

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

Shalene McNeill, PhD, RDN, LD

**E**  **XPLORE**  
HEALTHCARE SUMMIT

  
Funded by Beef Farmers and Ranchers

OKLAHOMA  
**BEEF**  
COUNCIL

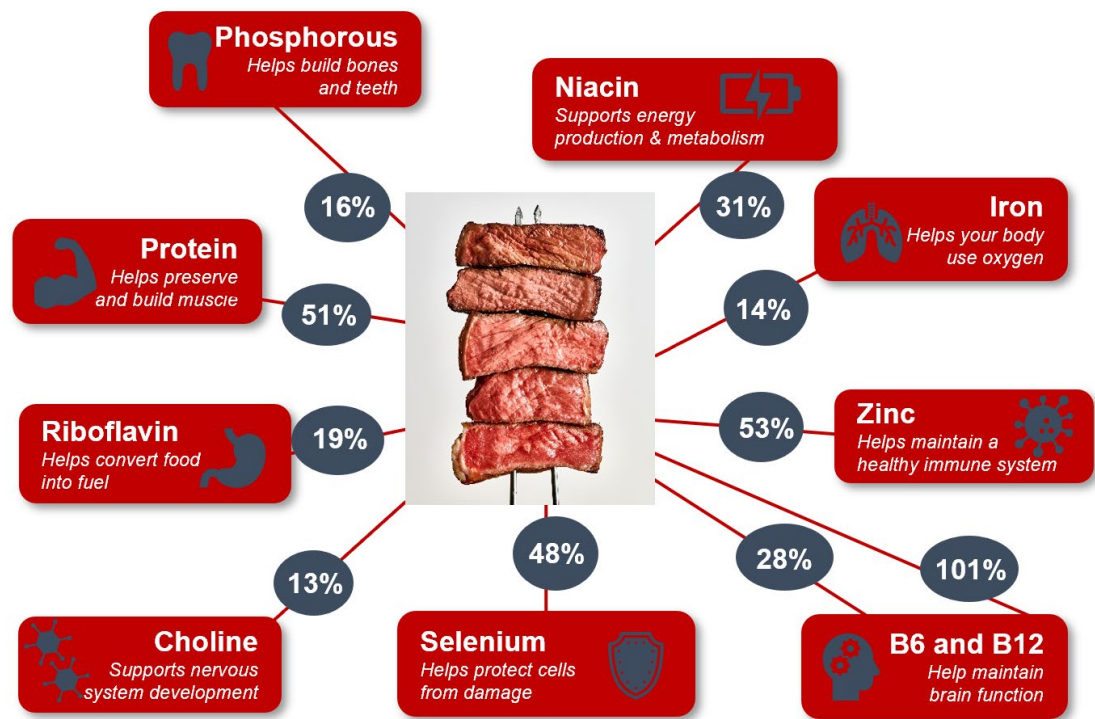
# Disclosures



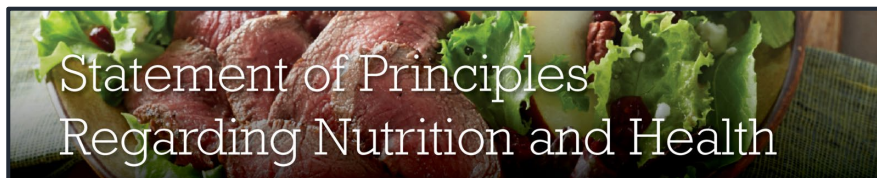
Employee of the  
National Cattlemen's  
Beef Association, a  
contractor to the Beef  
Checkoff



# Disclosure: Beef is my preferred nutrient-dense protein.



# Beef Nutrition Statement of Principles



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.



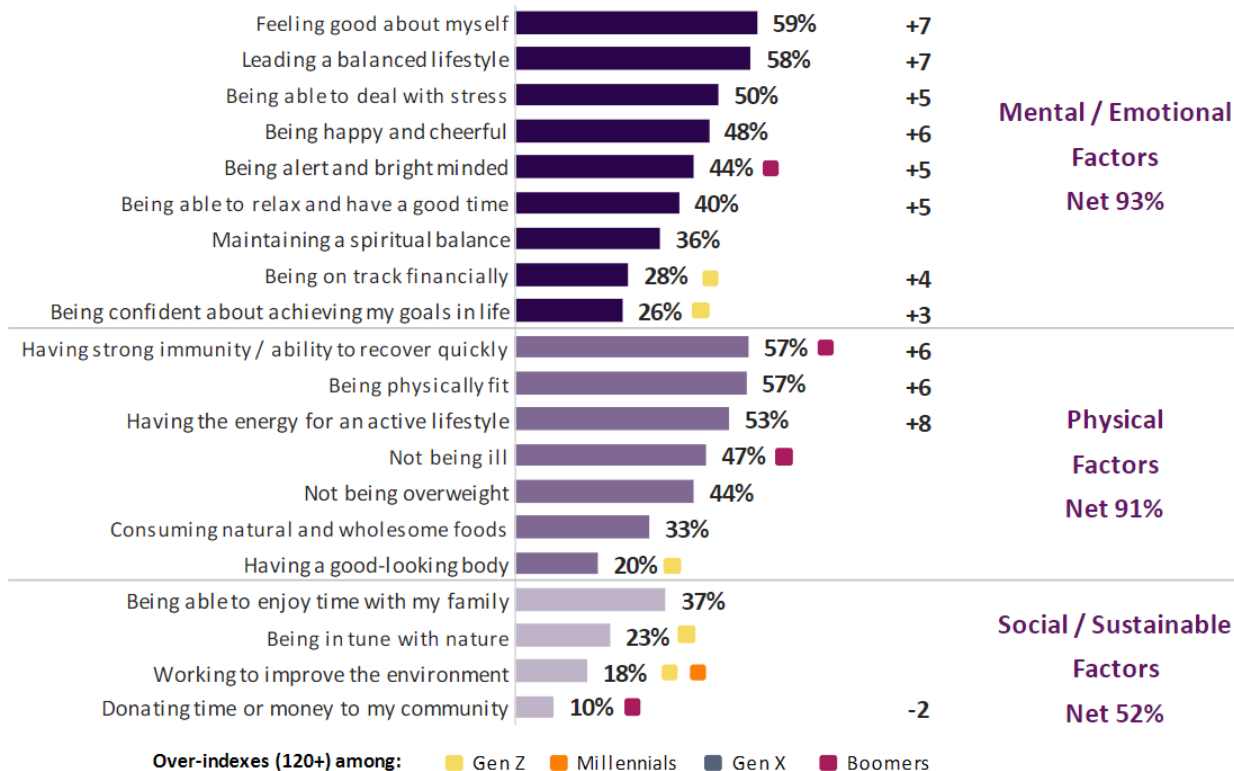


# Interest in our health and wellbeing at an all time high

## Health & Wellness Dimensions

Among Total, Trended to 2021

Change vs. 2021<sup>^</sup>



## FOOD IS MEDICINE NETWORKS OR CENTERS OF EXCELLENCE

Research	Education and Training
Interventional, behavioral, and implementation studies on the efficacy and health care economics of Food is Medicine services or activities to address food insecurity, disease-related malnutrition, and chronic conditions	Expansion of clinical nutrition training for health professionals, medical school curricula, and nutrition fellowships; inclusion of culinary medicine and teaching kitchen programs
Patient Services	Community Outreach and Engagement
Expand food insecurity and nutrition status assessments and, where needed, provide Food is Medicine services. Examples include: <ul style="list-style-type: none"> <li>Medically tailored meals or groceries</li> <li>Nutritious food referrals</li> <li>Produce prescriptions</li> </ul>	Partner, engage, and communicate with communities to improve health and reduce diet-related diseases

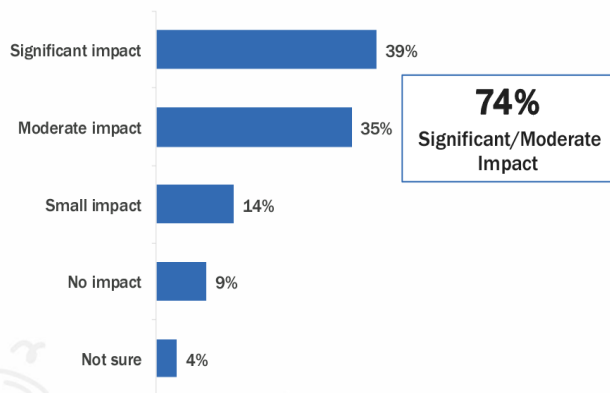


# Food Mood Connections

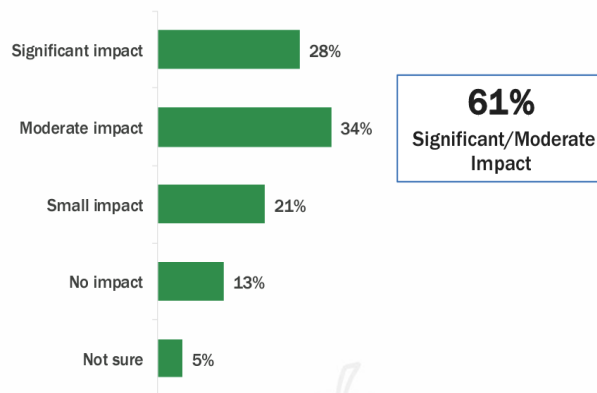
## Three in four say food consumption impacts their mental or emotional well-being

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

Impact of Food/Beverages Consumed on  
Mental/Emotional Well-being



Impact of Mental/Emotional Well-being on  
Food/Beverage Consumption



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)

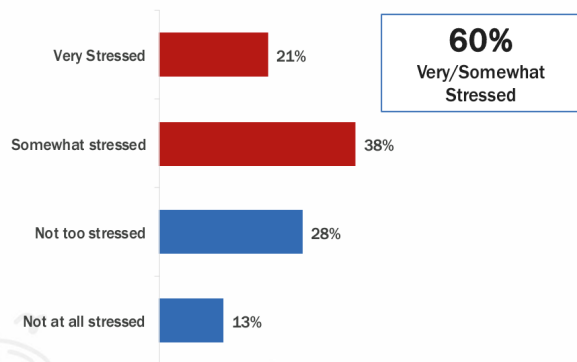


# Stress Derails Healthy Eating

## 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.

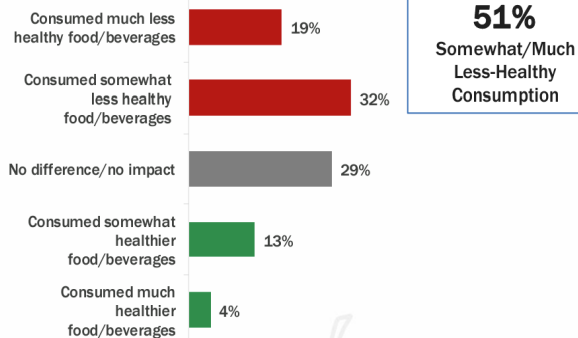
### Self-Reported Stress



No significant change vs. 2022

### Impact of Stress on Healthfulness of Food/Beverage Consumption

(If At Least Somewhat Stressed)



