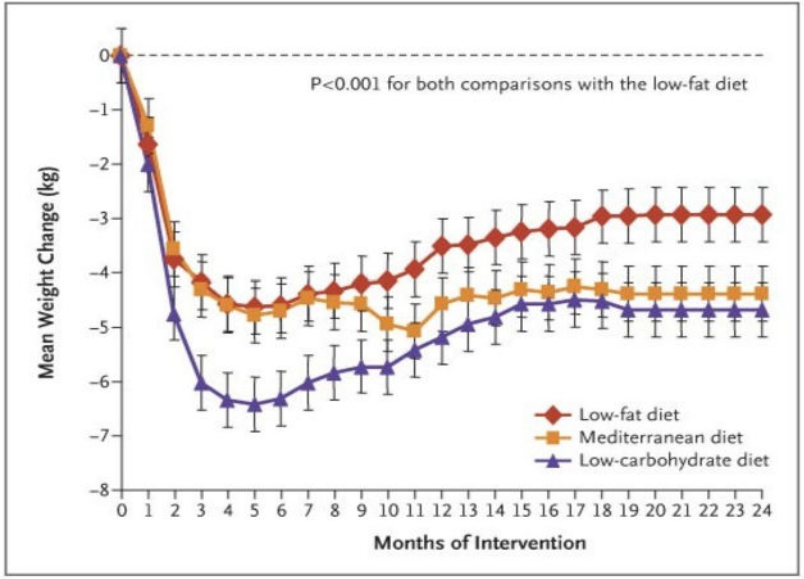
Dr. George Bray



PENNINGTON BIOMEDICAL RESEARCH FOUNDATION LSU

Bray, George A, and Patty W Siri-Tarino. "The Role of Macronutrient Content in the Diet for Weight Management." *Endocrinology and metabolism clinics of North America* vol. 45,3 (2016): 581-604. doi:10.1016/j.ecl.2016.04.009

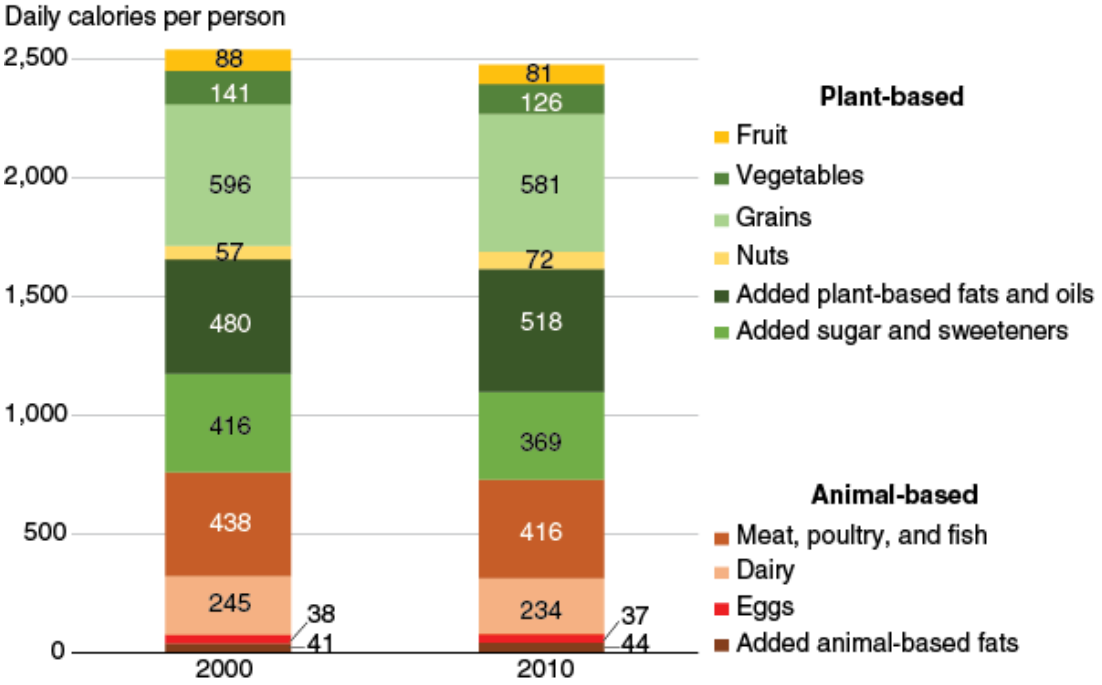
Behavioral Modifications Lead to Weight Loss, Regardless of Diet



- Research has shown that behavior modifications and lifestyle changes are more important than the particular diet chosen to follow.
- Dr. Gary Foster with Temple University followed participants on a low-carb or low-fat diet for two years, in addition to comprehensive behavioral treatment, for 2 years and both diet groups were successful in losing weight.
- Shai et al showed Mediterranean and low-carbohydrate diets may be effective alternatives to low-fat diets. The more favorable effects on lipids (with the low-carbohydrate diet) and on glycemic control (with the Mediterranean diet) suggest that personal preferences and metabolic considerations might inform individualized tailoring of dietary interventions.

Source: Foster GD, Wyatt HR, Hill JO, et al. Weight and metabolic outcomes after 2 years on a low-carbohydrate versus low-fat diet: a randomized trial. *Ann Intern Med*. 2010;153(3):147-157. doi:10.7326/0003-4819-153-3-201008030-00005; Shai et al. N Engl J Med 2008; 359:229-241

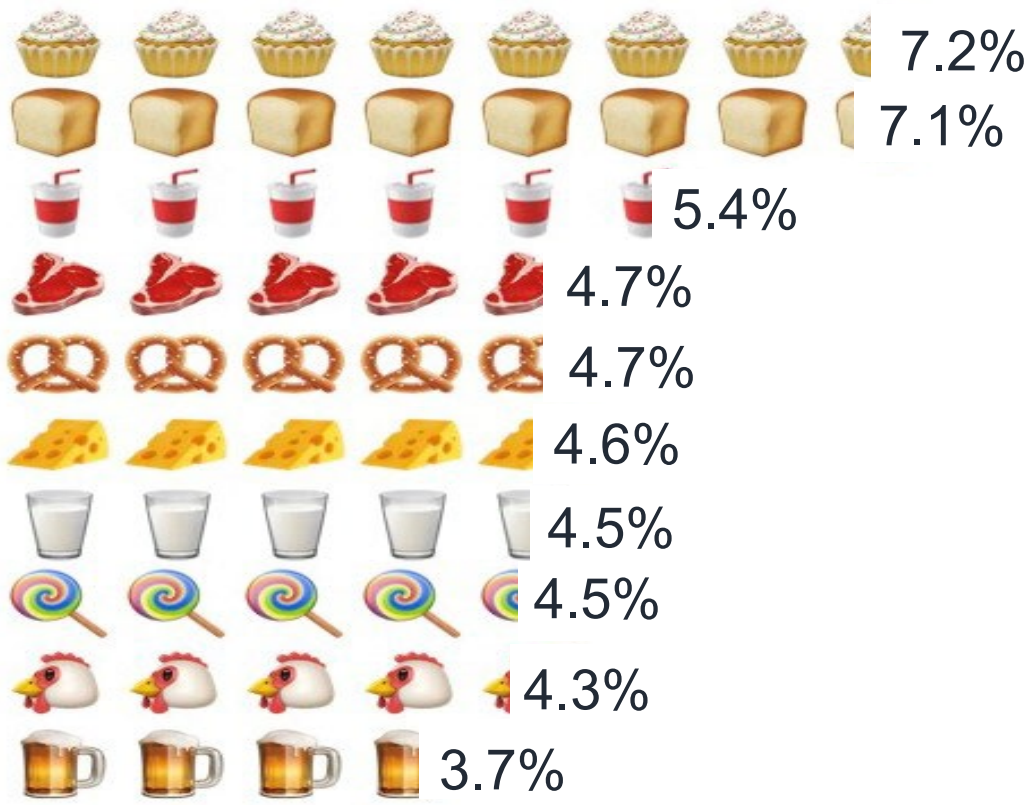
Plant-Based: Broad Advice Can Have Unintended Consequences



