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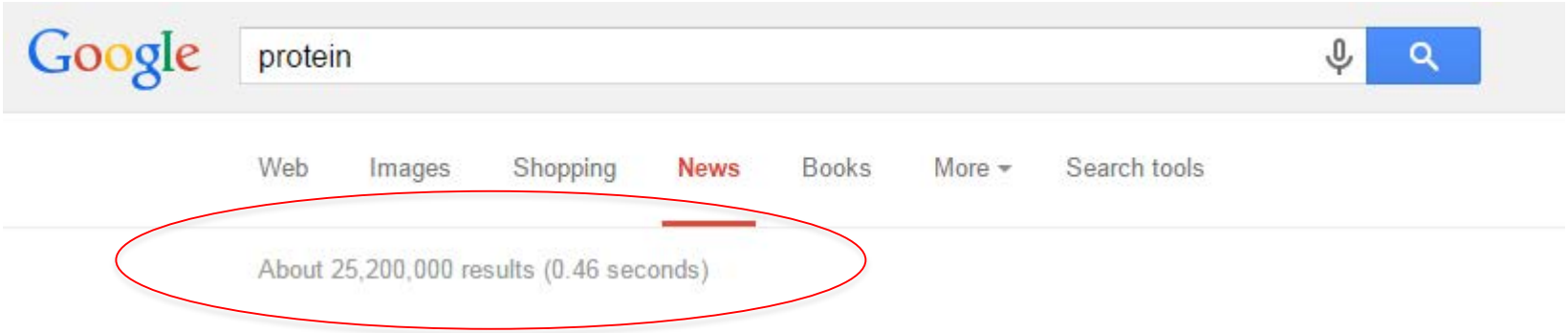
The Science of Protein

The Continued Exploration of the Impact of High-Quality Protein on Optimal Health

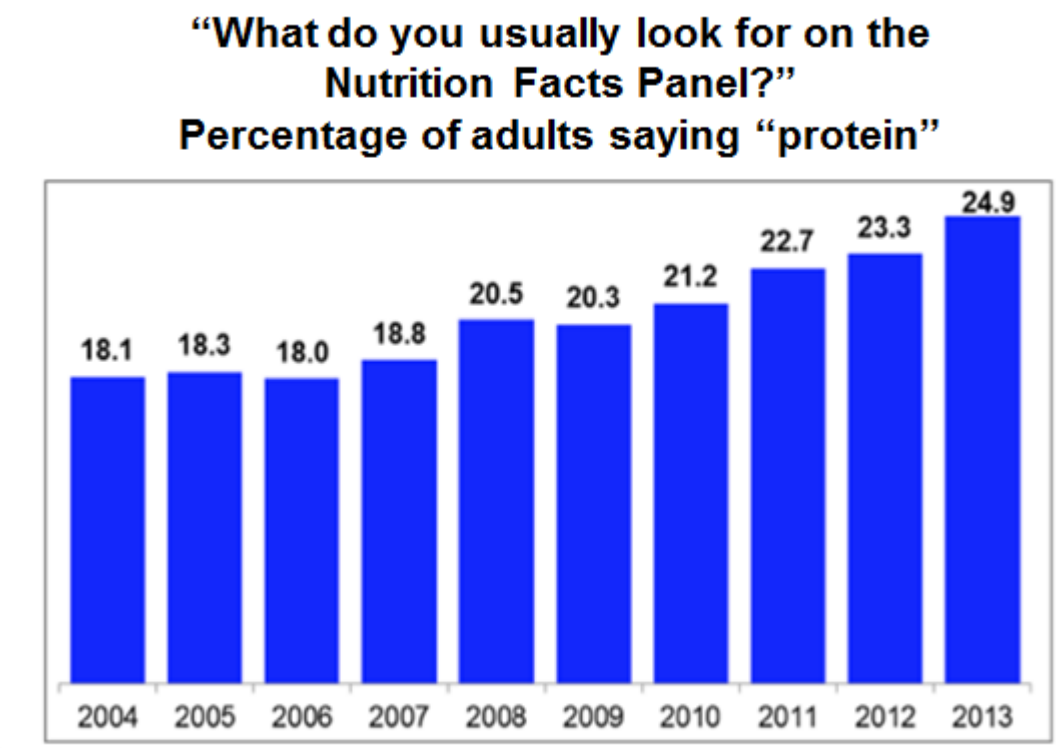
The Following Will Be Discussed

1. What is Protein?
2. Evolution of Protein Research
3. Protein's Role in Beneficial Health Outcomes
4. Current Protein Recommendations
5. Optimal Daily Protein Intake
6. Putting Protein Recommendations into Practice

Protein: Read All About It!



Consumer Interest Has Skyrocketed

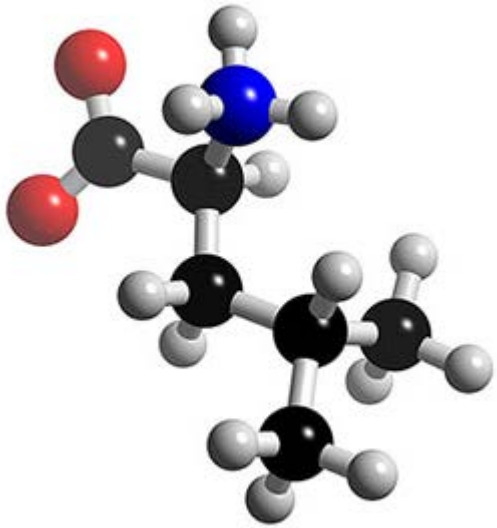


- 91% of Americans think that it is important to get enough protein in their diets (IFIC, 2014)
- 57% of Americans consider how much protein is in a food or beverage before purchase (IFIC, 2014)

What Is Protein?