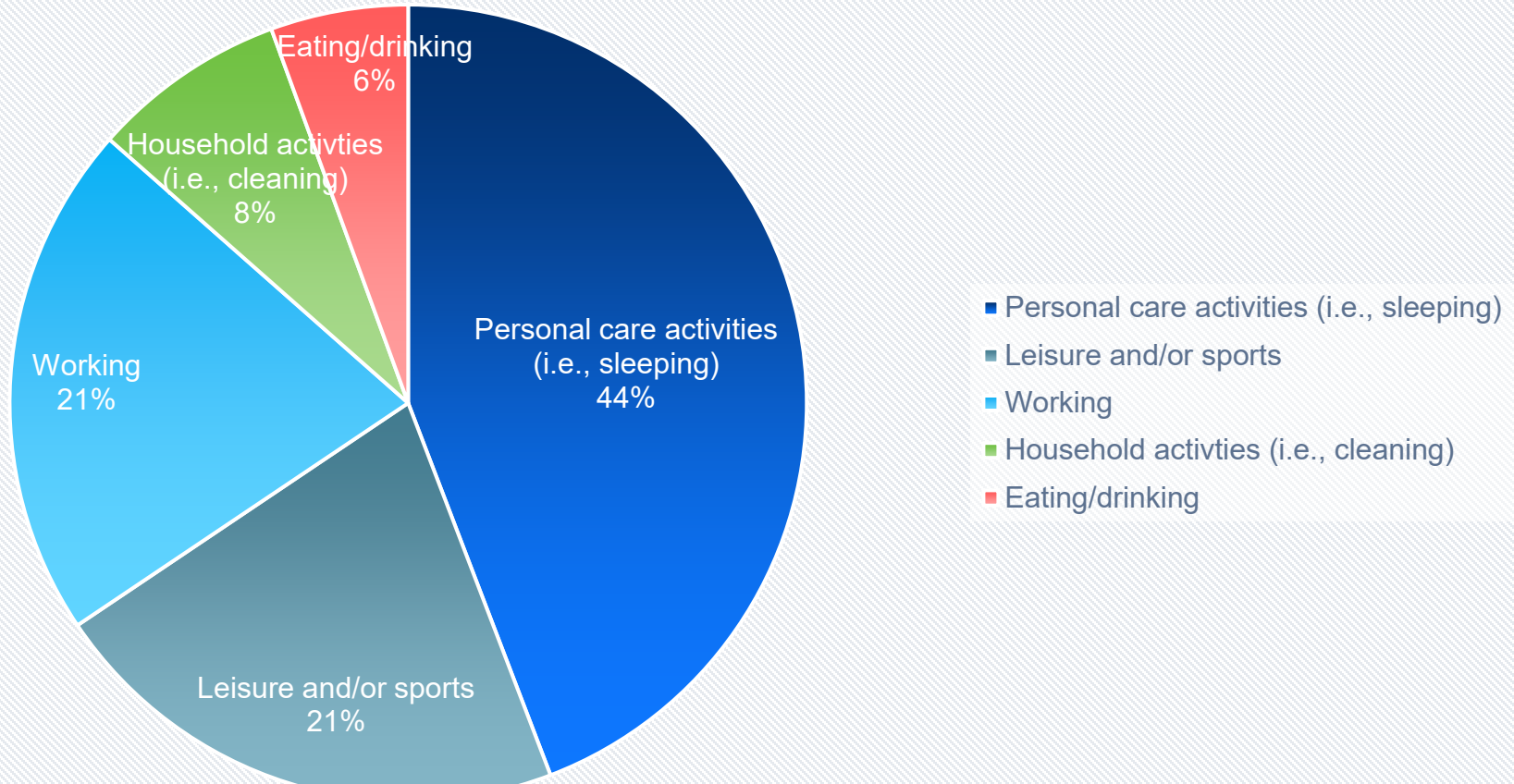
[TREND] Q13 Howstressed have you been? (n=1,022)/ Q14 What impact did your stress level over the past six months have on the healthfulness of the foods/beverages you consumed?  
Filter: Very/Somewhat stressed over the past six months (n=603) Note: "Not sure" is not shown; Response text abridged on each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



Adobe Stock | #569502134

# Time Spent Fueling Ourselves is Limited

## American's Top 5 Daily Activities



# Our Cooking IQ is a Little Low... But Confidence is Growing!



**56%**

of Americans **mess up**  
“easy to make” dishes

And **59% feel embarrassed**  
about not being able to cook  
certain foods the right way

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

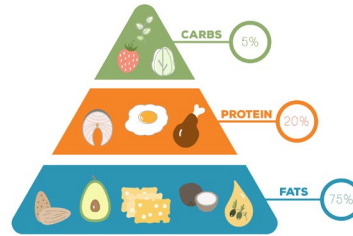
**26%**   
LEARNING MORE



# So much advice and so many “solutions”



## KETO DIET FOOD PYRAMID





# We Aren't Even Sure What Healthy Looks Like



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



**Nutrients**



**Foods**



**Dietary  
Patterns**



**Food  
Systems**











WHAT'S  
THE  
RIGHT  
DIET  
FOR YOU?

**There are  
no magic  
bullets in  
nutrition.**



**“There are no  
miracles in  
agricultural  
production”**

**– Norman Borlaug**

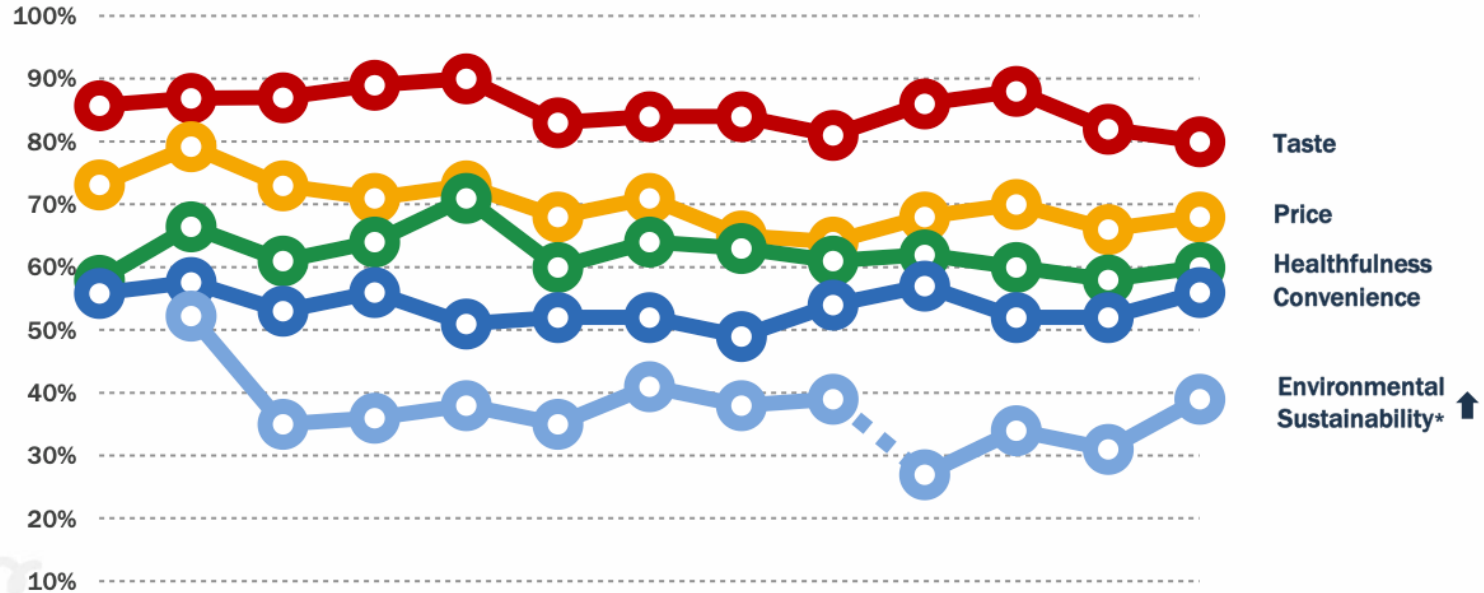




**Food  
nourishes  
our  
hearts,  
minds and  
souls.**

# Why do we eat what we eat?

## Purchase Drivers Over Time (% 4-5 Impact out of 5)



[TREND]Q6 How much of an impact do the following have on your decision to buy foods and beverages? SUMMARY: TOP 2 (Great Impact/Somewhat of an Impact); (n=1,005)

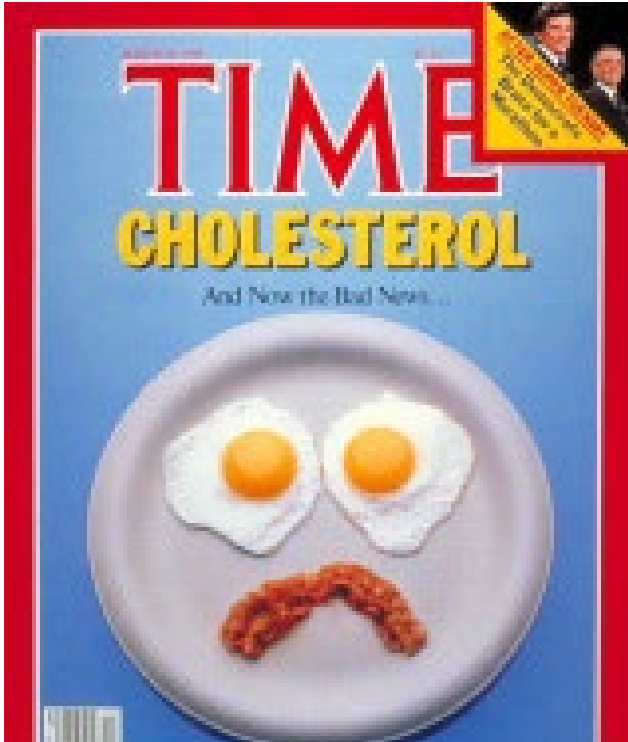
\*Prior to 2019, Environmental Sustainability was addressed as "Sustainability"