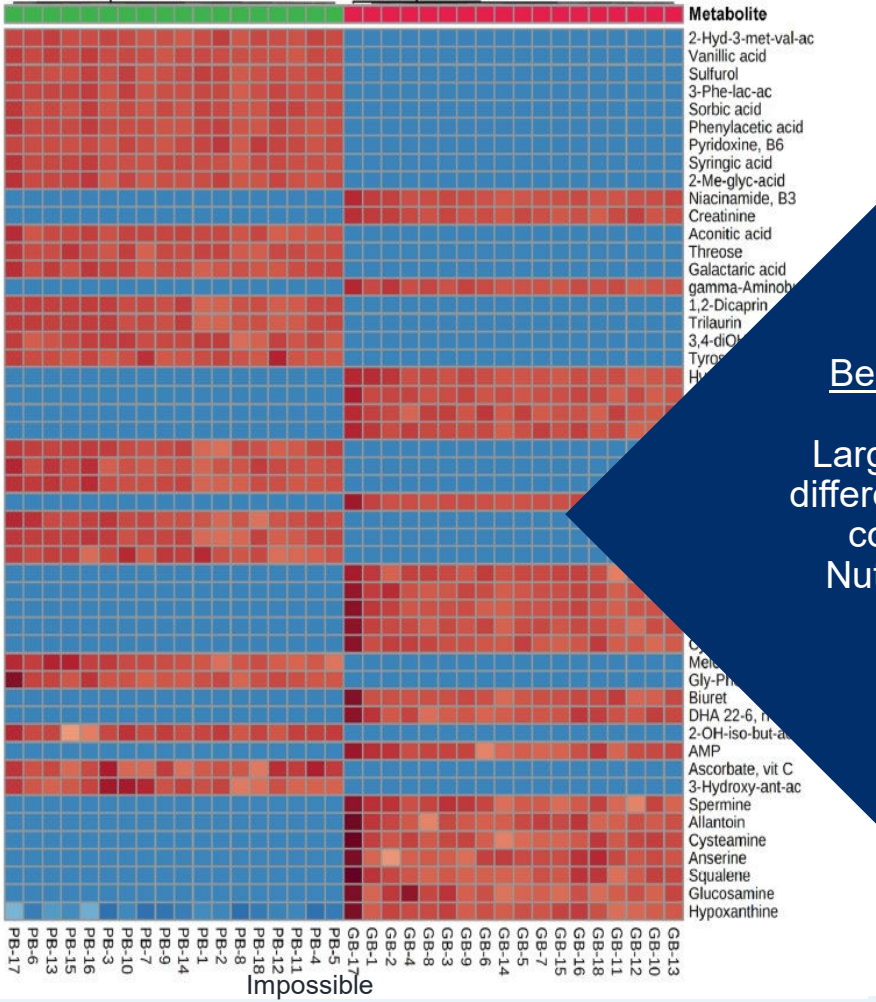
Added fats and oils are added to food during processing or preparation and do not include naturally occurring fats, such as in meat, dairy products, nuts, and avocadoes. Added animal-based fats include butter, lard, and edible beef tallow.
Source: USDA, Economic Research Service Loss-Adjusted Food Availability data.

The American diet is already plant-based.

Top Ten Sources of Calories



Source: Huth et al 2013; Data from NHANES 2003 - 2006

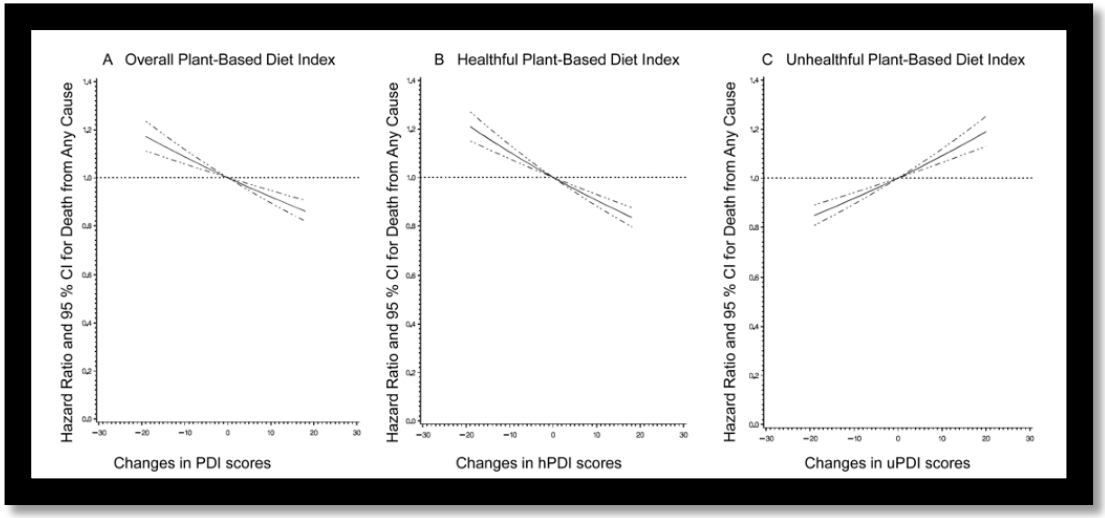


Impossible

Beef vs Plant-Based:
Large nutritional differences despite comparable Nutrition Facts panels

Source: Van Vliet et al.: https://www.nature.com/articles/s41598-021-93100-3.pdf

Dietary Quality Matters



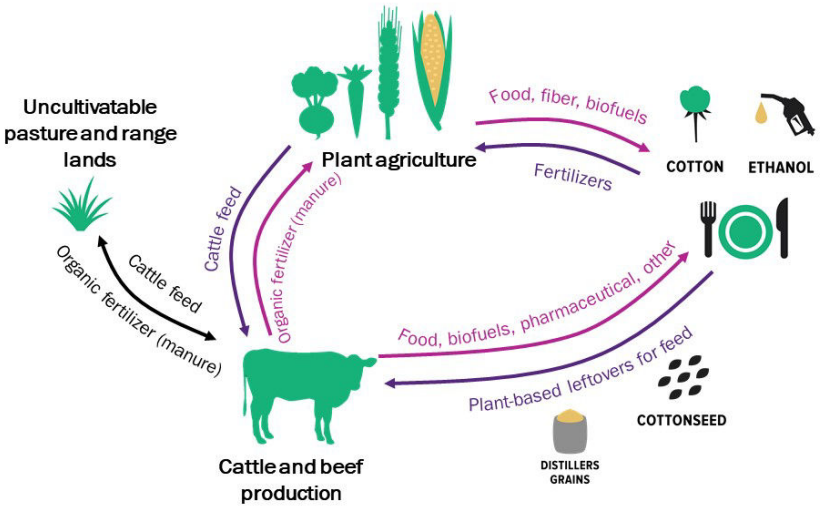
"In conclusion, we found that improving plant-based diet quality over a 12-year period was associated with a lower risk of total and CVD mortality, whereas increased consumption of an unhealthful plant-based diet was associated with a higher risk of total and CVD mortality. Our results support shifts toward diets that emphasize healthy plant foods for improved health outcomes."

Source: Circulation 2019 Sep 17;140(12):979-991. doi: 10.1161/CIRCULATIONAHA.119.041014. Epub 2019 Aug 12.

Plants and animal foods have different, but important roles in nutrition and sustainability

Complementary, Not Competitive

Grains	Vegetables	Fruits	Protein	Dairy
Bread, maize, millet, rice, etc., Limit refined grains (white bread or rice, etc.)	Variety of different colors and types (e.g. dark-green, starchy, beans & peas)	Variety of fruits of different colors	Meat, poultry, seafood, beans and peas, eggs, soy products, nuts, seeds	Milk, cheese, yogurt (choose fat-free or low-fat if possible for all choices)
Starches, fiber, some magnesium and iron, thiamin, and niacin	Carotenes, folates, fiber, potassium, vitamin A, vitamin C, and antioxidants	Vitamin C, potassium, fiber, folates	Iron, protein, B vitamins, zinc, magnesium	Calcium, protein, vitamins A & D, riboflavin



Animal and Plants are Co-Dependent

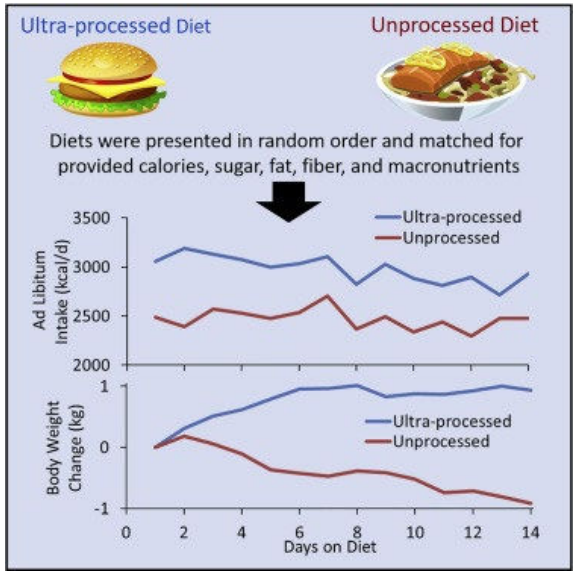
Source: https://sites.psu.edu/heseagh/vocational-school/general-health-and-nutrition/general-nutrition/

Processed Foods

Food Fear Mongering Is Not Productive

•The U.S. Department of Agriculture (USDA) defines a processed food as one that has undergone any changes to its natural state—that is, any raw agricultural commodity subjected to **washing, cleaning, milling, cutting, chopping, heating, pasteurizing, blanching, cooking, canning, freezing, drying, dehydrating, mixing, packaging, or other procedures that alter the food from its natural state**. The food may include the addition of other ingredients such as preservatives, flavors, nutrients and other food additives or substances approved for use in food products, such as salt, sugars, and fats.

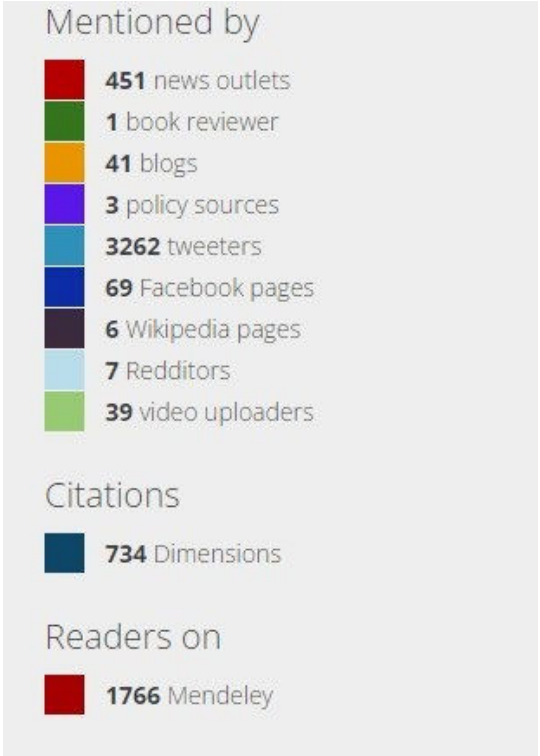
Ultra-Processed Foods Cause Excess Calorie Intake and Weight Gain?