Protein Is Made From Amino Acids, Which Are Essential Building Blocks for the Body

- Amino acids play numerous roles in the body, including:
  - Structural
    - Build, maintain and repair muscle
    - Build stronger bones
  - Transport
    - Deliver oxygen to tissues
  - Immune boosters



Protein and Amino Acids Have Life-Sustaining Benefits

- There are **20 amino acids needed** for the body to make proteins
- Benefits include:
  - Providing energy
  - Building better brains
  - Aiding the metabolism of other nutrients
  - Promoting feelings of satiety/fullness
  - Managing weight

Amino Acids Are Classified as "Essential" And "Nonessential"

- Essential: The body cannot make essential amino acids, so we must eat them in the diet
    - Essential amino acids stimulate and support muscle protein synthesis, which allows the body to make new muscle and repair old muscle
- Nonessential: The body can make these, so they don't have to be consumed in the diet

Essential and Nonessential Amino Acids

- **9 essential amino acids:**
  - Histidine
  - Isoleucine
  - Leucine
  - Lysine
  - Methionine
  - Phenylalanine
  - Threonine
  - Tryptophan
  - Valine

- **11 nonessential amino acids:**
  - Alanine
  - Arginine
  - Asparagine
  - Aspartic acid
  - Cysteine
  - Glutamic acid
  - Glutamine
  - Glycine
  - Proline
  - Serine
  - Tyrosine

Proteins Are Classified as Either "Complete" or "Incomplete"

- Complete proteins contain all of the essential amino acids
- Incomplete proteins are missing one or more of the essential amino acids
- Complete proteins are considered "high biological value"
  - High biological value proteins contain all of the amino acids in a proportion similar to what is required by humans
  - Easy for your body to fully digest, meaning that all of that essential protein is available to be absorbed and used by the body

Animal Sources and a Few Plant Sources Provide Complete Proteins

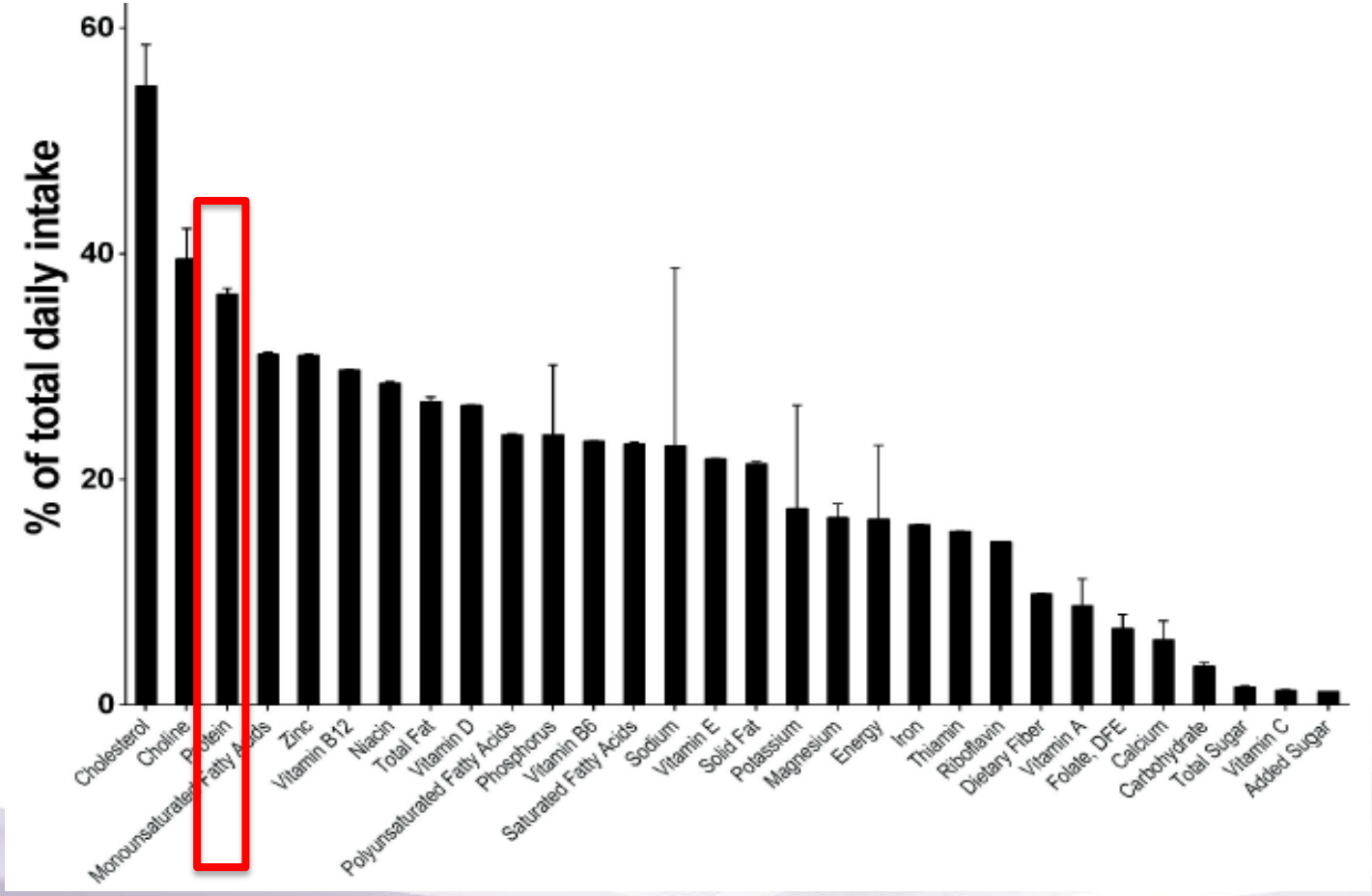
- Complete proteins include:
  - Meat, including beef, pork, chicken and fish
  - Eggs
  - Dairy, including milk, cheese and yogurt
  - Quinoa
  - Soy
- Incomplete proteins have a lower biological value and are found in other plant sources:
  - Beans and legumes
  - Nuts and seeds
  - Whole wheat
  - Rice

Top Sources of Protein in the American Diet: Poultry and Meats

Food	Rank	%Total Protein
Poultry	1	10.0
Meats	2	9.5
Mixed dishes – meat, poultry, fish	3	7.5
Breads, rolls, tortillas	4	6.4
Milk	5	6.4
Cured meats/poultry	6	6.0
Mixed dishes – pizza	7	4.8
Cheese	8	4.8
Mixed dishes – grain-based	9	4.4
Mixed dishes – sandwiches	10	4.1
Eggs	11	3.2
Plant-based protein foods	12	3.2
Seafood	13	3.1

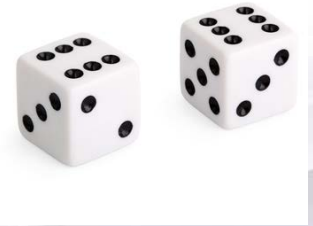
NHANES (2007-2010; N = 17,386), Unpublished [12]

Achieving Nutrient Adequacy Via Commonly Consumed Protein Foods



Phillips, SM et al. Commonly consumed protein foods contribute to nutrient intake, diet quality, and nutrient adequacy. Am J Clin Nutr. 2015 Apr 29. pii: ajcn084079. [Epub ahead of print]