2022

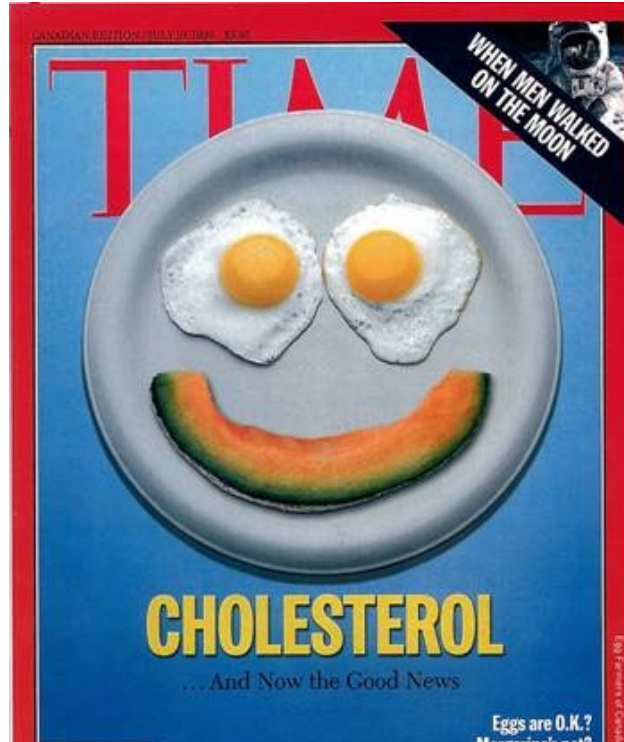




# Nutrition Science is Evolutionary, not Revolutionary



1984

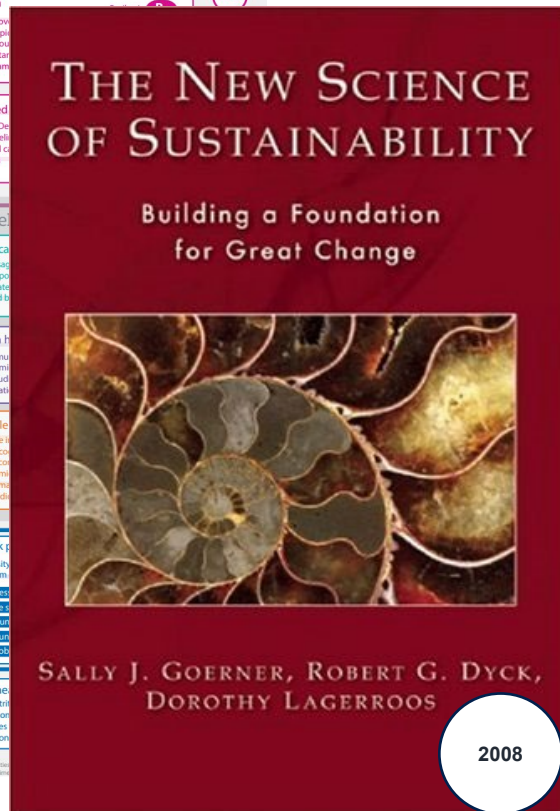
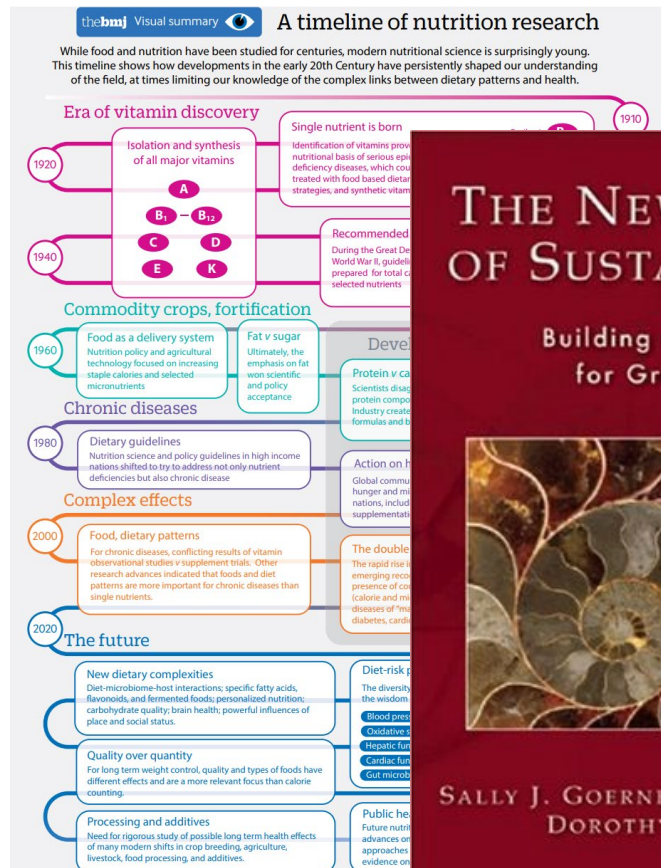


1999



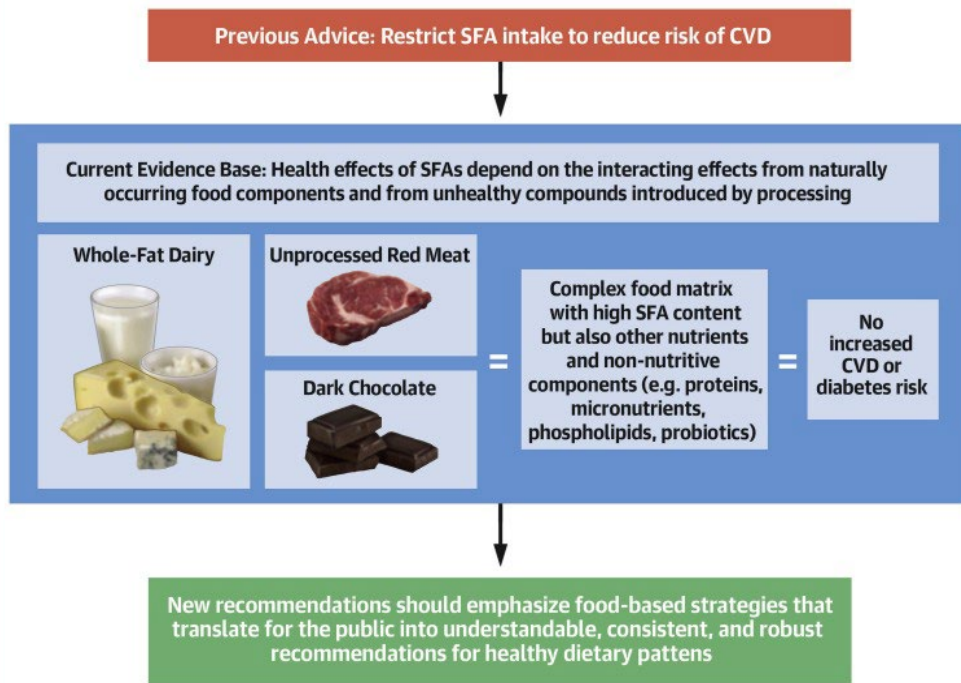
2014

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



# New Science on Saturated Fat

## CENTRAL ILLUSTRATION: Shifting From Saturated Fatty Acid-Based to Food-Based Dietary Guidelines for Cardiovascular Health



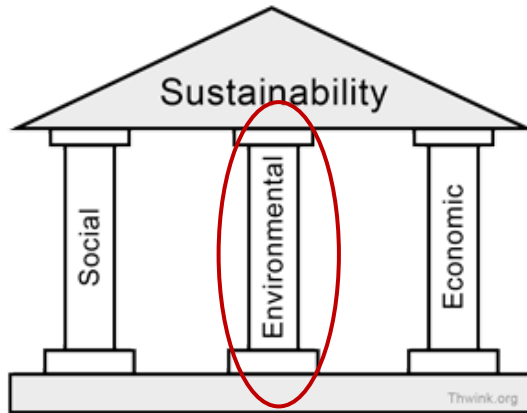
Astrup, A. et al. J Am Coll Cardiol. 2020;76(7):844-57.

“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.”

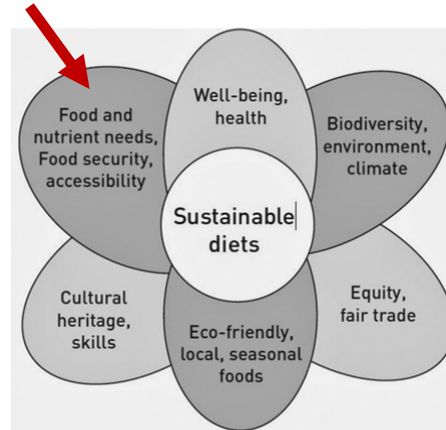
# Diets for Planetary Health: Frameworks help us make sense of it all, but they are increasingly complex



## Sustainability

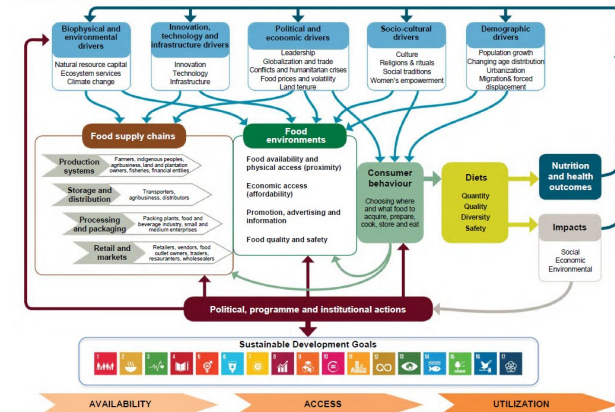


## Sustainable Diets



## Sustainable Food Systems

Figure 1 Conceptual framework of food systems for diets and nutrition



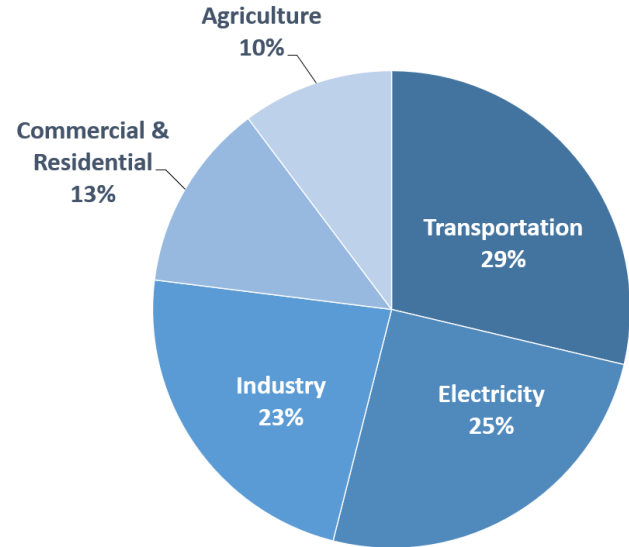


## Beware of Mental Shortcuts

*For every complex problem, there is a solution that is simple, neat, and wrong.*  
H.L. Menken



Total U.S. Greenhouse Gas Emissions  
by Economic Sector in 2019

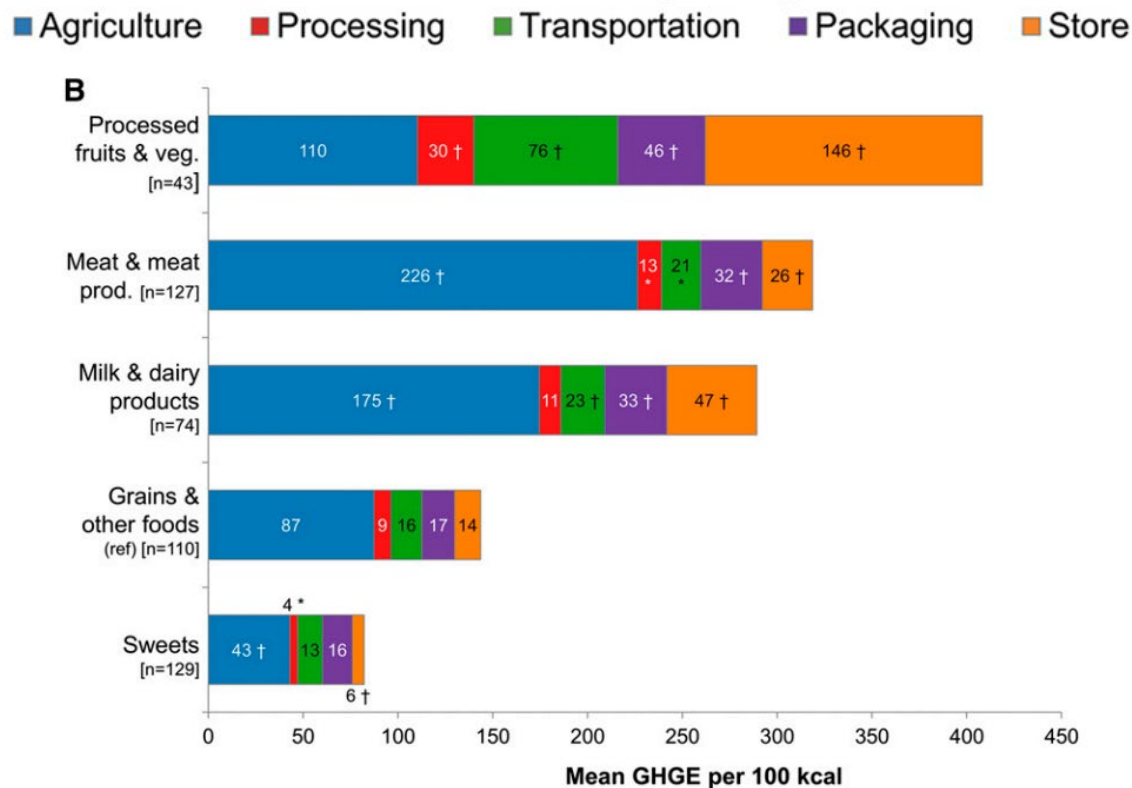


U.S. Environmental Protection Agency (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019



# 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”



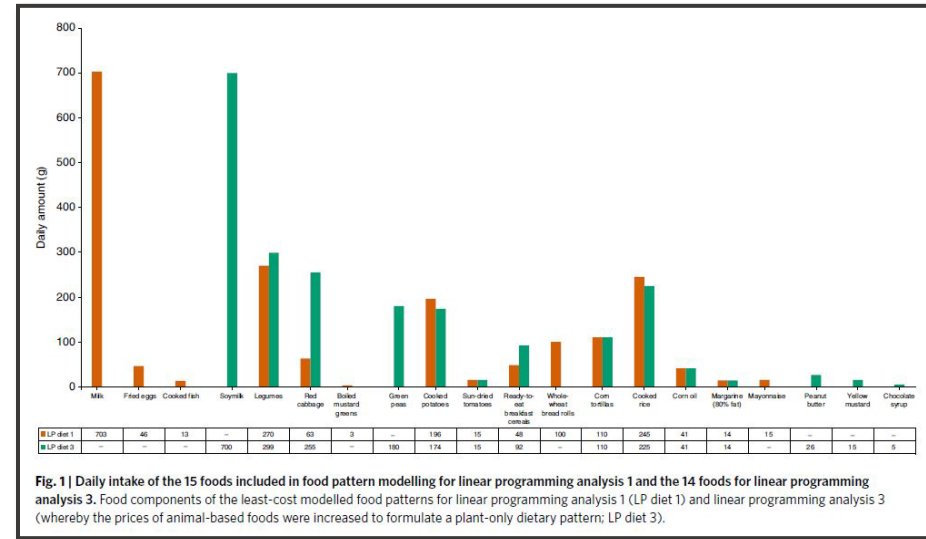
A person wearing a black long-sleeved shirt is holding a red plastic shopping basket with both hands. The basket contains some groceries, including a green bag. The person is standing in a grocery store aisle, with shelves of various products visible in the background. The lighting is warm and slightly blurred, creating a bokeh effect. A large blue circle is overlaid on the right side of the image, containing white text.