- People consumed more calories when exposed to the ultra-processed diet...and gained weight on the ultra-processed diet and lost weight on the unprocessed diet.

But there are trade-offs...

- Ultra-processed meals were estimated to be $106 versus $151 for the unprocessed meals as calculated using the cost of ingredients obtained from a local branch of a large supermarket



Source: Hall, Kevin D et al. "Ultra-Processed Diets Cause Excess Calorie Intake and Weight Gain: An Inpatient Randomized Controlled Trial of Ad Libitum Food Intake." *Cell metabolism* vol. 30,1 (2019): 67-77.e3. doi:10.1016/j.cmet.2019.05.008

Dietary Guidelines Meet NOVA

Hess et al., 2023

Average HEI Scores for All Americans (2+ yo)

FIGURE 5. Radar plot depicting the average Healthy Eating Index-2015 score for all Americans ages 2+, WWEIA, NHANES 2017-2018

Perfect HEI Score

FIGURE 3. Radar plot depicting a perfect score (100 points) of diet quality according to the Healthy Eating Index-2015 score

Ultra-Processed DGA Menu HEI Score

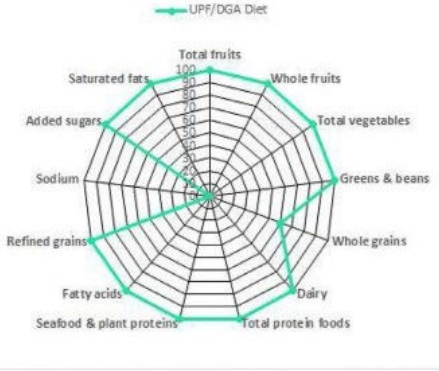
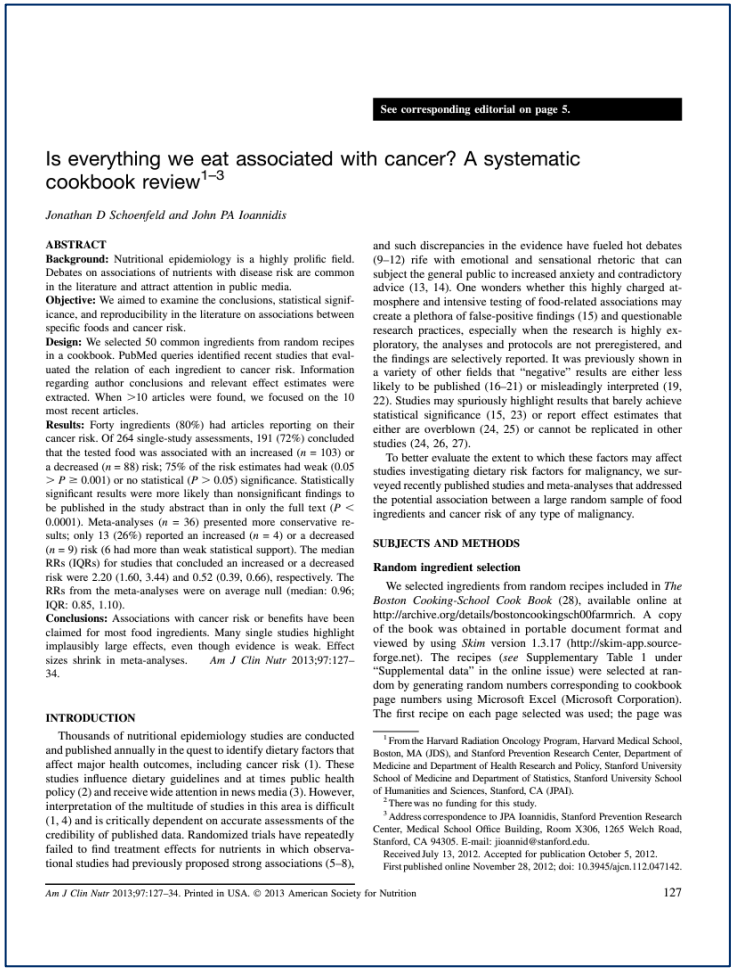


FIGURE 4. Radar plot depicting diet quality score of ultra-processed foods (UPF) Dietary Guidelines for Americans (DGA) menu according to the Healthy Eating Index-2015 score

- In the ultra-processed DGA menu that was created, 91% of kcal were from UPF, or NOVA category 4. The HEI-2015 score was **86** out of a possible 100 points.
- The ultra-processed DGA menu did not receive a perfect score primarily due to excess sodium and inadequate whole grains in the diet

Source: Hess JM, Comeau ME, Casperson S, et al. Dietary Guidelines Meet NOVA: Developing a Menu for A Healthy Dietary Pattern Using Ultra-Processed Foods. *J Nutr*. 2023;153(8):2472-2481. doi:10.1016/j.tjnut.2023.06.028



See corresponding editorial on page 5.

Is everything we eat associated with cancer? A systematic cookbook review[1–3]

Jonathan D Schoenfeld and John PA Ioannidis

ABSTRACT

Background: Nutritional epidemiology is a highly prolific field. Debates on associations of nutrients with disease risk are common in the literature and attract attention in public media.

Objective: We aimed to examine the conclusions, statistical significance, and reproducibility in the literature on associations between specific foods and cancer risk.

Design: We selected 50 common ingredients from random recipes in a cookbook. PubMed queries identified recent studies that evaluated the relation of each ingredient to cancer risk. Information regarding author conclusions and relevant effect estimates were extracted. When >10 articles were found, we focused on the 10 most recent articles.

Results: Forty ingredients (80%) had articles reporting on their cancer risk. Of 264 single-study assessments, 191 (72%) concluded that the tested food was associated with an increased (n = 103) or a decreased (n = 88) risk; 75% of the risk estimates had weak ($0.05 > P \geq 0.001$) or no statistical ($P > 0.05$) significance. Statistically significant results were more likely than nonsignificant findings to be published in the study abstract than in only the full text ($P < 0.0001$). Meta-analyses (n = 36) presented more conservative results; only 13 (26%) reported an increased (n = 4) or a decreased (n = 9) risk (6 had more than weak statistical support). The median RRs (IQRs) for studies that concluded an increased or a decreased risk were 2.20 (1.60, 3.44) and 0.52 (0.39, 0.66), respectively. The RRs from the meta-analyses were on average null (median: 0.96; IQR: 0.85, 1.10).

Conclusions: Associations with cancer risk or benefits have been claimed for most food ingredients. Many single studies highlight implausibly large effects, even though evidence is weak. Effect sizes shrink in meta-analyses. *Am J Clin Nutr* 2013;97:127–34.

INTRODUCTION

Thousands of nutritional epidemiology studies are conducted and published annually in the quest to identify dietary factors that affect major health outcomes, including cancer risk (1). These studies influence dietary guidelines and at times public health policy (2) and receive wide attention in news media (3). However, interpretation of the multitude of studies in this area is difficult (1, 4) and is critically dependent on accurate assessments of the credibility of published data. Randomized trials have repeatedly failed to find treatment effects for nutrients in which observational studies had previously proposed strong associations (5–8), and such discrepancies in the evidence have fueled hot debates (9–12) rife with emotional and sensational rhetoric that can subject the general public to increased anxiety and contradictory advice (13, 14). One wonders whether this highly charged atmosphere and intensive testing of food-related associations may create a plethora of false-positive findings (15) and questionable research practices, especially when the research is highly exploratory, the analyses and protocols are not preregistered, and the findings are selectively reported. It was previously shown in a variety of other fields that "negative" results are either less likely to be published (16–21) or misleadingly interpreted (19, 22). Studies may spuriously highlight results that barely achieve statistical significance (15, 23) or report effect estimates that either are overblown (24, 25) or cannot be replicated in other studies (24, 26, 27).

To better evaluate the extent to which these factors may affect studies investigating dietary risk factors for malignancy, we surveyed recently published studies and meta-analyses that addressed the potential association between a large random sample of food ingredients and cancer risk of any type of malignancy.

SUBJECTS AND METHODS

Random ingredient selection

We selected ingredients from random recipes included in *The Boston Cooking-School Cook Book* (28), available online at http://archive.org/details/bostoncookingsch00farmrich. A copy of the book was obtained in portable document format and viewed by using *Skim* version 1.3.17 (http://skim-app.sourceforge.net). The recipes (*see* Supplementary Table 1 under "Supplemental data" in the online issue) were selected at random by generating random numbers corresponding to cookbook page numbers using Microsoft Excel (Microsoft Corporation). The first recipe on each page selected was used; the page was

[1] From the Harvard Radiation Oncology Program, Harvard Medical School, Boston, MA (JDS), and Stanford Prevention Research Center, Department of Medicine and Department of Health Research and Policy, Stanford University School of Medicine and Department of Statistics, Stanford University School of Humanities and Sciences, Stanford, CA (JPAI).