Protein from Lean Sources: Portion Comparisons



Protein Research

Continuing the Exploration of Protein on Optimal Health

2007

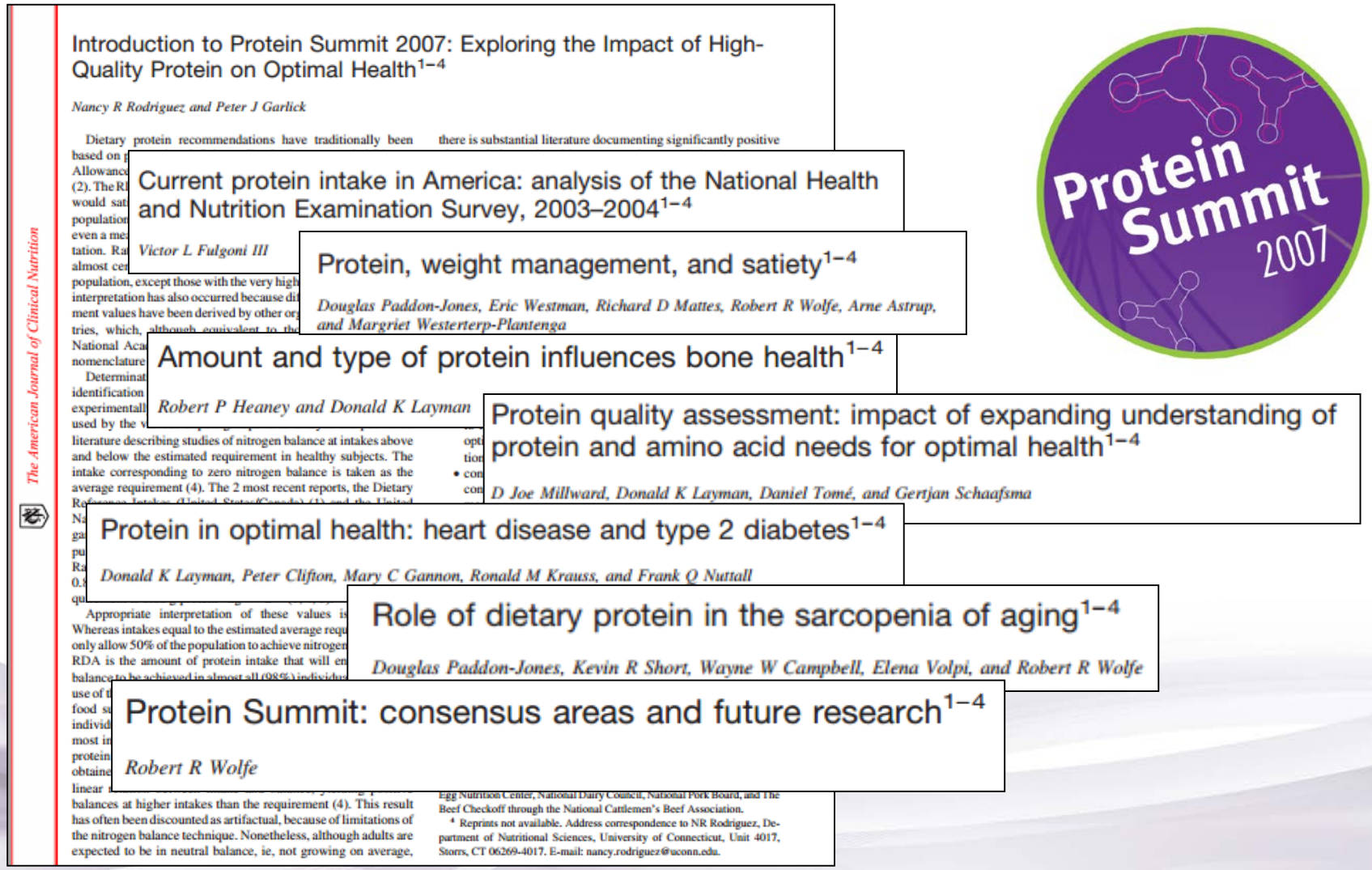
Exploring the Impact of High-Quality Protein on Health

2013

Evaluating the Role of Protein in Public Health

PROTEIN SUMMIT 2.0

Extensive Research Emerged From Protein Summit 2007



Body of Evidence on Role of Protein in Promoting Health

Beef in an Optimal Lean Diet study: effects on lipids, lipoproteins, and apolipoproteins[1–3]

The Journal of Nutrition
Nutrition and Disease

A Moderate-Protein Diet Produces Sustained Weight Loss and Long-Term Changes in Body Composition and Blood Lipids in Obese Adults[1,2]

Donald K. Layman,[3]* Ellen M. Evans,[4] Donna Erickson,[3] Jennifer Seyler,[3] Judy Weber,[3] Deborah Bagshaw,[3] Amy Griel,[3] Tricia Psota,[3] and Penny Kris-Etherton[3]

[1]University of Illinois, Department of Food Science and Human Nutrition, and [4]Department of Kinesiology and Community H... Urbana, IL 61801; and [3]Department of Nutritional Sciences, The Pennsylvania State University, University Park, PA 16802

Abstract

Diets with increased protein and reduced carbohydrates (PRO) are effective for weight loss, but the long-term e... maintenance is unknown. This study compared changes in body weight and composition and blood lipids after s... weight loss (4 mo) followed by weight maintenance (8 mo) using moderate PRO or conventional high-carbohydrat... diets. Participants [age = 45.4 ± 1.2 y; BMI = 32.6 ± 0.8 kg/m²; n = 130] were randomized to 2 energy-restrict... (−500 kcal/d or −2093 kJ/d): PRO with 1.6 g·kg⁻¹·d⁻¹ protein and <170 g/d carbohydrates or CHO with 0.8 g·k... protein, >220 g/d carbohydrates. At 4 mo, the PRO group had lost 22% more fat mass (FM) (−5.6 ± 0.4 kg) than t... group (−4.6 ± 0.3 kg) but weight loss did not differ between groups (−8.2 ± 0.5 kg vs. −7.0 ± 0.5 kg; P = 0.10). A... the PRO group had more participants complete the study (64 vs. 45%, P < 0.05) with greater improvement... composition; however, weight loss did not differ between groups (−10.4 ± 1.2 kg vs. −8.4 ± 0.9 kg; P = 0.18)... compliance criterion of participants attaining >10% weight loss, the PRO group had more participants (31 vs. 21... more weight (−16.5 ± 1.5 vs. −12.3 ± 0.9 kg; P < 0.01) and FM (−11.7 ± 1.0 vs. −7.9 ± 0.7 kg; P < 0.01) than t... group. The CHO diet reduced serum cholesterol and LDL cholesterol compared with PRO (P < 0.01) at 4 mo, but th... did not remain at 12 mo. PRO had sustained favorable effects on serum triacylglycerol (TAG), HDL cholesterol a... and TAG:HDL-C compared with CHO at 4 and 12 mo (P < 0.01). The PRO diet was more effective for FM loss a... composition improvement during initial weight loss and long-term maintenance and produced sustained reductions... and increases in HDL-C compared with the CHO diet. J. Nutr. 139: 514–521, 2009.