**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).”*



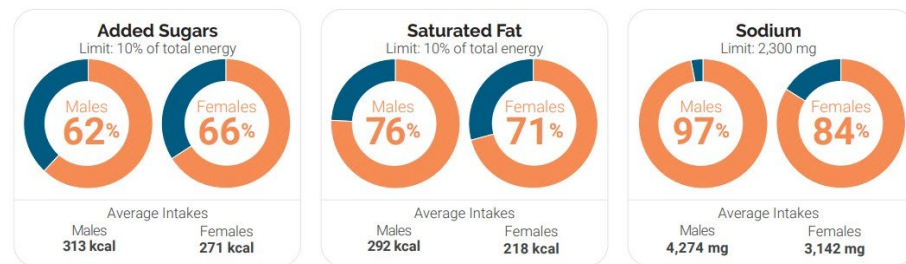


# What does sustainability mean to you?



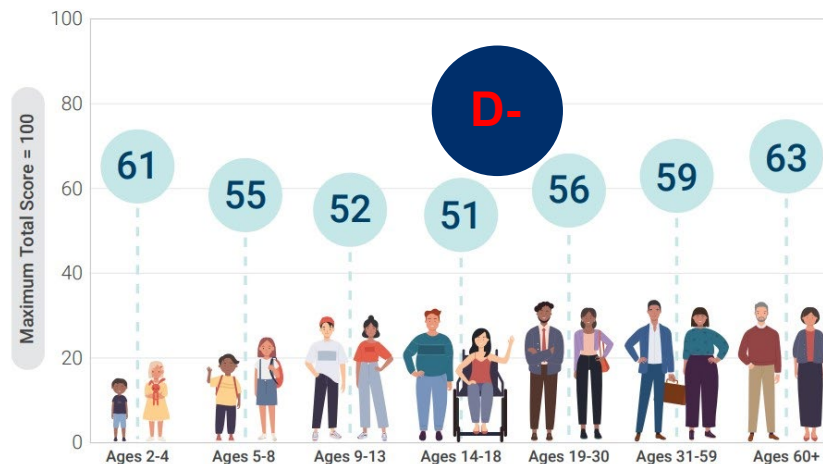
# Overall...There is Room for Improvement in Dietary Patterns

Percent Exceeding Limits of Added Sugars, Saturated Fat, and Sodium



**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.

Adherence of the U.S. Population to the *Dietary Guidelines* Across Life Stages, as Measured by Average Total Healthy Eating Index-2015 Scores



**NOTE:** HEI-2015 total scores are out of 100 possible points. A score of 100 indicates that recommendations on average were met or exceeded. A higher total score indicates a higher quality diet.

**Data Source:** Analysis of What We Eat in America, NHANES 2015-2016, ages 2 and older, day 1 dietary intake data, weighted.

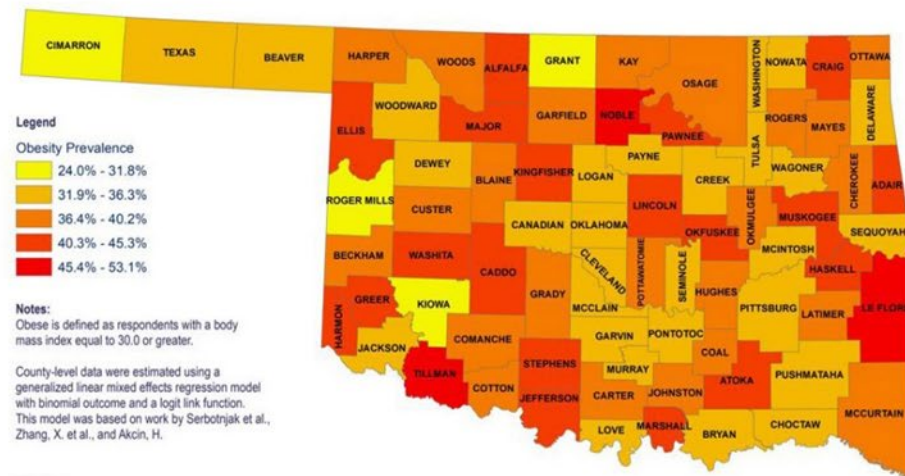


Dietary Guidelines for Americans, 2020-2025



# 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



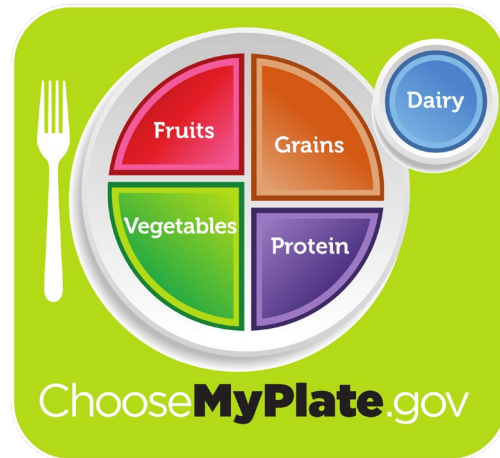
APPROXIMATELY  
**1 MILLION**  
OKLAHOMA ADULTS  
WERE OBESE IN 2019



That's about 1 out of every 3 adults.



# Dietary Intakes Compared to Recommendations



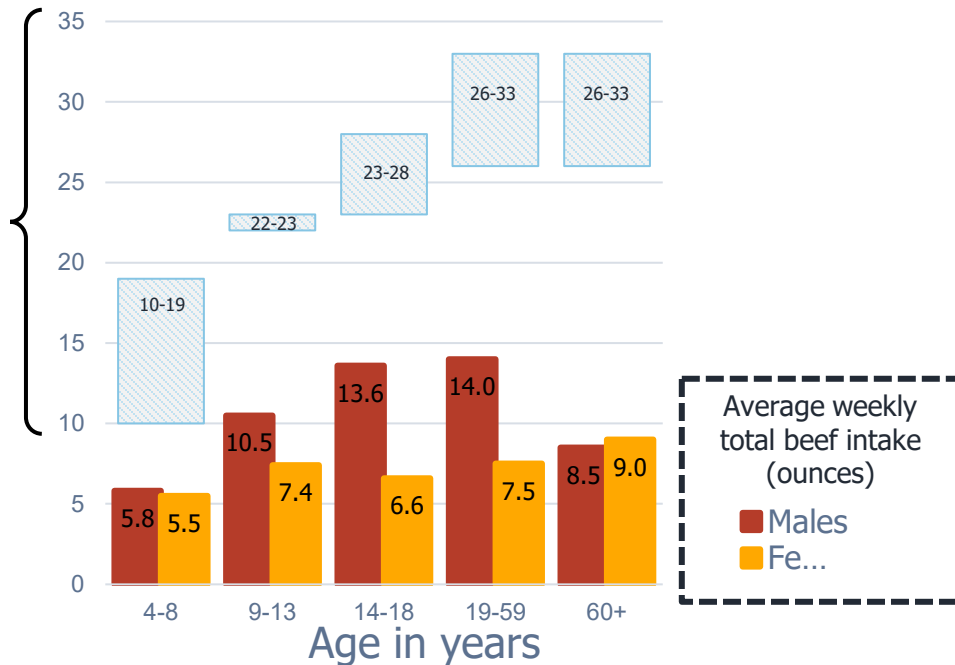
**NOTE:** Recommended daily intake of whole grains is to be at least half of total grain consumption, and the limit for refined grains is to be no more than half of total grain consumption.

**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)

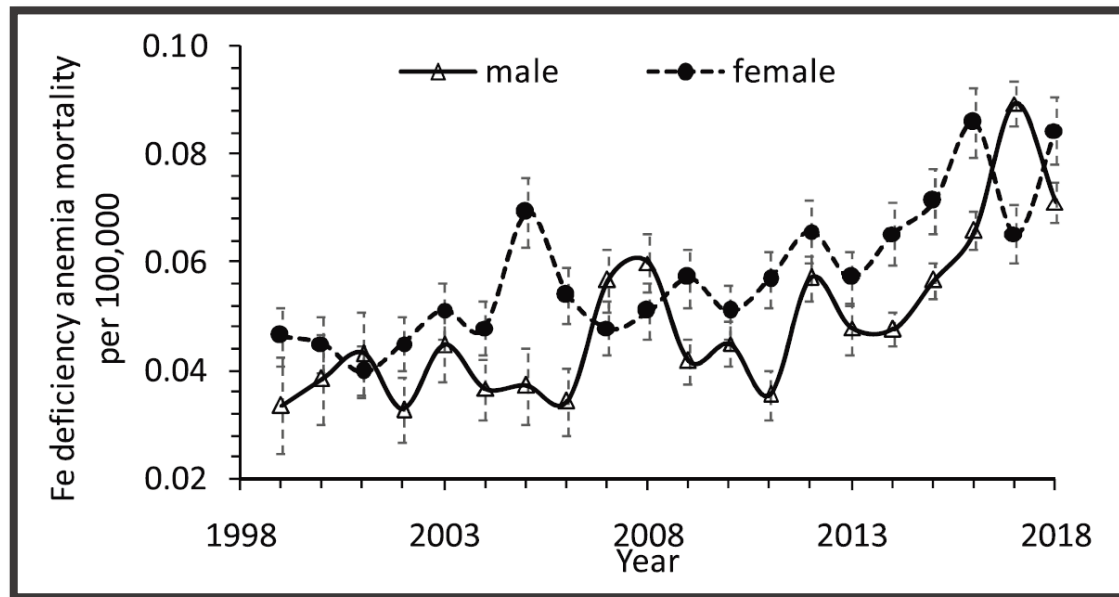


Note: DGA = Dietary Guidelines for Americans

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



# 9 in 10 **WOMEN** IN SEVERAL COUNTRIES IN SOUTH ASIA AND SUB-SAHARAN AFRICA **HAVE AT LEAST ONE MICRONUTRIENT DEFICIENCY**