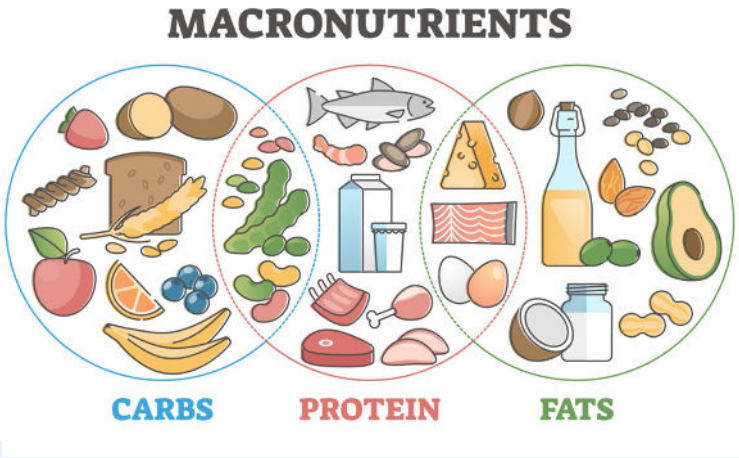
[2] There was no funding for this study.

[3] Address correspondence to JPA Ioannidis, Stanford Prevention Research Center, Medical School Office Building, Room X306, 1265 Welch Road, Stanford, CA 94305. E-mail: jioannid@stanford.edu.

Received July 13, 2012. Accepted for publication October 5, 2012.
First published online November 28, 2012; doi: 10.3945/ajcn.112.047142.

Overgeneralized advice or 'all or nothing" approaches are not effective tools for public health behavior change.

Nourishing for Strength & Resilience:
The Power of Protein



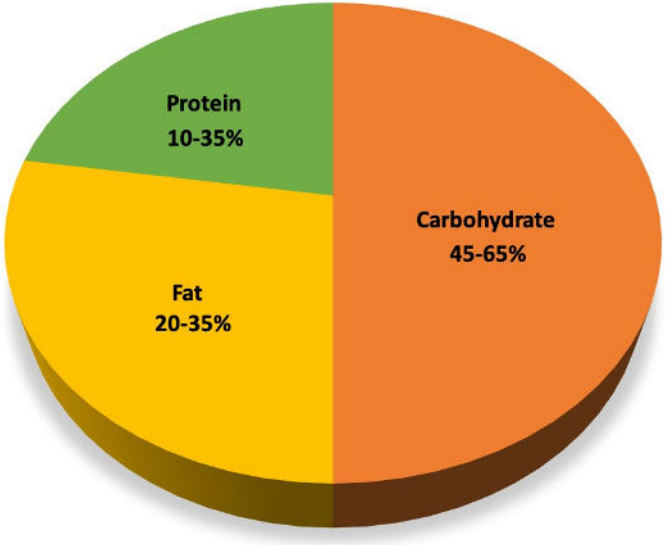
Acceptable Macronutrient Distribution Range (AMDR)

- The intake range “associated with reduced risk of chronic diseases, while providing adequate intakes of essential nutrients.”

Protein: 10-35% of total calories

Carbohydrate: 45-65% of total calories

Fat: 20-35% of total calories

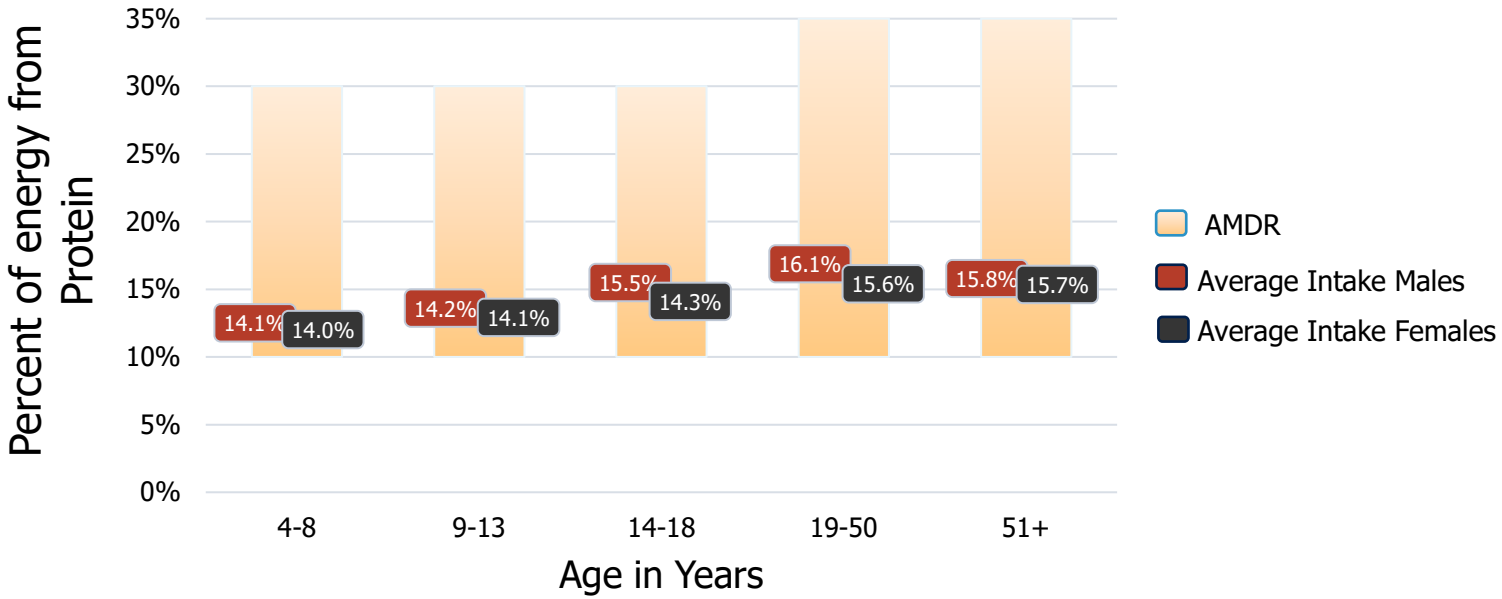


INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Source: Institute of Medicine. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington, DC: National Academies Press, 20

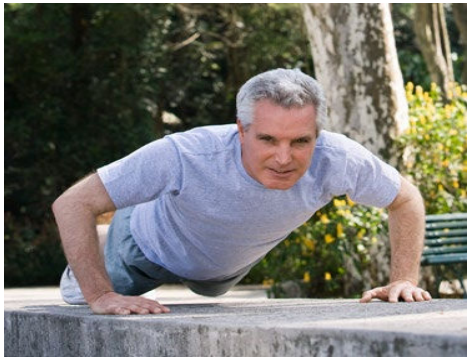
Americans Consume Protein At The Low End of the Recommended Range

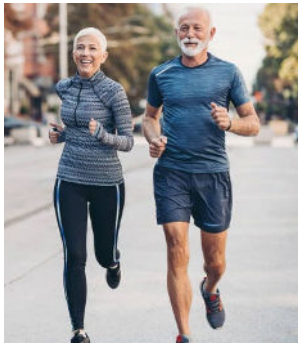
At every life stage, both males and females are consuming protein within the acceptable macronutrient distribution range (AMDR).



Source: U.S. Department of Agriculture, Agricultural Research Service. Usual Nutrient Intake from Food and Beverages. What We Eat in America, NHANES 2015-2018. Updated January 2021.

Increased Dietary Protein Supports Strength and Resilience Across the Lifespan





How can protein centric meal planning support strength and resilience?

- ✓ Muscle
- ✓ Spare lean body mass during weight loss
- ✓ Promote weight management
- ✓ Enhance glycemic regulation
- ✓ Increases calcium absorption which can lead to long term improvements in bone health
- ✓ Decreases Appetite
- ✓ Source of other nutrients (nutrient-density)

Source: 2015 Mar;80 Suppl 1:A2-7. doi: 10.1111/1750-3841.12804.

Muscle is the Organ of Longevity

Review Article

The underappreciated role of muscle in health and disease[1–3]

Robert R Wolfe

ABSTRACT
Muscle plays a central role in whole-body protein metabolism by serving as the principal reservoir for amino acids to maintain protein synthesis in vital tissues and organs in the absence of amino acid absorption from the gut and by providing hepatic gluconeogenic precursors. Furthermore, altered muscle metabolism plays a key role in the genesis, and therefore the prevention, of many common pathologic conditions and chronic diseases. Nonetheless, the maintenance of adequate muscle mass, strength, and metabolic function has rarely, if ever, been targeted as a relevant endpoint of recommendations for dietary intake. It is therefore imperative that factors directly related to muscle mass, strength, and metabolic function be included in future studies designed to demonstrate optimal lifestyle behaviors throughout the life span, including physical activity and diet. Am J Clin Nutr 2006;84:475–82.

KEY WORDS Strength, muscle, protein metabolism, sarcopenia, dietary requirements

INTRODUCTION

The importance of muscle mass, strength, and metabolic function in the performance of exercise, as well as the activities of daily living (ADL), has never been questioned. Perhaps less well recognized, muscle plays a central role in whole-body protein metabolism, which is particularly important in the response to stress. Furthermore, abundant evidence points to a key role of altered muscle metabolism in the genesis, and therefore prevention, of many common pathologic conditions and chronic diseases. This review discusses the various roles of muscle metabolism in health and disease, including consideration of possible solutions to muscle loss. Particular emphasis will be given to the notion that increasing protein or amino acid intakes may optimize muscle strength and metabolism and thereby improve health.