Introduction

Obesity is a major public health crisis in the United States. Diet strategies for successful long-term weight loss and maintenance remain relatively untested. High-carbohydrate, low-protein, low-fat (CHO)[6] diets are often recommended for weight management (1–3). However, recent studies have shown that diets with increased protein and reduced carbohydrates (PRO) are often more effective, at least for short-... diets with protein >1.4 g·kg⁻¹·d⁻¹... tend to increase weight and fat lo... compared with CHO diets (6–8). ... beneficial during periods of short-... compliance and effect on body ... unknown (9).

Most studies evaluating PRO ... examined fewer than 40 participan... that greater initial weight losses ... are not maintained at 12 mo, la... compliance (9–12). However, few ... these studies usually lack continu... diet monitoring, a fact that provide... study (6,10–18).

We previously completed 2 ... effects of PRO and CHO diets de... ence Intake (DRI) guidelines for m... short-term weight loss (8,16,17).

[2] Supported by the National Cattlemen's Beef Association, Beef Checkoff, and Kraft Foods (Principal Investigator: D. K. Layman).
[3] Author disclosures: D. K. Layman serves on Speakers Bureau for National Cattlemen's Beef Association. E. M. Evans, D. Erickson, J. Seyler, J. Weber, D. Bagshaw, A. Griel, T. Psota, and P. Kris-Etherton, no conflicts of interest.
[6] Abbreviations used: AMDR, Acceptable Macronutrient Distribution Range; apoB, apolipoprotein B; CHO, high-carbohydrate, low-protein, low-fat diet; DRI, Dietary Reference Intake; %Fat, relative body fatness; FM, fat mass; ITT, intention-to-treat; HDL-C, HDL cholesterol; LDL-C, LDL cholesterol; PRO, diet with increased protein and reduced carbohydrates; RDA, Recommended Daily Allowance; TAG, triacylglycerol; TC, total cholesterol.
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Review

Nutrient-rich meat proteins in offsetting age-related muscle loss

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McMaster University, Department of Kinesiology, Hamilton, ON, Canada

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ABSTRACT

From a health perspective, an underappreciated consequence of the normal aging process is the impacts that the gradual loss of skeletal muscle mass, termed sarcopenia, has on health beyond an effect on locomotion. Sarcopenia, refers to the loss of muscle mass, and associated muscle weakness, which occurs in aging and is thought to proceed at a rate of approximately 1% loss per year. However, periods of inactivity due to illness or recovery from orthopedic procedures such as hip or knee replacement are times of accelerated sarcopenic muscle loss from which it may be more difficult for older persons to recover. Some of the consequences of age-related sarcopenia are easy to appreciate such as weakness and, eventually, reduced mobility; however, other lesser recognized consequences include, due to the metabolic role the skeletal muscle plays, an in... currently know is ...ifically resistance ...otein that people ...

...l rights reserved.

The Journal of Nutrition. First published ahead of print January 21, 2015 as doi: 10.3945/jn.114.205203.

The Journal of Nutrition
Nutritional Epidemiology

Higher-Protein Diets Are Associated with Higher HDL Cholesterol and Lower BMI and Waist Circumference in US Adults[1–4]

Stefan M Pasiakos,[1]* Harris R. Lieberman,[1] and Victor L Fulgoni III[5,7]

[1]Military Nutrition Division, US Army Research Institute of Environmental Medicine, Natick, MA; [4]Oak Ridge Institute for Science and Education, Oak Ridge, TN; and [7]Nutrition Impact LLC, Battle Creek, MI

Abstract

ACCEPTED ARTICLE PREVIEW

Accepted Article Preview: Published ahead of advance online publication

International Journal of Obesity

The role of higher protein diets in weight control and obesity-related comorbidities

A Astrup, A Raben, N Geiker

...icle as: A Astrup, A Raben, N Geiker, The role of higher protein diets ...control and obesity-related comorbidities, *International Journal of* ...epted article preview 26 December 2014; doi: 10.1038/ijo.2014.216.

...F file of an unedited peer-reviewed manuscript that has been accepted ...on. NPG are providing this early version of the manuscript as a service ...mers. The manuscript will undergo copyediting, typesetting and a proof ...e it is published in its final form. Please note that during the production ...rs may be discovered which could affect the content, and all legal ...pply.

Accepted manuscript

Role of dietary protein in the sarcopenia of aging[1–4]

Douglas Paddon-Jones, Kevin R Short, Wayne W Campbell, Elena ...

ABSTRACT

Sarcopenia is a complex, multifactorial process facilitated by a combination of factors including the adoption of a more sedentary lifestyle and a less than optimal diet. Increasing evidence points to a blunted anabolic response after a mixed nutrient meal as a likely explanation for chronic age-related muscle loss. There is currently insufficient longer-term research with defined health outcomes to specify an optimal value for protein ingestion in elderly individuals. However, there is general agreement that moderately increasing daily protein intake beyond 0.8 g·kg⁻¹·d⁻¹ may enhance muscle protein anabolism and provide a means of reducing the progressive loss of muscle mass with age. The beneficial effects of resistance exercise in aging populations are unequivocal. However, research has not identified a synergistic effect of protein supplementation and resistance exercise in aging populations. There is little evidence that links high protein intakes to increased risk for impaired kidney function in healthy individuals. However, renal function decreases with age, and high protein intake is contraindicated in individuals with renal disease. Assessment of renal function is recommended for older individuals before they adopt a higher-protein diet. *Am J Clin Nutr* 2008;87(suppl):1562S–6S.

INTRODUCTION

Sarcopenia is a complex, multifactorial process facilitated by a combination of voluntary and involuntary factors including the adoption of a more sedentary lifestyle and a less than optimal diet (1–3) (**Figure 1**). Advanced sarcopenia is synonymous with physical frailty and is associated with an increased likelihood of falls and impairment in the ability to perform routine activities of daily living (1). Some loss of muscle is viewed as a largely inevitable yet undesirable consequence of aging. After reaching a peak in early adult years, skeletal muscle mass declines by ≈0.5–1.0%·y⁻¹ beginning at about 40 y of age. In its early stages, a gradual loss of lean muscle mass may be masked by a concurrent increase in fat mass along with subtle lifestyle adaptations. However, a breakpoint can occur when a previously asymptomatic individual experiences an injurious event or is acutely/temporarily disabled (4). In such instances, the loss of skeletal muscle is accelerated and may rapidly facilitate a debilitating loss of functional capacity.