## Women with at least one micronutrient deficiency

**1 in 2** WOMEN IN UK



**1 in 3** WOMEN IN US

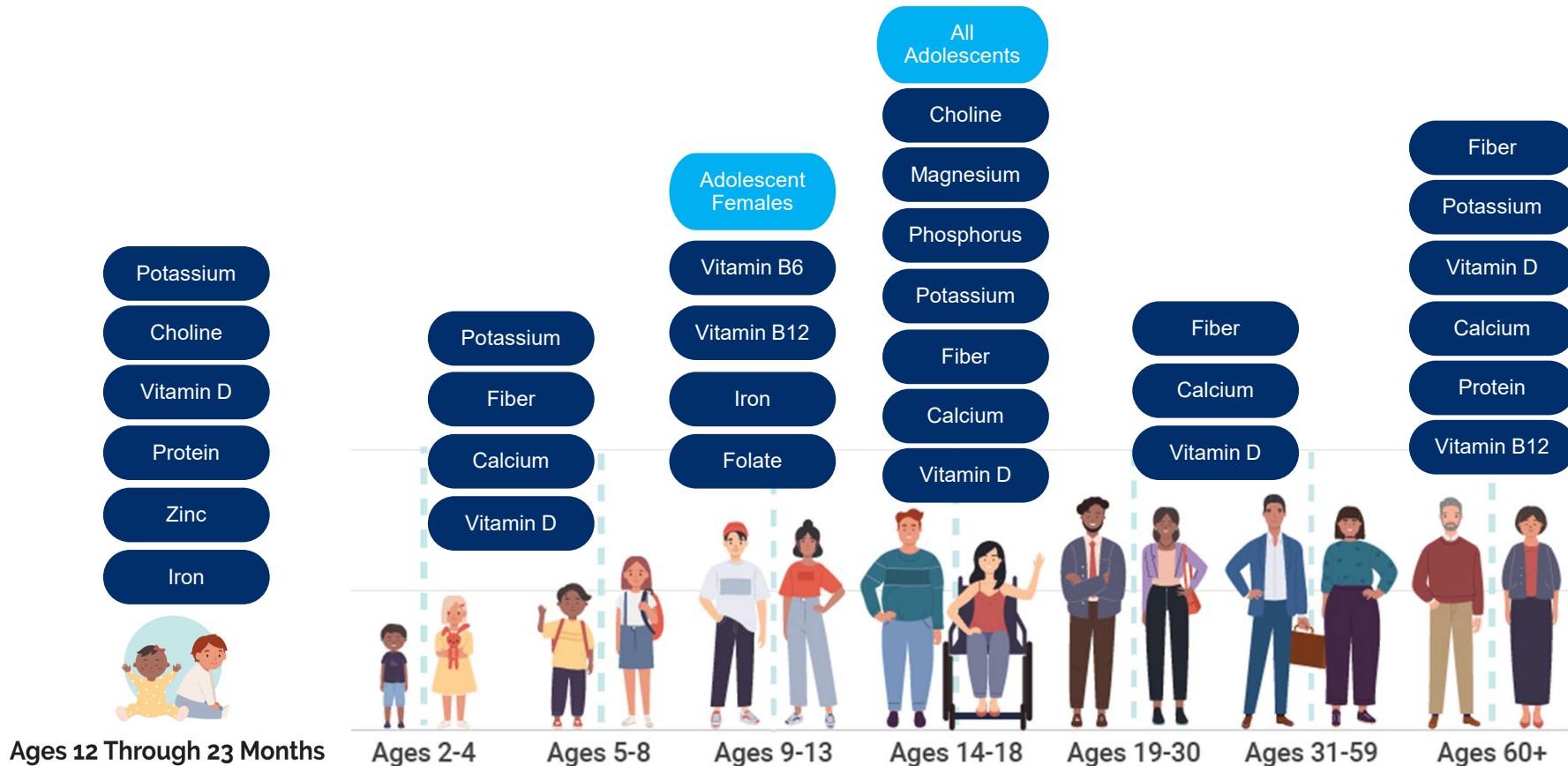


## Iron deficiency

**1 in 5** WOMEN IN UK & US

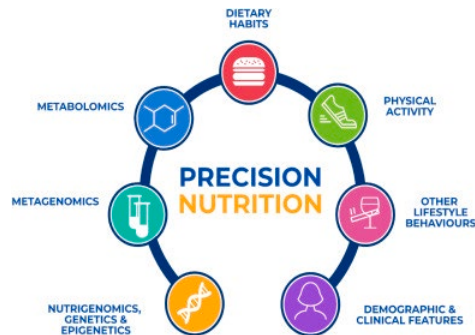
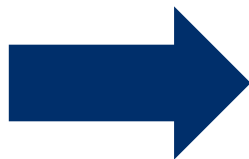
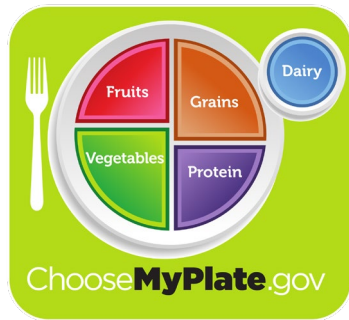


# Nutrients of Public Health Concern Across the Life Stages





# Moving from Population to Personalization



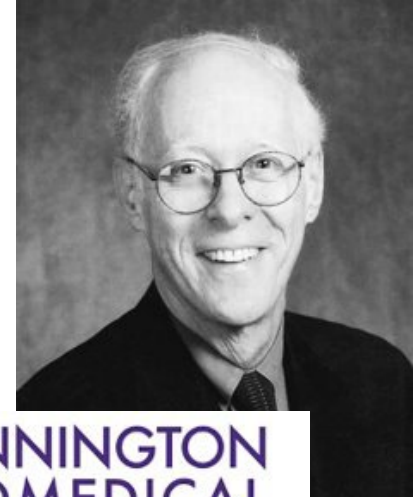
# No One Size Fits All Diet

“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

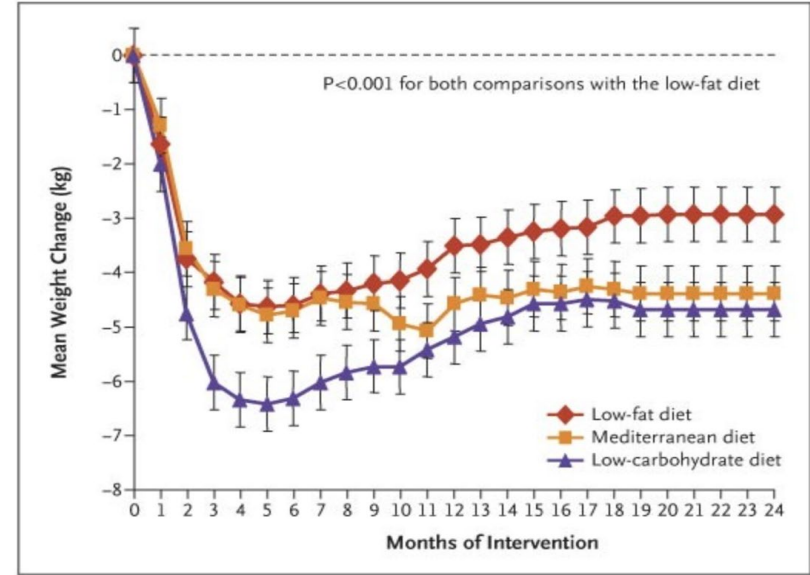
**all diets work when adhered to**

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



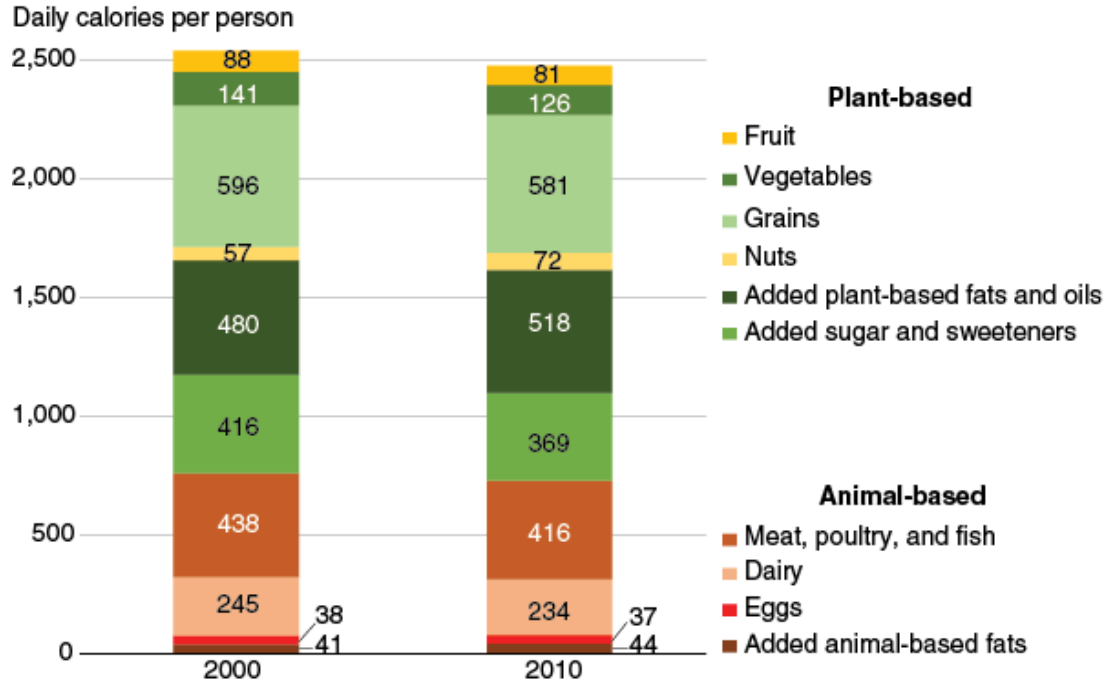
# Behavioral Modifications Lead to Weight Loss, Regardless of Diet



- 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.



# Plant-Based: Broad Advice Can Have Unintended Consequences



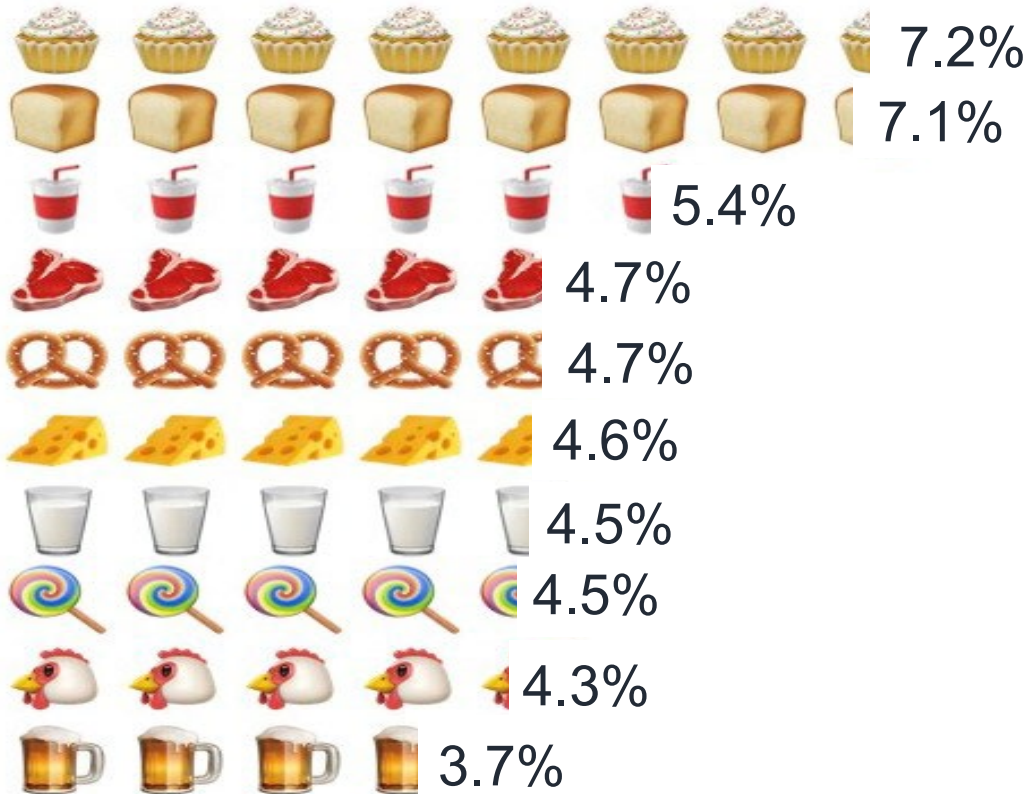
Added fats and oils are added to food during processing or preparation and do not include naturally occurring fats, such as in meat, dairy products, nuts, and avocados. Added animal-based fats include butter, lard, and edible beef tallow.

Source: USDA, Economic Research Service Loss-Adjusted Food Availability data.