CENTRAL ROLE OF MUSCLE PROTEIN IN WHOLE-BODY METABOLISM

Maintenance of the protein content of certain tissues and organs, such as the skin, brain, heart, and liver, is essential for survival. In the postabsorptive state these essential tissues and organs rely on a steady supply of amino acids via the blood to serve as precursors for the synthesis of new proteins to balance the persistent rate of protein breakdown that occurs in all tissues. It has been recognized since the early 1960s that, in the absence of nutrient intake, muscle protein serves as the principal reservoir to replace blood amino acid taken up by other tissues (1–3). In the fasting state, blood amino acids serve not only as precursors for the synthesis of proteins but also as precursors for hepatic gluconeogenesis (4). Consequently, the protein mass of essential tissues and organs, as well as the necessary plasma glucose concentration, can be maintained relatively constant despite the absence of nutritional intake, provided muscle mass is adequate to supply the required amino acids.

The demands for amino acids in most organs and tissues do not vary significantly from the fed to the postabsorptive state because little surplus protein is accumulated. Furthermore, the hepatic uptake of gluconeogenic amino acids decreases with nutrient intake (5). Consequently, the primary fate of ingested amino acids is incorporation into muscle protein to replete the reserves of amino acids lost in the fasting state. Under normal conditions, gains in muscle protein mass in the fed state balance the loss of muscle protein mass in the postabsorptive state.

The ability of net muscle protein breakdown to maintain plasma amino acid concentrations is remarkable, provided adequate muscle mass is available. For example, obese individuals (with increased muscle mass) were able to maintain normal concentrations of plasma amino acids after ≥60 d of fasting (6). In contrast, depletion of muscle mass is incompatible with life. For example, there is a strong association between the depletion of body cell mass (presumably reflecting depletion of muscle mass) and the length of survival of seriously ill patients with AIDS (7). Studies performed by Jewish physicians in the Warsaw ghetto suggest that death from starvation, uncomplicated by critical

[1] From the University of Texas Medical Branch, Department of Surgery and Shriners Burns Hospital, Metabolism Unit, Galveston, TX.
[2] Supported by NIH grants R01 AR49038, P30 AG024832, and SHC grant 8490 and the UTMB Claude Pepper Older Americans Independence Center grant P30 AG024832.
[3] Reprints not available. Address correspondence to RR Wolfe, 815 Market Street, Galveston, TX 77550. E-mail: rwolfe@utmb.edu.
Received December 12, 2005.
Accepted for publication March 21, 2006.

- ✓Whole Body Metabolism
- ✓Response to Critical Illness
- ✓Obesity
- ✓Insulin resistance and Diabetes
- ✓Osteoporosis
- ✓Sarcopenia

Source: Wolfe, 2005. https://doi.org/10.1093/ajcn/84.3.475

Positive Associations Of Higher Protein Intake and Less Muscle Loss in Older Adults

"A 1 ounce per increase in beef consumption predicts for a 2.3 cm^2 increase in mid-arm muscle area"

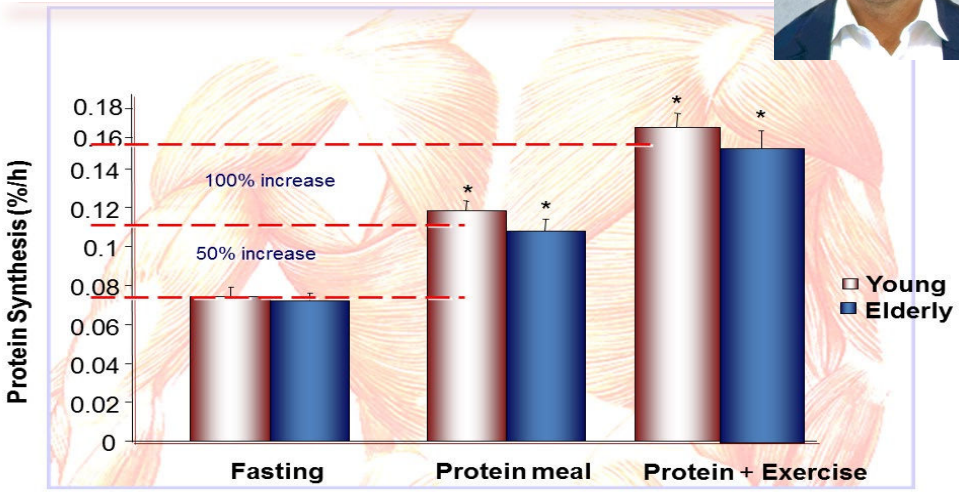
Martha Belury PhD, RD
The Ohio State University

Source: Asp ML, et al. Dietary protein and beef consumption predict for markers of muscle mass and nutrition status in older adults. J Nutr Health Aging. 2012;16(9):784-90.

Aging Muscle Responds To Dietary Protein And Exercise

- Compare healthy young and healthy older adults (n=7 in each group)
- Meal consisting of 340g (12 oz) lean ground beef
  (90g protein)
- A bout of resistance exercise

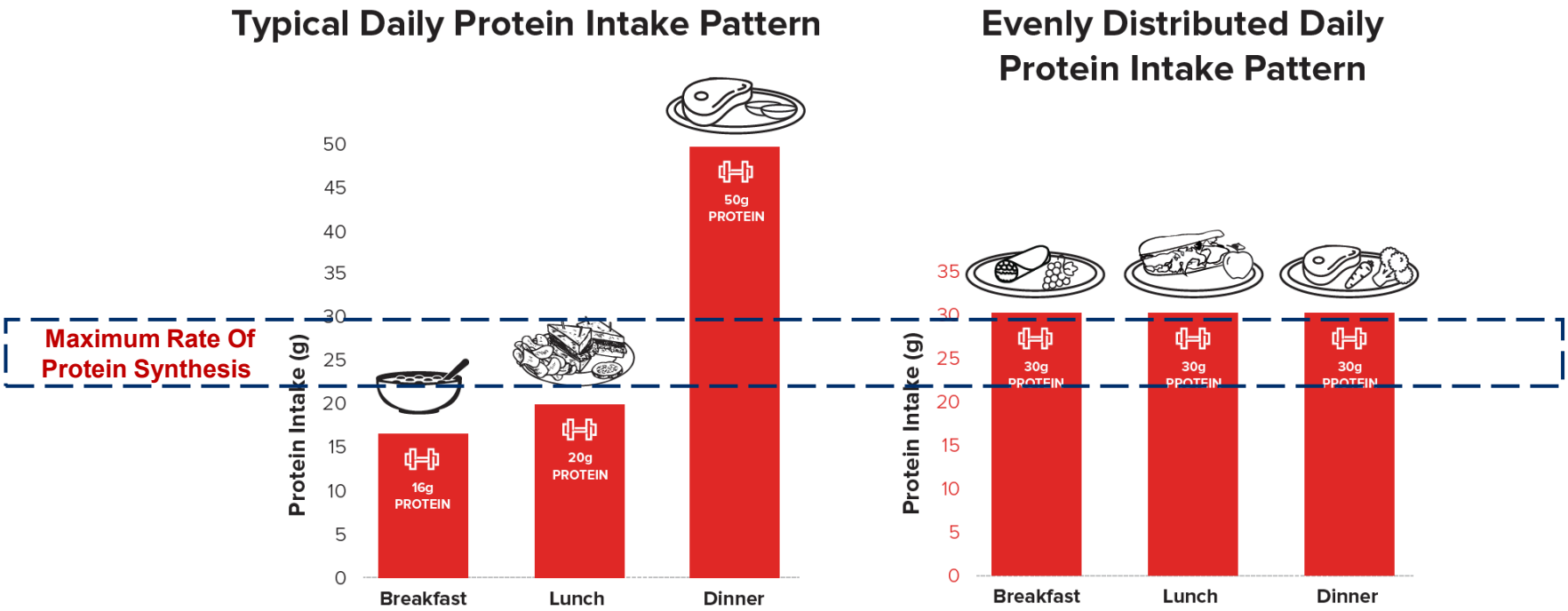
Douglas Paddon-Jones, PhD
University of Texas, Medical Branch
at Galveston



Graphic courtesy of Doug Paddon-Jones, University of Texas Medical Branch

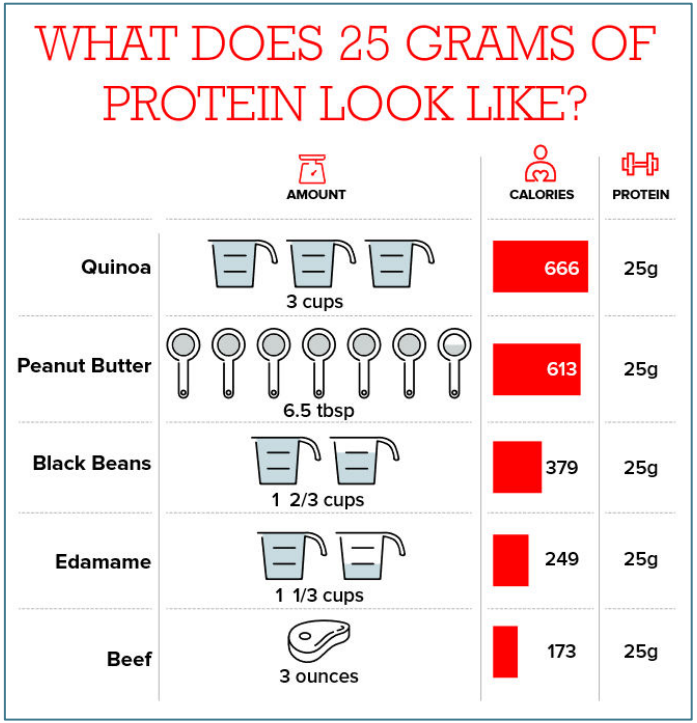
Source: Symons TB, et al. The anabolic response to resistance exercise and a protein-rich meal is not diminished by age. J Nutr Health Aging. 2011;15(5):376-81.