Chronic muscle loss is estimated to affect 30% of people older than 60 y and may affect >50% of those older than 80 y (5). Sarcopenia is associated with a 3- to 4-fold increased likelihood of disability, which in turn is associated with substantial socioeconomic and health care spending. One analysis estimated that in 2000, sarcopenia was responsible for $18.5 billion in health care costs (6). As the number of people older than 65 y continues

1562S

Am J Clin Nutr 2008;87(suppl)

The American Journal of Clinical Nutrition

Protein Distribution Effect on Indices of Satiety

Madonna Marie Mamerow[1], Joni A Mettler[1], Kirk L English[1], Donald K Layman[4], Elena Volpi[2], Douglas Paddon-Jones[3]. [1]Rehabilitation Sciences, [2]Internal Medicine-Geriatrics, [3]Nutrition and Metabolism, University of Texas Medical Branch, Galveston, TX, [4]Food Science & Human Nutrition, University of Illinois, Urbana, IL

Healthy adult men and women (n=11, 38+/-2.98 y, BMI: 26.1+/-1.1) participated in a 7-day crossover feeding study with 30 day washout to evaluate the acute and sustained effects of protein distribution on indices of satiety. Study diets were isoenergetic and isonitrogenous, containing 90 g total protein/day. The even protein distribution diet provided: 30 g (breakfast), 30 g (lunch) and 30 g (dinner). The skewed protein distribution diet provided: 10 g (breakfast), 15 g (lunch) and 65 g (dinner). Visual analog questionnaires measured hunger and fullness three hours after ingestion of each meal. On day one, subjects reported less hunger (p=0.02) and greater fullness (p=0.04) following the breakfast meal containing 30 g vs. 10 g of protein. Conversely, the skewed, high protein (65 g) evening meal had no greater effect on satiety than the more moderate 30 g protein meal (p>0.2). Following 7 days habituation to each diet, there was no change in satiety indices in response to the morning and evening meals. In conclusion, compared to a typical skewed daily protein intake, consuming a moderate amount of protein with each meal promotes satiety following breakfast and may enable more efficient and effective management of daily protein and energy intake.

Continued Exploration of Protein on Optimal Health at Protein

- Discussions identified effective strategies to help health professionals translate protein science to optimize their clients' protein intake for health and combat misperceptions related to protein

PROTEIN SUMMIT 2.0

Meeting Proceedings Advance Science and Detail Protein's Role Optimal

The American Journal of
CLINICAL NUTRITION

A Publication of the American Society for Nutrition

JUNE 2015 • VOLUME 101 • NUMBER 6

EDITORIALS

SPECIAL ARTICLE

ORIGINAL RESEARCH COMMUNICATIONS

SUPPLEMENT

- A supplement to the June 2015 edition of the *American Journal of Clinical Nutrition* contains five comprehensive reviews from presentations and discussions from Protein Summit 2.0

Supporting Protein's Role in Beneficial Health Outcomes

The Role of Protein In Weight Loss and Maintenance

- Eating more protein, as part of a reduced-calorie diet, can support weight loss and maintenance by:
  - Boosting metabolism
  - Controlling/curbing appetite
  - Helping the body retain muscle while losing fat

Science suggests that a good goal for total protein intake, as part of a reduced-calorie diet, is about 1.2-1.6 grams of protein per kilogram of body weight, mostly from high-quality sources.

Defining Meal Requirements for Protein to Optimize Metabolic

- Eating high-quality protein foods helps support a healthy metabolism, which can help optimize health by improving markers of health.
- The body's ability to effectively use the amino acids found in dietary protein can decline with age and with reduced physical activity.

Eating about 20-30 grams of high-quality protein at each meal can help support a healthy metabolism to improve markers of health.

Protein and Healthy Aging

- Eating more high-quality protein combined with regular physical activity can help slow or prevent sarcopenia, the gradual muscle loss associated with aging.

Consuming between 1.0-1.5 grams of high-quality protein per kilogram of body weight (or 0.45-0.68 grams per pound of body weight) evenly throughout the day may be most effective to maintain muscle and support a healthy, vibrant life.

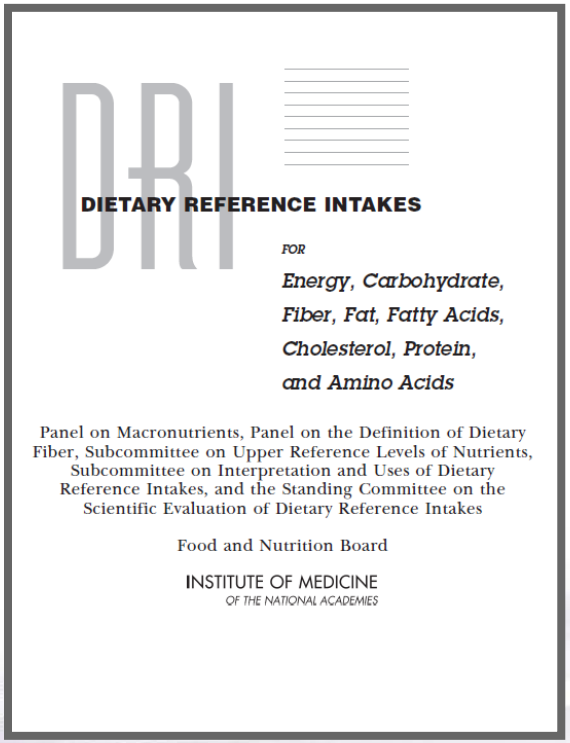
Research Questions and Future Needs

- What is the sustained protein satiety effect over the long-term?
- What is the impact of dietary protein distribution at meals ?
- What are optimal levels of protein?
- What are the ideal types of protein-containing foods to help achieve nutrient adequacy?
- Should we be using the Protein Digestibility Corrected Amino Acid Score (PDCAAS) or the Digestible Indispensable Amino Acid Score (DIAAS) to evaluate dietary sources of protein?