**The  
American  
diet is  
already  
plant-  
based.**

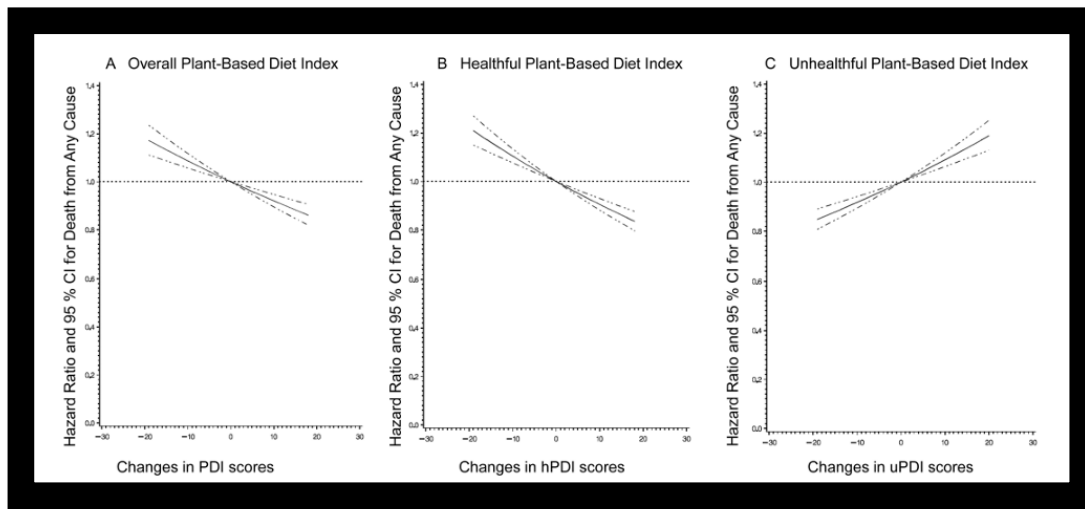


# Top Ten Sources of Calories





# Dietary Quality Matters

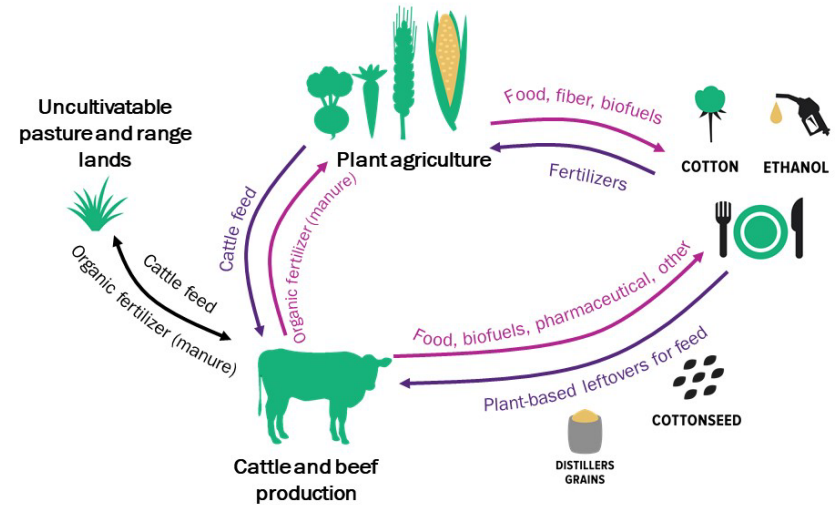


“In conclusion, we found that improving plant-based diet quality over a 12-year period was associated with a lower risk of total and CVD mortality, whereas increased consumption of an unhealthful plant-based diet was associated with a higher risk of total and CVD mortality. Our results support shifts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

# 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



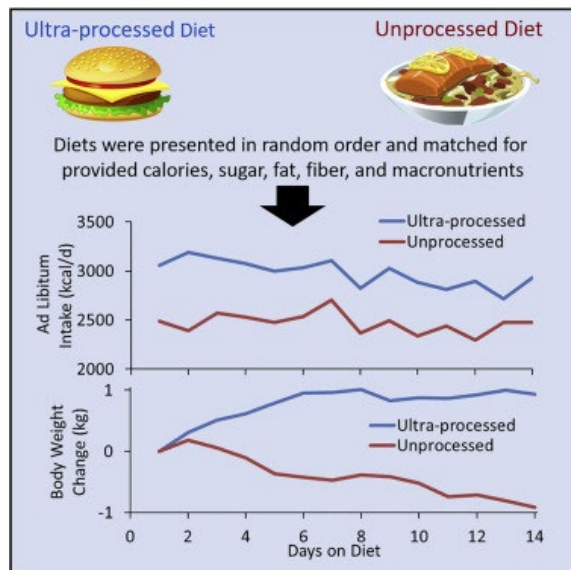
# Processed Foods

## 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

## Mentioned by

451	news outlets
1	book reviewer
41	blogs
3	policy sources
3262	tweeters
69	Facebook pages
6	Wikipedia pages
7	Redditors
39	video uploaders

## Citations

734	Dimensions
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## Readers on

1766	Mendeley
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# Dietary Guidelines Meet NOVA

Hess et al., 2023

## Average HEI Scores for All Americans (2+ yo)

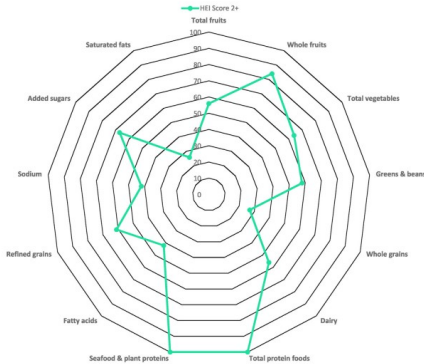


FIGURE 5. Radar plot depicting the average Healthy Eating Index-2015 score for all Americans ages 2+, WWEIA, NHANES 2017-2018

## Perfect HEI Score

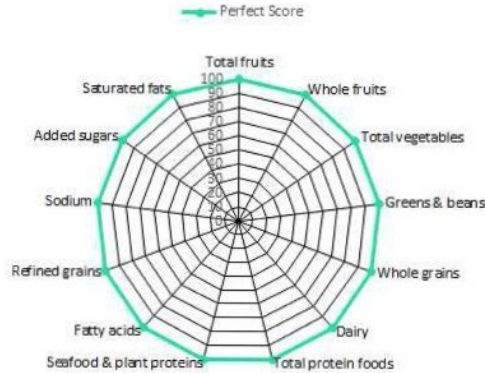


FIGURE 3. Radar plot depicting a perfect score (100 points) of diet quality according to the Healthy Eating Index-2015 score

## Ultra-Processed DGA Menu HEI Score

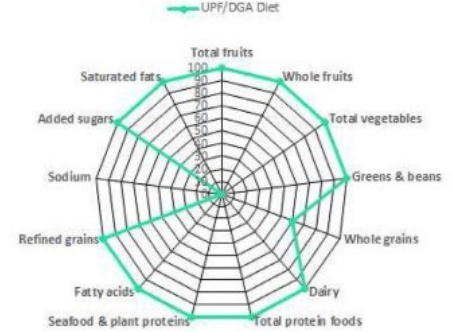


FIGURE 4. Radar plot depicting diet quality score of ultra-processed foods (UPF) Dietary Guidelines for Americans (DGA) menu according to the Healthy Eating Index-2015 score

- 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

## Is everything we eat associated with cancer? A systematic cookbook review<sup>1-3</sup>

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

<sup>1</sup>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).

<sup>2</sup>There was no funding for this study.

<sup>3</sup>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](mailto: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.

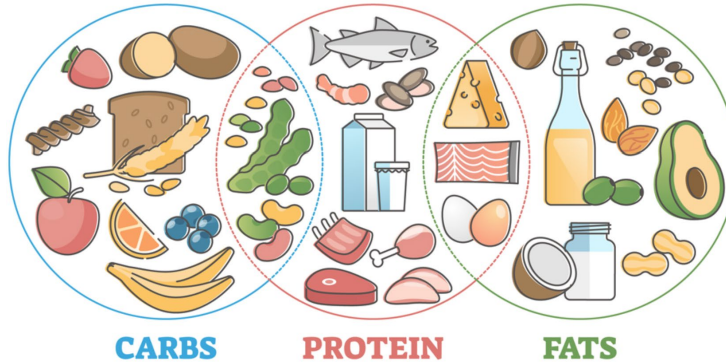
Overgeneralized advice or 'all or nothing' approaches are not effective tools for public health behavior change.





# Nourishing for Strength & Resilience: The Power of Protein

## MACRONUTRIENTS



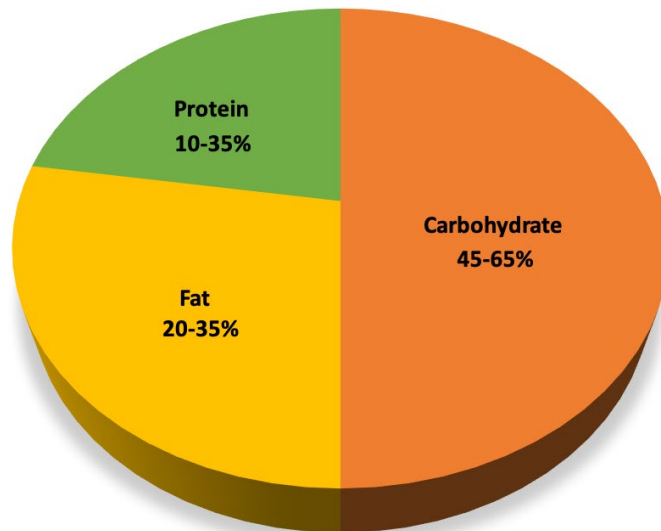
# Acceptable Macronutrient Distribution Range (AMDR)

- 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

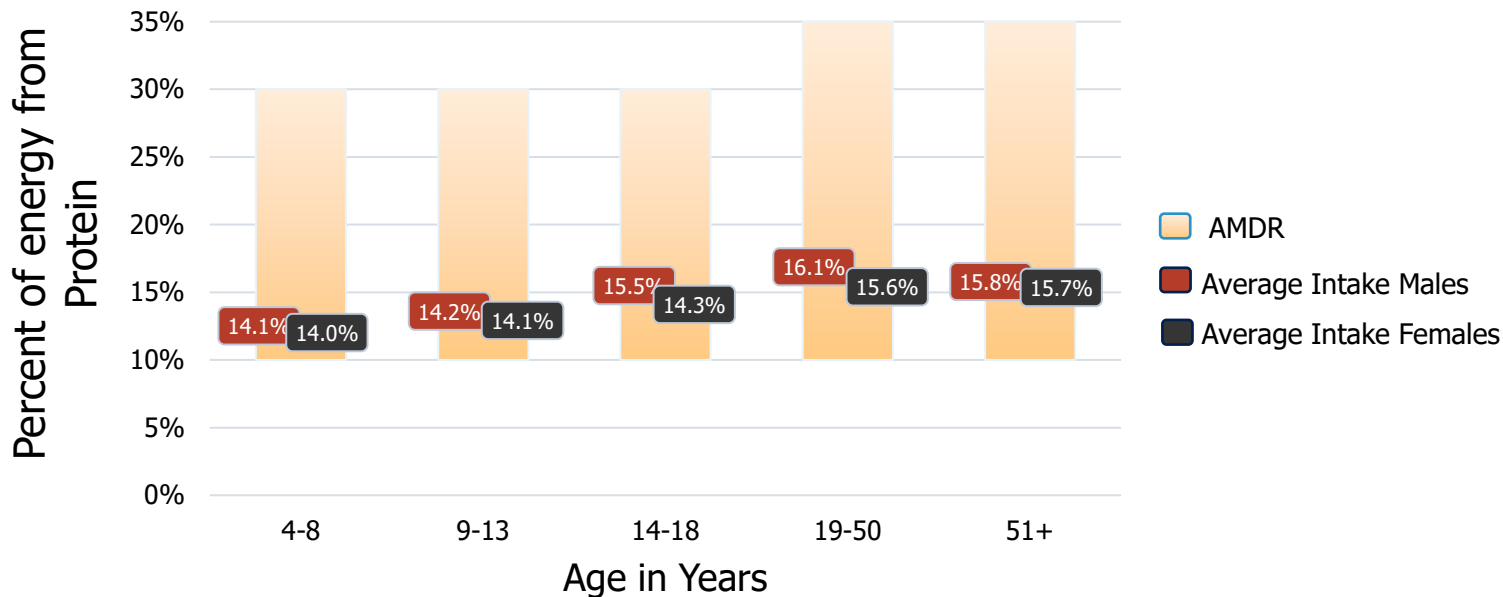


INSTITUTE OF MEDICINE  
OF THE NATIONAL ACADEMIES

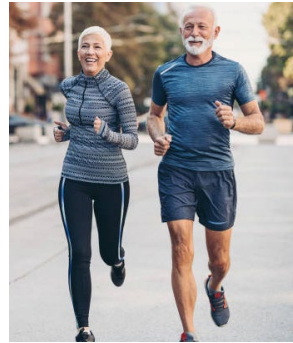


# Americans Consume Protein At The Low End of the Recommended Range

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



# 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)

# Muscle is the Organ of Longevity

## Review Article

### The underappreciated role of muscle in health and disease<sup>1-3</sup>

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 replenish 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

<sup>1</sup> From the University of Texas Medical Branch, Department of Surgery and Shriners Burns Hospital, Metabolism Unit, Galveston, TX.