Even Protein Consumption Throughout the Day



Layman, Donald K et al. “Defining meal requirements for protein to optimize metabolic roles of amino acids.” *The American journal of clinical nutrition* vol. 101,6 (2015): 1330S-1338S. doi:10.3945/ajcn.114.084053

Protein Density
Calorie for Calorie, Animal Proteins Offer More Protein



- A 3-ounce cooked serving of beef has about 25 grams of protein in 173 calories.
- Most plant proteins have 2-3x the calories to get the same amount of protein.

Source: U.S. Department of Agriculture, Agricultural Research Service, Nutrient Data Laboratory. FoodData Central, 2019. Available at fdc.nal.usda.gov (Beef composite, cooked – NDB# 13364; Quinoa, cooked– NDB# 20137; peanut butter, smooth – NDB# 16167; black beans, cooked – NDB# 16015; edamame – NDB# 11212).

Non-Meat Healthy Diets are Lower in Protein and Higher in Calories

- Researchers modeled omnivore and vegan eating patterns that met established essential amino acids recommendations.

Omnivore
(3 oz. Beef)

Vegan-calorie matched

Vegan-protein matched

•The vegan-calorie matched pattern resulted in **20g less protein** and a lower total protein contribution to diet, which may negatively impact muscle health.

•The vegan protein matched pattern resulted in **+ 300 calories**, which may impact body weight and composition.

Source: Fussell M, et al. Essential Amino Acid Density. Differences in Animal- and Plant-Based Dietary Patterns Designed for Older Women. Nutr Today 2021;56(2):70-5.

Not All Protein Foods Are Created Equally: Protein Quality

- Researchers compared 2 oz-eq of protein foods (beef sirloin, pork loin, eggs, tofu, kidney beans, peanut butter, mixed nuts) on protein synthesis and breakdown in young adults

2 oz

2 oz

2 eggs

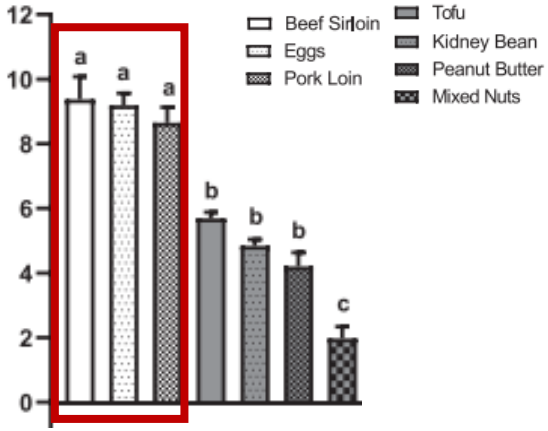
1/2 cup

2 Tbsp

4 oz

1 oz

Changes in whole-body protein kinetics [net protein balance]



Animal-based protein food sources elicited greater protein synthesis rates and less protein breakdown than plant-based protein food sources

Source: Park S, et al. Metabolic evaluation of the Dietary Guidelines' ounce equivalents of protein food sources in young adults: A randomized controlled trial. J Nutr 2021; 151(5):1190-6.

Beef In A Healthy Weight Loss Diet Improves Body Composition And Muscle Strength In Older Adults

- Obese older adults (n=36) participating in 12-week controlled-feeding dietary intervention, calorie-restricted DASH-like diet with daily intakes of 4.5 oz of fresh, lean red meat (beef & pork)

	Weeks of Intervention					
Variable	**0**	**3**	**6**	**9**	**12**	**+ *p*-Value**
Weight (kg)						
All Participants	* 91.2 (18.0)	88.6 (17.3)	87.3 (16.9)	86.4 (16.6)	* 85.5 (16.3)	<0.001
Females	* 85.9 (19.9)	84.0 (19.3)	82.9 (18.9)	82.0 (18.4)	* 81.3 (18.2)	<0.001
Males	* 98.7 (11.8)	95.0 (11.9)	93.4 (11.6)	92.5 (11.5)	* 91.5 (11.1)	<0.001
BMI (kg/m^2)						
All Participants	* 32.0 (6.9)	31.2 (6.7)	30.7 (6.6)	30.4 (6.5)	* 30.1 (6.4)	<0.001
Females	* 32.5 (8.5)	31.8 (8.3)	31.4 (8.2)	31.0 (8.0)	* 30.8 (7.9)	<0.001
Males	* 31.4 (3.6)	30.3 (3.6)	29.7 (3.5)	29.4 (3.5)	* 29.1 (3.3)	<0.001
Body Fat (%)						
All Participants	* 37.2 (9.8)	36.9 (10.1)	35.7 (10.1)	35.3 (10.4)	* 34.7 (10.3)	<0.001
Females	* 41.8 (9.5)	41.7 (9.7)	40.4 (9.8)	40.3 (9.9)	* 39.8 (9.6)	<0.001
Males	* 30.7 (5.8)	30.2 (6.1)	29.2 (6.2)	28.2 (6.5)	* 27.6 (6.4)	<0.001
AFM (kg)						
All Participants	* 34.5 (12.7)	33.4 (12.9)	31.9 (12.6)	31.1 (12.7)	* 30.3 (12.4)	<0.001
Females	* 37.3 (14.8)	36.4 (14.8)	34.9 (14.6)	34.4 (14.4)	* 33.7 (14.1)	<0.001
Males	* 30.5 (7.9)	29.1 (8.3)	27.5 (7.8)	26.4 (8.0)	* 25.5 (7.7)	<0.001
Handgrip (per kg mass)						
All Participants	* 0.70 (0.21)	0.73 (0.20)	0.75 (0.20)	0.74 (0.19)	* 0.77 (0.19)	<0.0001
Females	* 0.62 (0.18)	0.65 (0.17)	0.66 (0.17)	0.66 (0.17	* 0.68 (0.16)	<0.0001
Males	* 0.81 (0.21)	0.84 (0.19)	0.87 (0.19)	0.86 (0.17)	* 0.90 (0.17)	<0.0001
Sit/Stand (reps)						
All Participants	* 11.4 (2.3)	11.9 (2.4)	12.9 (2.5)	13.1 (2.9)	* 13.8 (2.5)	<0.001
Females	* 11.1 (2.1)	11.6 (2.3)	12.5 (2.3)	12.8 (2.8)	* 13.4 (2.1)	<0.001
Males	* 11.9 (2.6)	12.4 (2.4)	13.4 (2.8)	13.5 (3.0)	* 14.3 (3.0)	<0.001

Cydne Perry, PhD
Indiana University School of Public Health-Bloomington

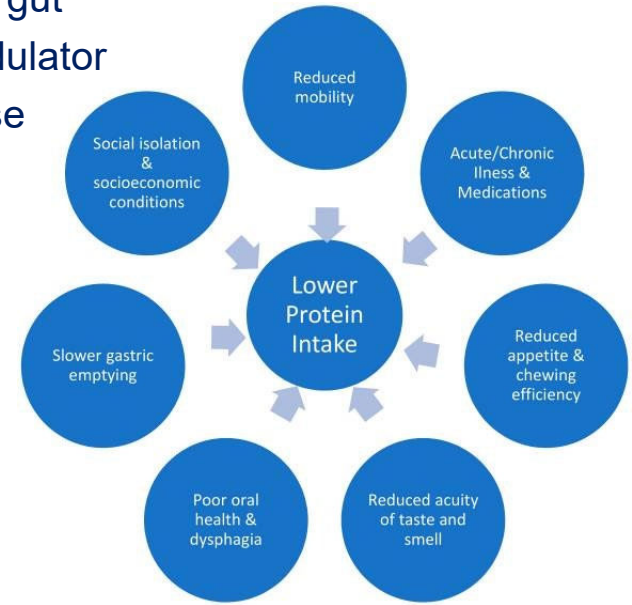
Red meat in a healthy weight loss diet can help to preserve muscle strength while reducing fat mass in obese older adults.

Source: Perry CA, et al. A Calorie-Restricted DASH Diet Reduces Body Fat and Maintains Muscle Strength in Obese Older Adults. Nutrients. 2019;12(1):102.

Protein Supplementation for Muscle Strength & Future Direction

- Protein supplementation enhances muscle strength and size alongside resistance exercise training in older adults

- **Looking ahead**: The gut microbiome as a modulator for individual response to protein, and the impact no muscle strength as we age.