Current Protein Recommendations

Recommended Dietary Allowance For Protein: 0.8 g/kg body weight/day

- "An estimate of the minimum daily average dietary intake **level** that meets the nutrient requirements of nearly all (97-98%) healthy individuals"
  - **Protein**:
    - Women: 46 g/day
    - Men: 56 g/day
    - Or 0.8 g/kg body weight/day
  - **Fat**:
    - *Not determined*
  - **Carbohydrate**:
    - 130 g/day



Acceptable Macronutrient Distribution Range For Protein: 10-35% of total calories

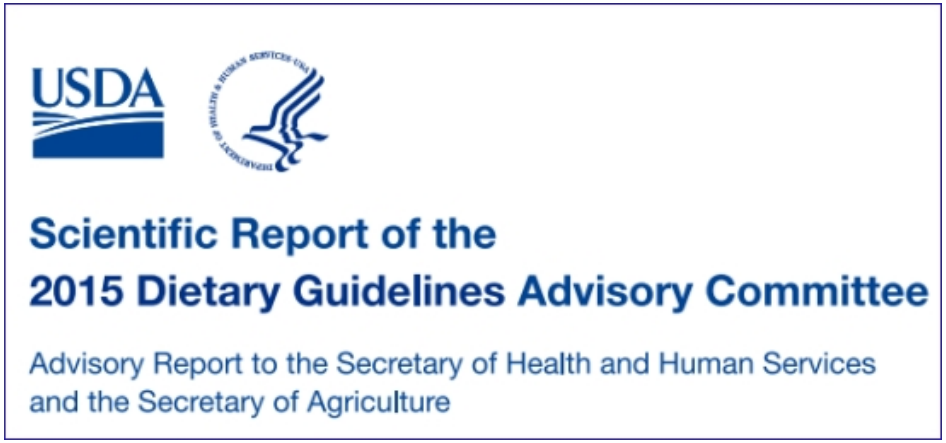
- The intake **range** "associated with reduced risk of chronic diseases, while providing adequate intakes of essential nutrients."
  - **Protein**:
    - 10-35% of total calories
  - **Fat**:
    - 20-35% of total calories
  - **Carbohydrate**:
    - 45-65% of total calories

INSTITUTE OF MEDICINE

OF THE NATIONAL ACADEMIES

2015 DGAC Report Shows Americans Getting Adequate Protein

"…intakes of protein (as grams/day) are adequate across the population and protein is not a shortfall nutrient."



Across all age groups and in both males and females, nearly 60 percent of the U.S. population meets the protein foods intake recommendation.

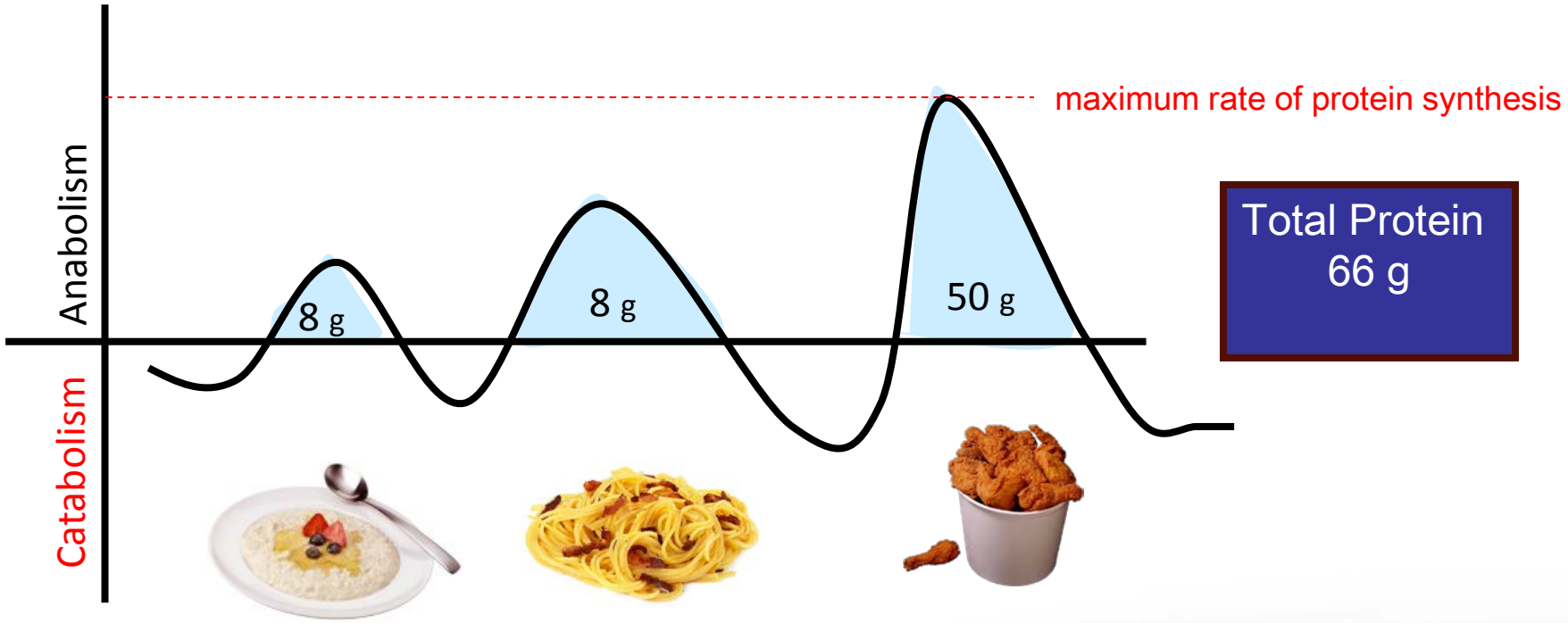
2015 DGAC Report. Part D. Chapter 1: Food and Nutrient Intakes, and Health: Current Status and Trends. WWEIA/NHANES data.