<sup>2</sup> Supported by NIH grants R01 AR49038, P30 AG024832, and SHC grant 8490 and the UTMB Claude Pepper Older Americans Independence Center grant P30 AG024832.

<sup>3</sup> 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



# 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<sup>2</sup> increase in mid-arm muscle area”



Martha Belury PhD, RD  
The Ohio State University

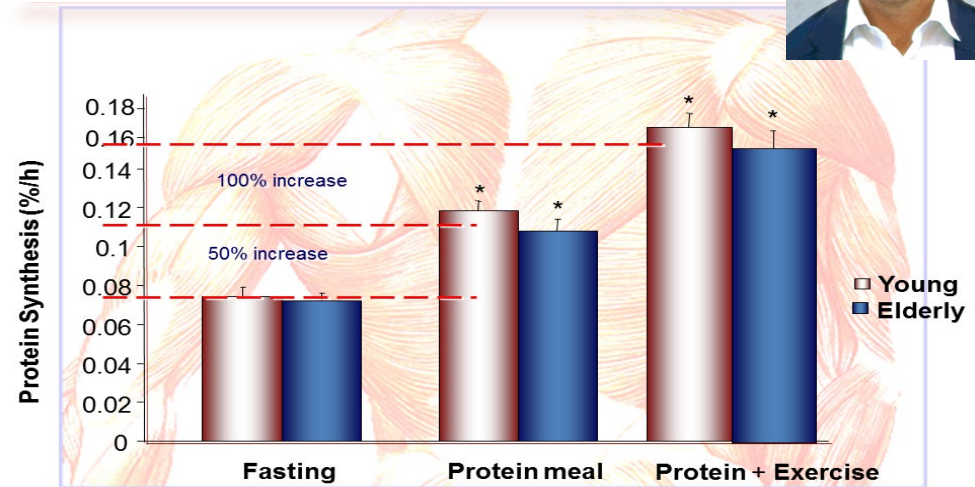


# Aging Muscle Responds To Dietary Protein And Exercise

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



- 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

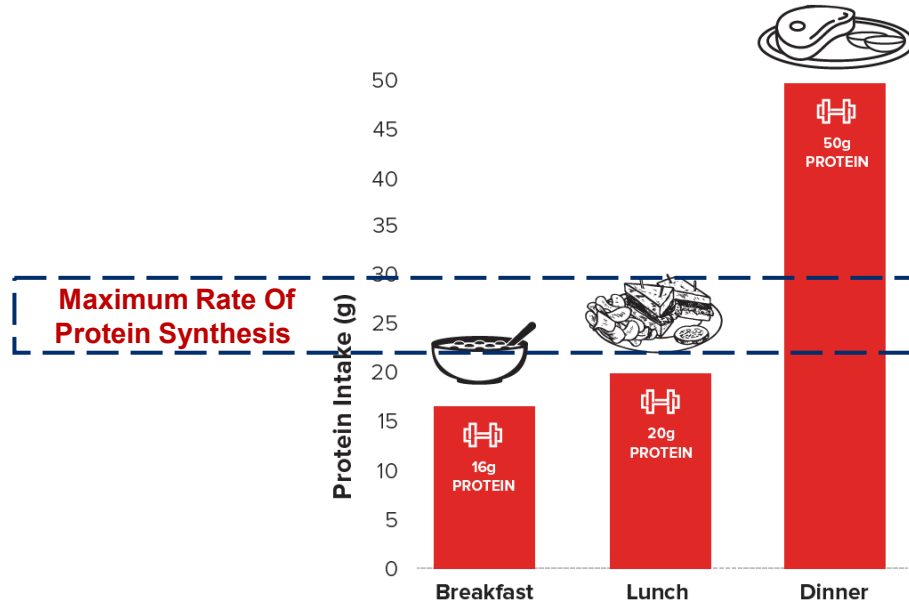


Graphic courtesy of Doug Paddon-Jones, University of Texas Medical Branch

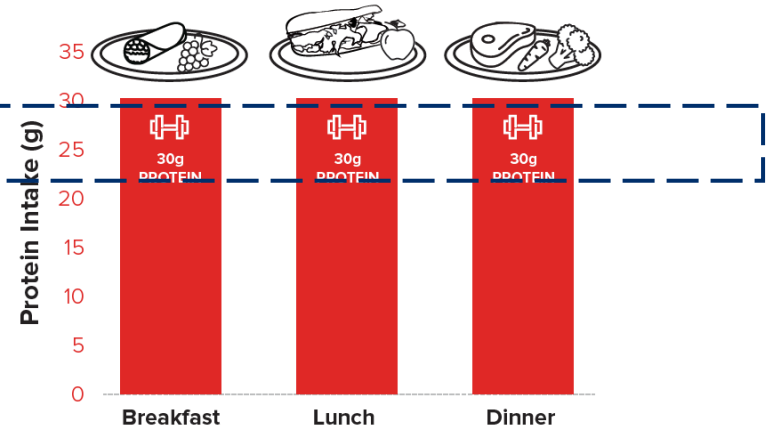


# Even Protein Consumption Throughout the Day

## Typical Daily Protein Intake Pattern








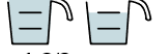


## Evenly Distributed Daily Protein Intake Pattern





# Protein Density

## Calorie for Calorie, Animal Proteins Offer More Protein

WHAT DOES 25 GRAMS OF PROTEIN LOOK LIKE?			
	 AMOUNT	 CALORIES	 PROTEIN
Quinoa	 3 cups	666	25g
Peanut Butter	 6.5 tbsp	613	25g
Black Beans	 1 2/3 cups	379	25g
Edamame	 1 1/3 cups	249	25g
Beef	 3 ounces	173	25g

- 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.



# 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

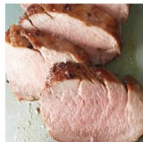
- The vegan-calorie matched pattern resulted in **20g less protein** and a lower total protein contribution to diet, which may negatively impact muscle health.
- The vegan protein matched pattern resulted in **+ 300 calories**, which may impact body weight and composition.

# 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

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



1/2 cup



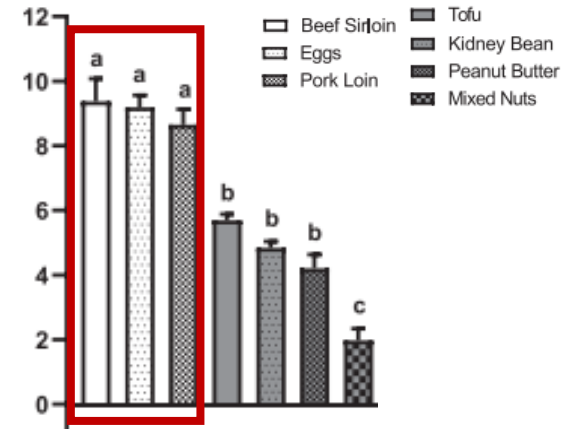
2 Tbsp



4 oz



1 oz



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



# 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	+ <i>p</i> -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 <sup>2</sup> )							
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



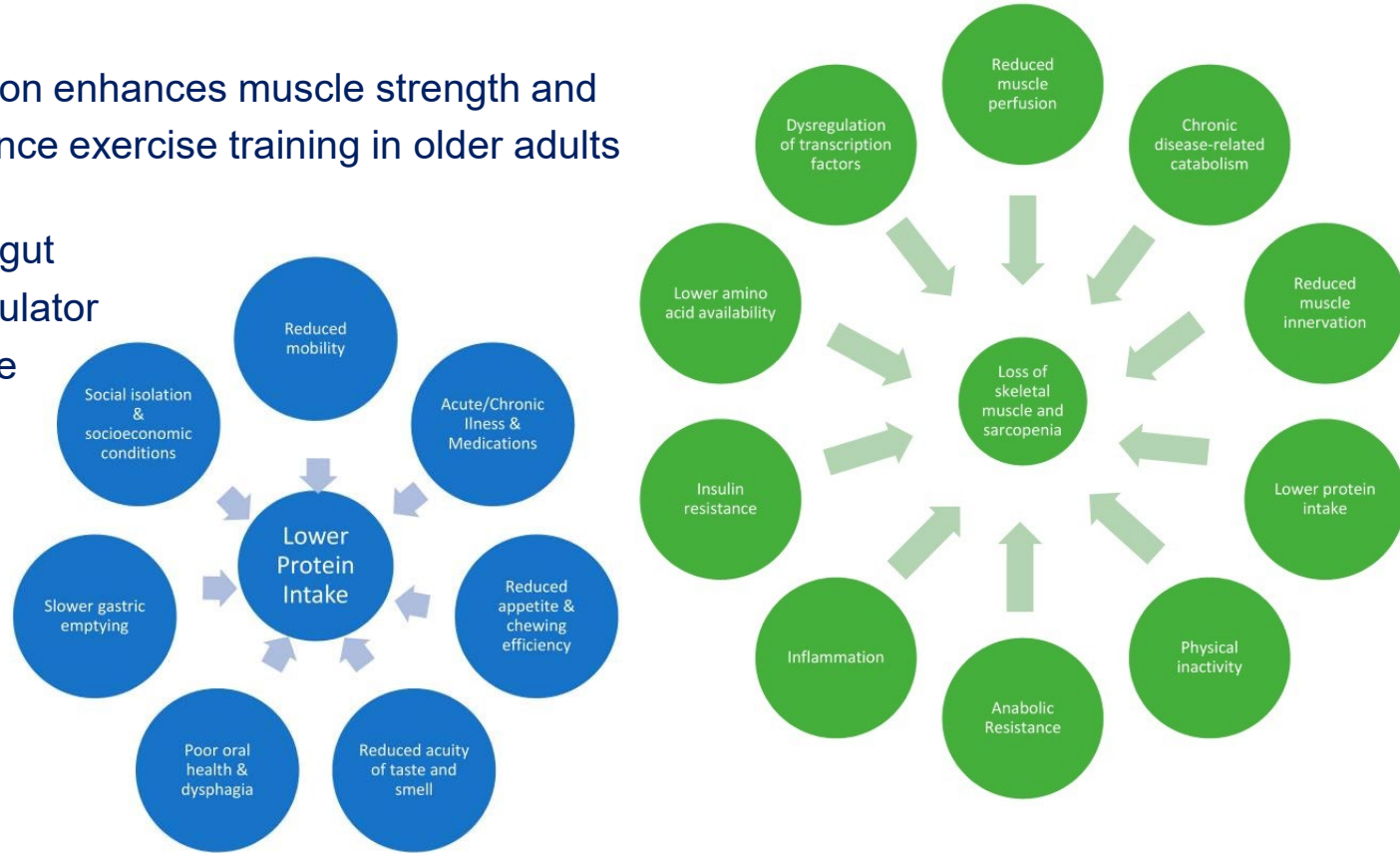
Cydne Perry, PhD  
Indiana University  
School of Public  
Health-Bloomington

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



# Protein Supplementation for Muscle Strength & Future Direction

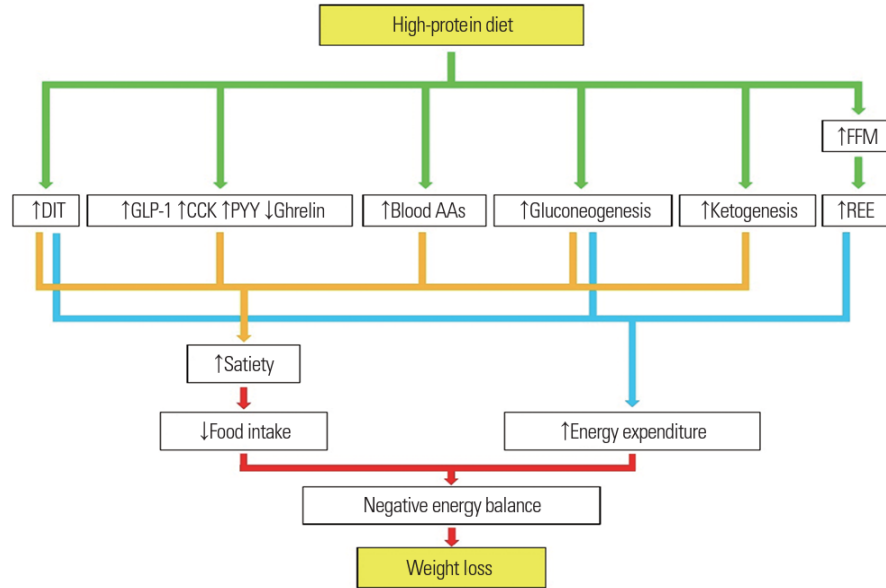
- Protein supplementation enhances muscle strength and size alongside resistance exercise training in older adults
- **Looking ahead:** The gut microbiome as a modulator for individual response to protein, and the impact on muscle strength as we age.