Morton, Robert W et al. “A systematic review, meta-analysis and meta-regression of the effect of protein supplementation on resistance training-induced gains in muscle mass and strength in healthy adults.” British journal of sports medicine vol. 52,6 (2018): 376-384. doi:10.1136/bjsports-2017-097608; Ni Lochlainn, Mary et al. “Dietary Protein and Muscle in Aging People: The Potential Role of the Gut Microbiome.” Nutrients vol. 10,7 929. 20 Jul. 2018, doi:10.3390/nu10070929

Protein and Weight Management

Mechanisms: Increased Satiety and Energy Expenditure

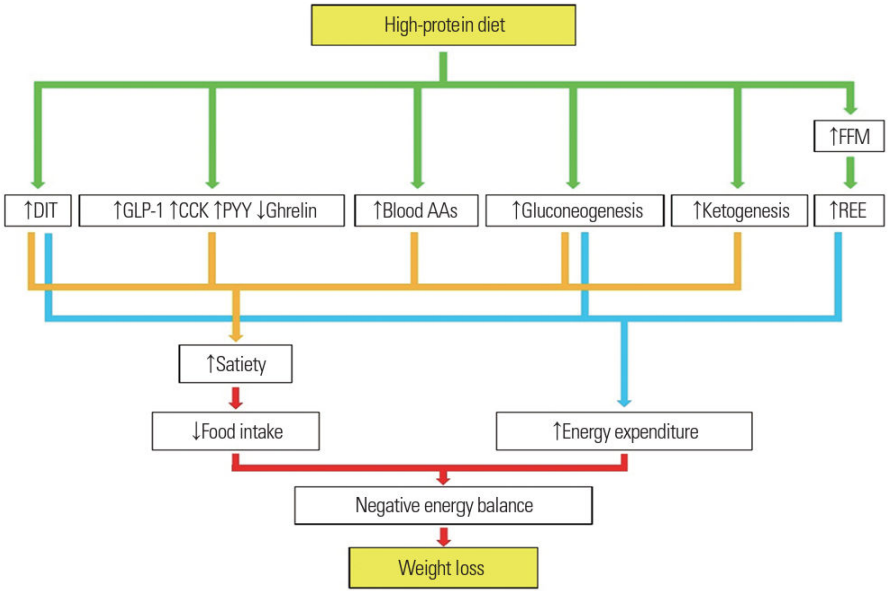


Figure 1. Schematic of the proposed high-protein diet-induced weight loss mechanism. ↑, increase; ↓, decrease; FFM, fat-free mass; DIT, diet-induced thermogenesis; GLP-1, glucagon-like peptide-1; CCK, cholecystokinin; PYY, peptide tyrosine-tyrosine; AA, amino acid; REE, resting energy expenditure.

Source Moon J, et al. High-Protein Diet and Weight Loss Journal of Obesity & Metabolic Syndrome 2020;29:166-173 https://doi.org/10.7570/jomes20028

Protein and Insulin Sensitivity

Dietary Protein increases insulin secretion and lowers blood glucose

Findings from this study suggest that protein intake above the recommended daily intake (greater than 1.0 g/kg bw), in overweight and obese individuals with prediabetes and T2D is associated with lower insulin resistance, in addition to lower BMI, WC, FM, and FM/LM ratio as compared with individuals consuming less than 1.0 g/kg bw. (Akhaven, et al. Nutrients 2020)

A High Protein Diet Is More Effective in Improving Insulin Resistance and Glycemic Variability Compared to a Mediterranean Diet—A Cross-Over Controlled Inpatient Dietary Study (Tettamanzi, Nutrients. 2021 Dec; 13(12): 4380)

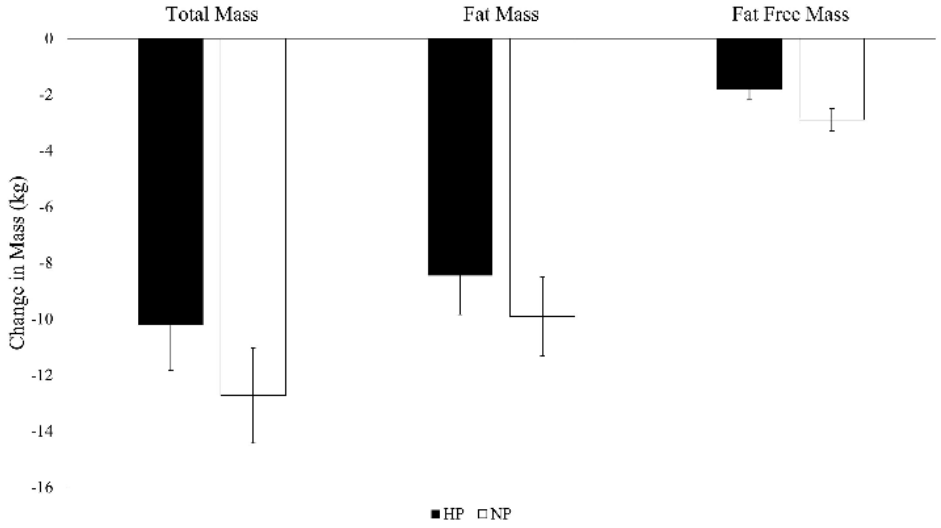
FLEXBILITY TO CHOOSE:

Consumers with Diabetes Have the Flexibility of Including Red Meat in a Moderate to High Protein Diet

High Protein (HP) group (40% of energy from protein)
(n=37)

Normal Protein (NP) group (21% of energy from protein)
(n=34)

State of Slim Diet & Excercise

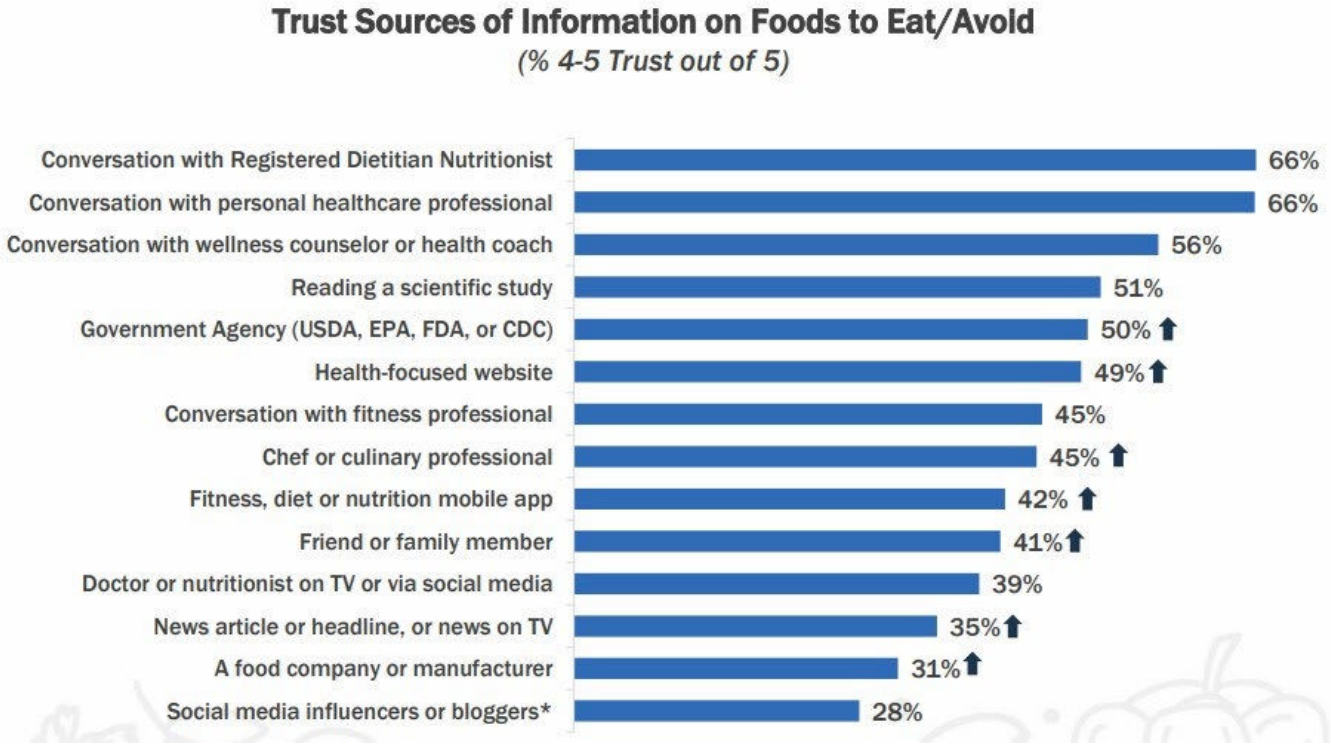


Higher protein diets can be flexible in managing type 2 diabetes, with protein intake at both 40% and 21% of calories – and with and without lean beef – to help people achieve goals based on their protein preferences.

Source: Clina JG, Sayer RD, Pan Z, Cohen CW, McDermott MT, Catenacci VA, Wyatt HR, Hill JO. High- and normal-protein diets improve body composition and glucose control in adults with type 2 diabetes: a randomized trial. Obesity 2023;31(8):2021-30.

1. Anchor the plate with high-quality protein-rich foods
2. Maximize nutrient density and satisfaction by complementing plant and animal food sources
3. Pair protein rich meals with strength training for optimal body composition and muscle preservation
4. Nourish physical and emotional well-being by finding enjoyment and mindfulness in food experiences.

You Are a Trusted Source of Food Information
Make Recommendations That Matter!