Addressing Current Uneven Daily Protein Distribution

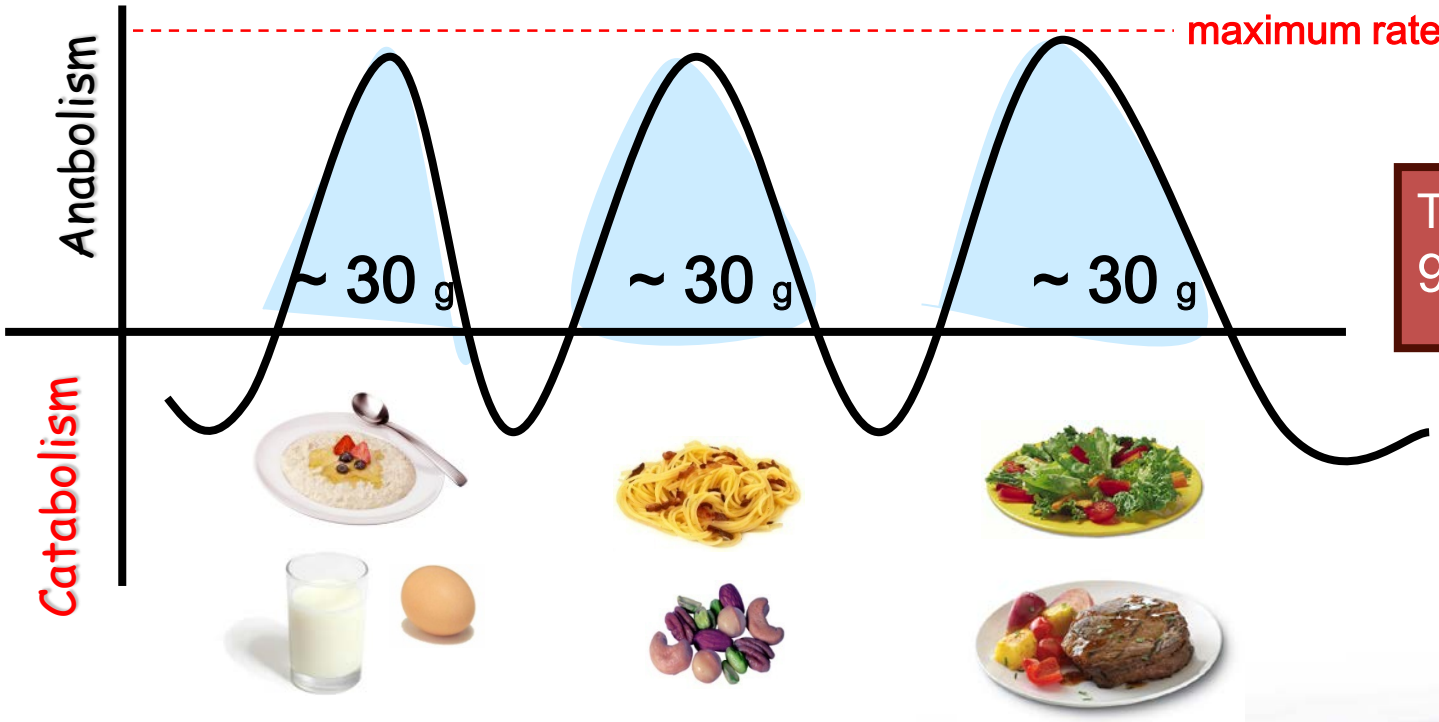
National Health and Nutrition Examination Survey (NHANES) data shows:

- People consume more than 65% of their daily protein in a single large dinner meal
- That leaves less than 35% distributed among other meals and snacks

Recognizing Typical Daily Protein Distribution



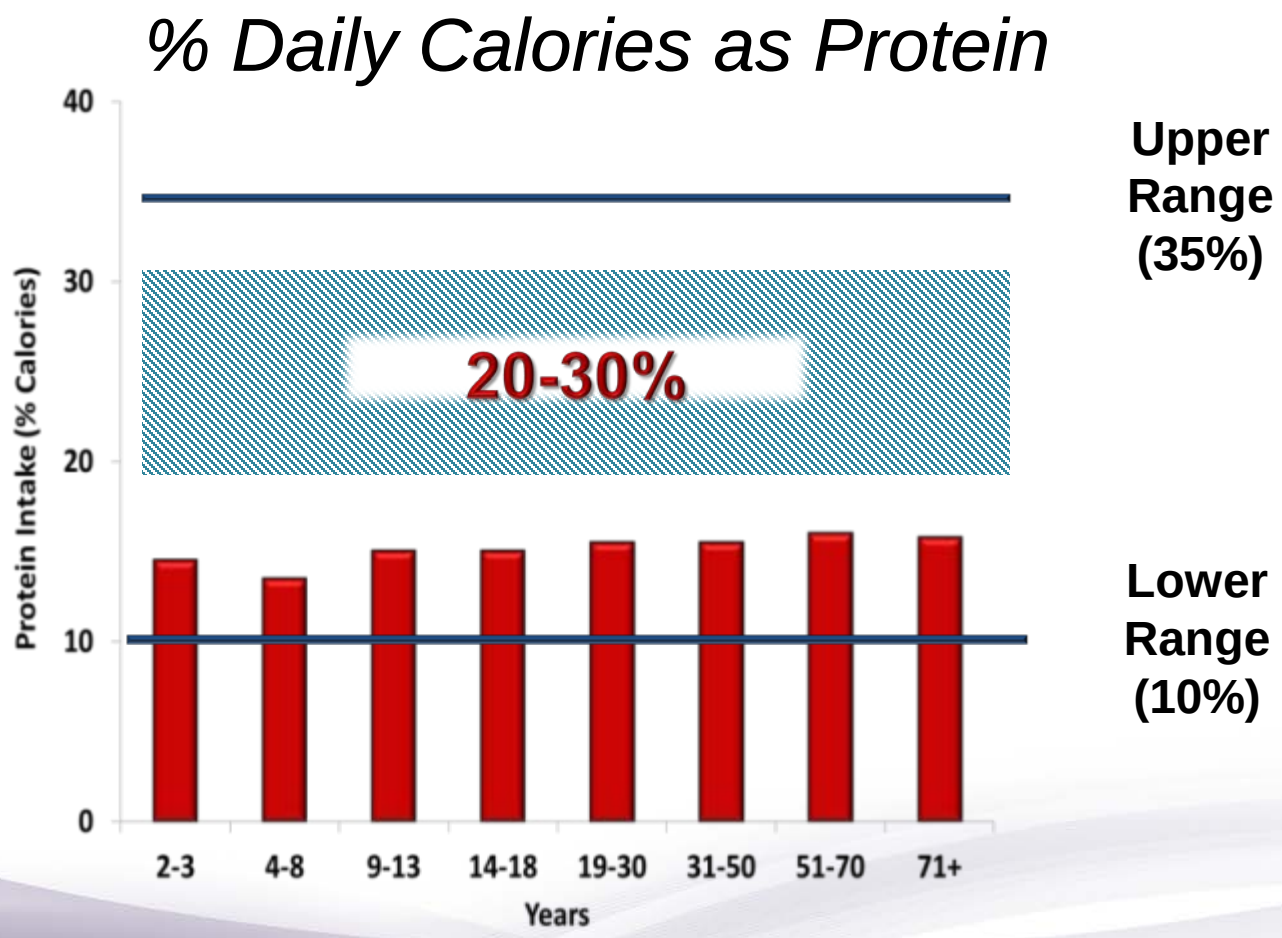
Achieving Optimal Protein Intakes



Total Protein
90 g

Repeated maximal stimulation of protein synthesis
→ increase / maintenance of muscle mass

Is There A Case For More Protein?