# 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.

# 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)

# FLEXIBILITY TO CHOOSE:

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

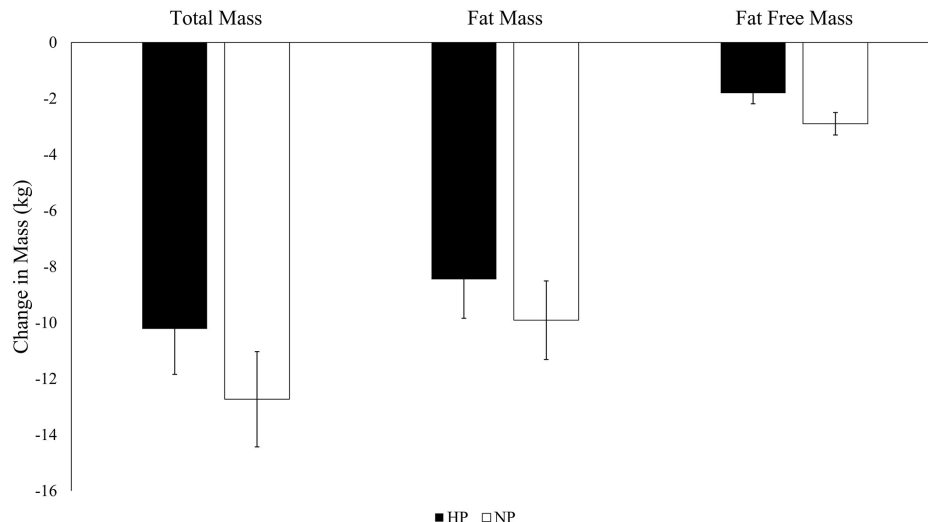
**High Protein (HP) group**  
(40% of energy from protein)  
(n=37)



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



**State of Slim Diet  
& Exercise**



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.





# **Food for Thought**

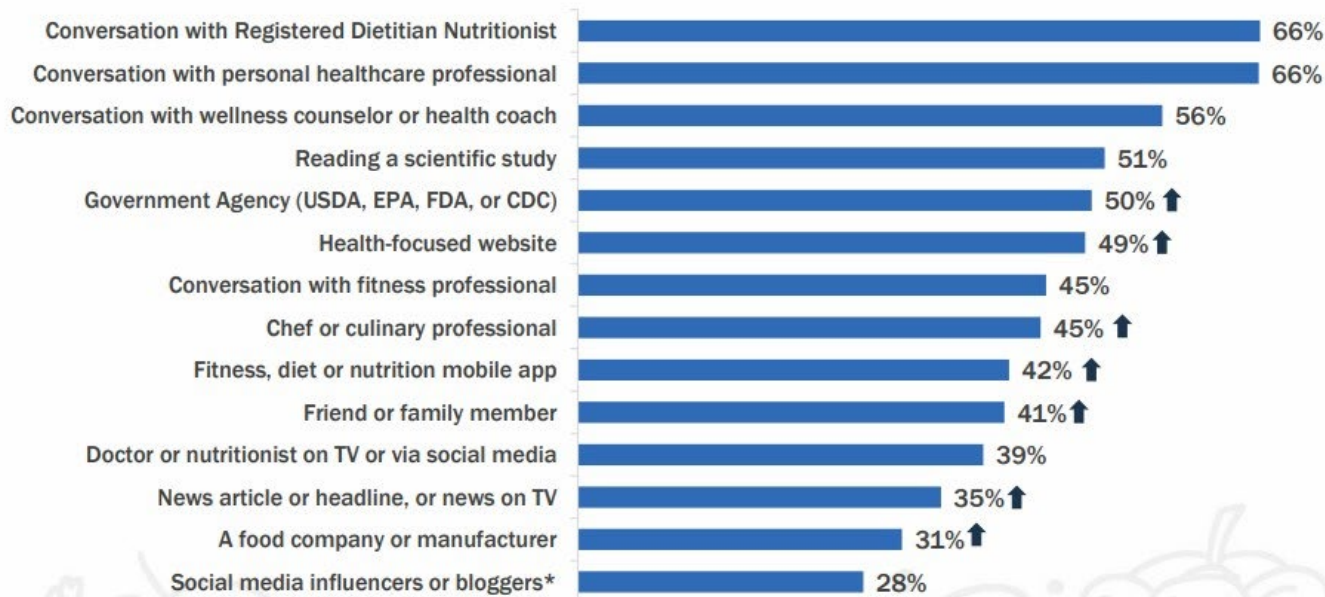
1. **Anchor the plate with high-quality protein-rich foods**
2. **Maximize nutrient density and satisfaction by complementing plant and animal food sources**
3. **Pair protein rich meals with strength training for optimal body composition and muscle preservation**
4. **Nourish physical and emotional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

# You Are a Trusted Source of Food Information

## Make Recommendations That Matter!

### Trust Sources of Information on Foods to Eat/Avoid

(% 4-5 Trust out of 5)

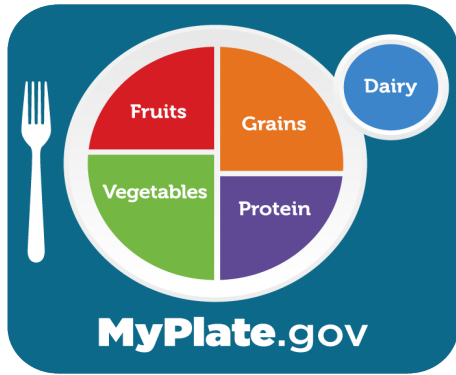




# Resources



Beef Nutrition Education Hub



MyPlate

**BEEF.**  
IT'S WHAT'S FOR DINNER®

[www.beefitswhatsfordinner.com](http://www.beefitswhatsfordinner.com)



Dietary Guidelines for Americans

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

## STRENGTH

### THE FIELD MANUAL

Nutrition that gives you strength to be your best self

Michael Roussell, PhD  
with National Cattlemen's Beef Association, a contractor to the Beef Checkoff

## Strength 7-Day Healthy Meal Plan

Tuesday		Wednesday		
Breakfast	<b>Beef + Spinach Breakfast Sandwich</b> 3 oz. beef, top sirloin steak, cooked 1 egg, scrambled 2 Tbsp. baby spinach 2 Tbsp. tomatoes 1 slice fat-free Swiss cheese 1 whole wheat sandwich thin 1 cup fat-free milk <b>Protein: 45g</b>	<b>Peanut Butter Banana Toast</b> + Cottage Cheese 1/2 cup unsalted, low-fat cottage cheese 1 slice whole grain bread 1 Tbsp. peanut butter 1 banana 1 cup fat-free milk <b>Protein: 38g</b>	<b>Crackers + Grapes</b> 5 whole grain crackers 1/2 cup grapes <b>Protein: 3g</b> <b>Calorie Saver Swap</b> Replace crackers and grapes with 10 baby carrots Saves 115 calories	
	<b>Blueberry Yogurt Parfait</b> 1/2 cup plain, fat-free Greek yogurt 1/2 cup fresh blueberries 2 Tbsp. granola <b>Protein: 13g</b>			
	<b>Greek Tzatziki</b> 8 oz. plain, 1% 1 trail mix bar <b>Protein: 25g</b>			
Lunch	<b>Calorie Saver</b> Replace trail mix Saves 110 cal	<b>Apple + Peanut Butter</b> 1 apple 2 Tbsp. peanut butter <b>Protein: 7g</b> <b>Calorie Saver Swap</b> Replace apple with 1/2 cup celery and reduce to 1 Tbsp. peanut butter Saves 180 calories	<b>Sandwich + Steamed Carrots</b> 3 oz. lean protein of choice, cooked* (e.g., low-sodium deli roast beef, chicken breast, turkey) 1/2 whole grain pita bread 2 cups romaine lettuce 1/2 cup cherry tomatoes 1/2 cup cucumber 1 cup fat-free milk 1 Tbsp. mustard 1 Tbsp. fat-free mayo 1 Tbsp. relish 1 cup baby carrots <b>Protein: 41g</b>	<b>Hard-Cooked Egg + Mixed Veggies</b> 1 hard-cooked egg 1/2 cup cherry tomatoes 1/2 cup sugar snap peas <b>Protein: 7g</b>
	<b>Baby Carrots</b> 1/2 cup baby c 1/2 cup humm <b>Protein: 5g</b>			
	<b>Asian-Style Noodle Bowl</b> 3 oz. lean protein of choice, cooked* (e.g., beef strip steak, salmon, tofu) 2 oz. cooked soba noodles 1/2 cup red pepper 1/2 cup bok choy 1/2 cup baby carrots <b>Protein: 40g</b>			
Dinner	<b>Asian-Style + Blackberry</b> 3 oz. lean protein of choice, cooked* (e.g., beef strip steak, chicken breast) 1 cup cooked 1/2 cup edamame 1/2 cup red be 1/2 cup baby c 1/2 cup water 1 1/2 Tbsp. olive 1/2 cup blackb <b>Protein: 38g</b>	<b>Farmer's Market Vegetable, Beef, + Brown Rice Salad</b> 4 oz. beef, top round steak, cooked 1/2 cup olive oil 1/2 cup asparagus 1/2 cup summer squash 1/2 cup cooked brown rice 1/2 cup tomatoes 1/2 cup garbanzo beans 1 Tbsp. fresh basil Marinade: 1 Tbsp. olive oil, 1/2 Tbsp. lemon juice, 1/2 Tbsp. garlic, 1/2 Tbsp. honey, 1/2 tsp fresh thyme, pinch of salt, pinch of pepper <b>Protein: 49g</b>	<b>Calories 2,035; Carbohydrate 244g; Protein 151g; Total Fat 53g; Saturated Fat 11g; Sodium 1,791mg; Added Sugar 0g</b> <small>*Nutrition analysis reflects chicken breast</small>	<b>Calories 1,900; Carbohydrate 245g; Protein 126g; Total Fat 53g; Saturated Fat 15g; Sodium 2,046mg; Added Sugar 1g</b> <small>*Nutrition analysis reflects chicken breast</small>



# 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



**COMING  
SOON!**

# WELCOME BEEF AFICIONADO



## Community Highlights

From conferences and recipe content, to broadcast comments and social...



## Resource Library

Whether you are looking for a handout on heart health or an article to educate...



## Partner with Us

Do you have an idea or opportunity for the Beef Nutrition Team? We want to...

**Sign Up for  
our newsletter  
to find out  
when Beef  
Aficionados  
launches!**





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

Shalene McNeill, PhD, RDN, LD