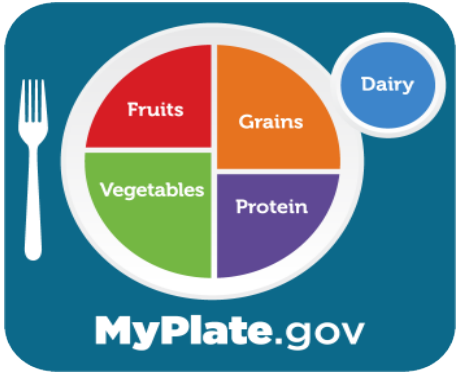
Source: International Food Information Council. 2023 Food & Health Survey. 23 May 2023. [https://foodinsight.org/2023-food-health-survey/]

Resources

Beef Nutrition Education Hub

BEEF.
IT'S WHAT'S FOR DINNER®

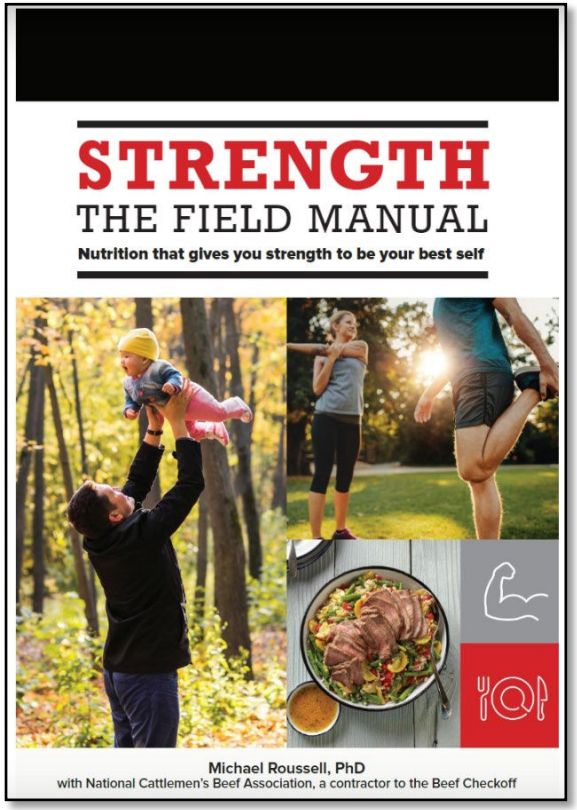
www.beefitswhatsfordinner.com



MyPlate

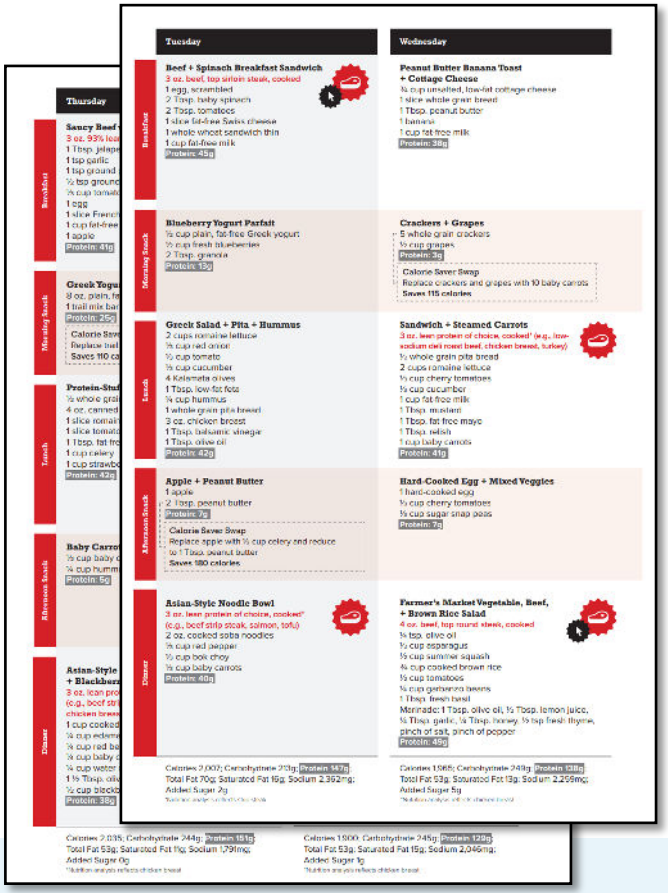
Dietary Guidelines for Americans

Beef. It's What's For Dinner. Resources



Strength

7-Day Healthy Meal Plan



Know Your Beef Choices

GRAIN-FINISHED

(most beef is raised this way and likely doesn't have a specific label claim)

THIS BEEF COMES FROM CATTLE THAT...

- Spend the majority of their lives eating grass or forage
- Spend 4-6 months at a feedyard eating a balanced diet of grains, local feed ingredients, like potato hulls or sugar beets, and hay or forage
- May or may not be given U.S. Food and Drug Administration (FDA)-approved antibiotics to treat, prevent or control disease and/or growth-promoting hormones

GRASS-FINISHED OR GRASS-FED

THIS BEEF COMES FROM CATTLE THAT...

- Spend their whole lives eating grass or forage
- May also eat grass, forage, hay or silage at a feedyard
- May or may not be given FDA-approved antibiotics to treat, prevent or control disease and/or growth-promoting hormones

CERTIFIED ORGANIC

THIS BEEF COMES FROM CATTLE THAT...

- Never receive any antibiotics or growth-promoting hormones
- May be either grain-or grass-finished, as long as the USDA's Agriculture Marketing Service (AMS) certifies the feed is 100% organically grown
- May spend time at a feedyard

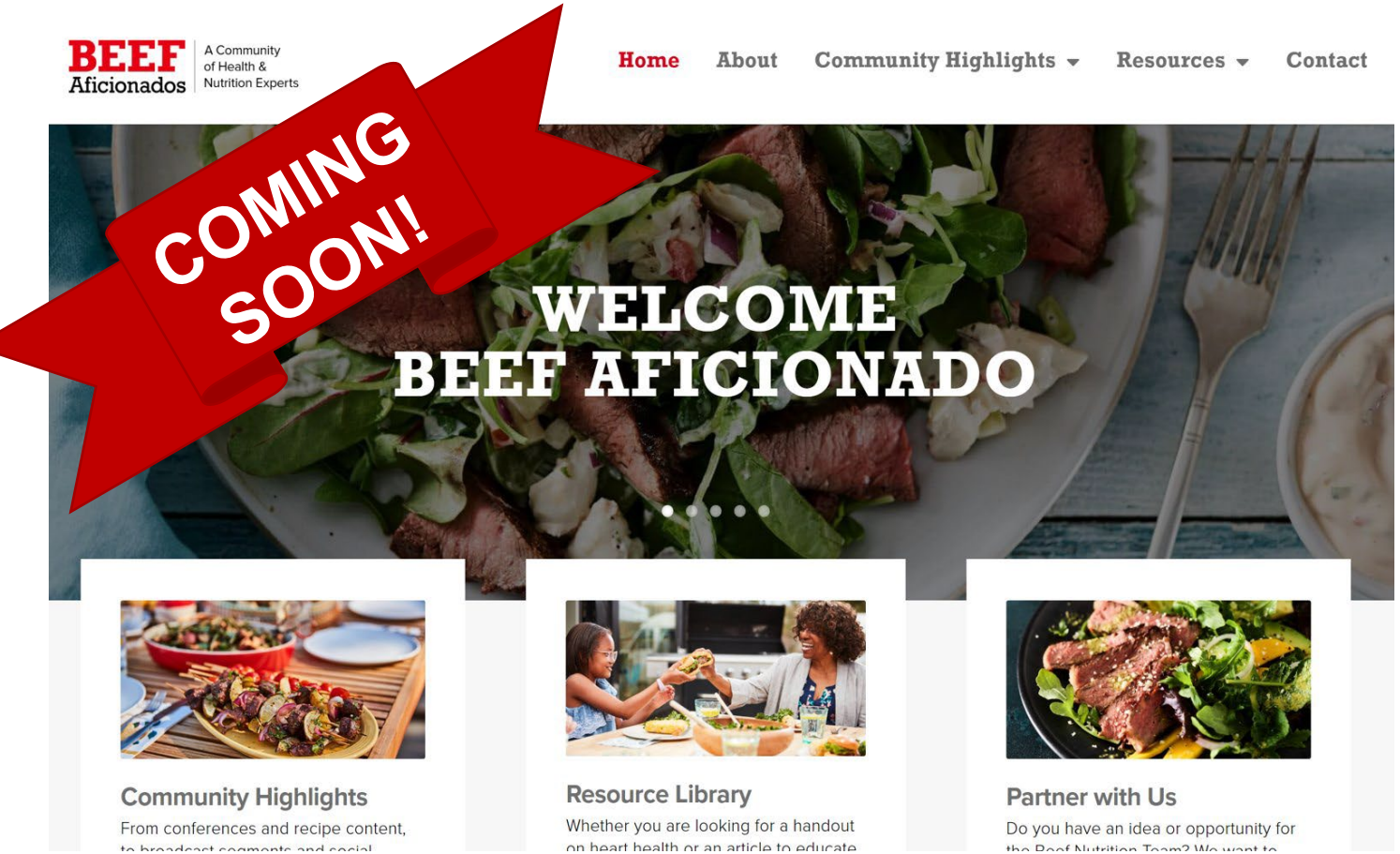
NATURALLY RAISED

(may be referred to as "never-ever")

THIS BEEF COMES FROM CATTLE THAT...

- Never receive any antibiotics or growth-promoting hormones
- May be either grain- or grass-finished
- May spend time at a feedyard

Source: U.S. Department of Agriculture 'Choices of Beef Definitions,' October, 2016 and USDA 2012 Ag Census Cattle Industry Highlights, February, 2015



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Nourishing for Strength and Resilience: What Healthcare Professionals Need to Know about Sustainable Nutrition

Shalene McNeill, PhD, RDN, LD

EXPLORE HEALTHCARE SUMMIT

Funded by Beef Farmers and Ranchers

OKLAHOMA BEEF COUNCIL