Case Study Part 1: Protein Needs

Two 41-year-old women, Amy and Betty, both weighing 125 lbs.

Protein needed to meet the RDA:

125 lbs. / 2.2 kg/lb. = **56.8 kg**

56.8 kg x 0.8 g pro/kg = **45.5 g protein**

- Amy is sedentary and consumes about **1,400** calories/day. If she consumes the RDA, what percentage of her calories will come from protein?

  45.5 g protein x 4 kcal/g = **182 kcals**

  182 kcals / 1,400 kcals = **13% kcals**

- **Observation:** This percentage is within the AMDR, but on the low end

- Betty is moderately active and consumes **2,000** calories/day. If she consumes the RDA, what percentage of her calories will come from protein?

  45.5 g protein x 4 kcal/g = **182 kcals**

  182 kcals / 1,850 kcals = **9.1% kcals**

- **Observation:** This percentage is below the AMDR, which is particularly concerning because this woman is more active

Case Study Part 2: Prescribing Protein Intake

Betty: 125 lb. moderately active female consuming 2,000 calories/day

- We know she needs 45.5 g of protein to meet the RDA, but this is only 9% of her total caloric intake, which falls below the minimum amount recommended by the AMDR.
- Using what you know about the AMDR and Betty's level of physical activity, how would you calculate her protein needs?
  - Estimated protein needs: ~20-25% total caloric intake
  - 2,000 kcal x 20% = 400 kcal / 4 kcal/g protein = 100 g protein
  - 2,000 kcal x 25% = 500 kcal / 4 kcal/g protein = 125 g protein
- Recommendation: Betty should consume between **100-125 g protein** per day, which is above the RDA but still well within the AMDR

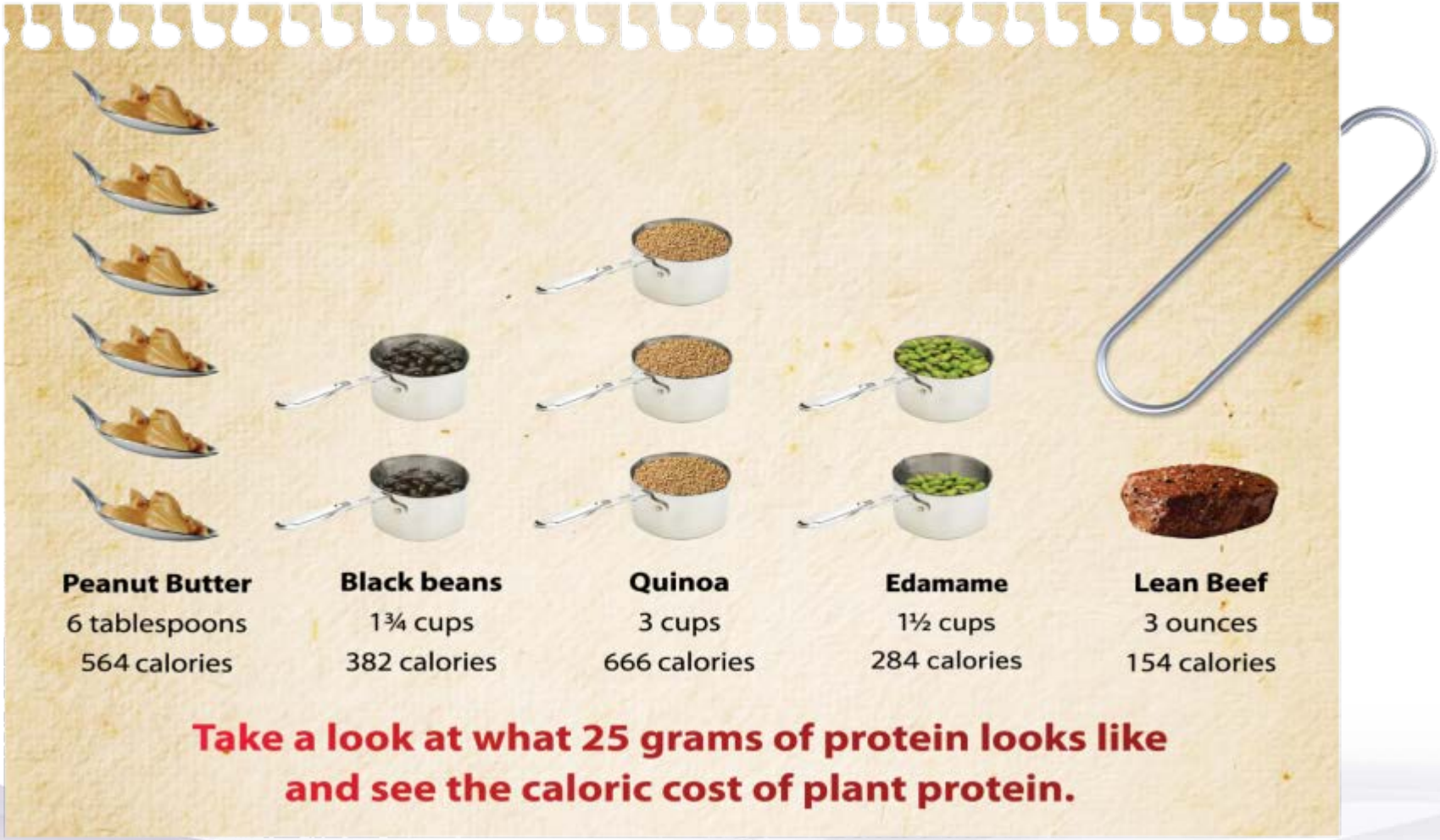
Applying Protein Recommendations to Everyday Life

Focus On High-Quality Protein Sources

Consume a variety of protein foods, but focus on high-quality sources of protein from nutrient-rich foods such as:

- Lean meats
- Poultry
- Fish
- Eggs
- Low-fat milk/dairy products

A Look At Beef's Caloric Advantage



Effective Translation of Current Dietary Guidelines: Understanding and Communicating the Concepts of Minimal and Optimal Levels of Dietary Protein

- Significant research shows that when they consume more high-quality protein within calorie goals, some people can:
  - Lose and maintain a healthy weight
  - Support a healthy metabolism
  - Age more healthfully
- On average, consuming between 20-30 grams of high-quality protein at each meal is associated with benefits for:
  - Improved metabolism
  - Healthy aging
  - Weight loss and maintenance, as part of a reduced-calorie diet

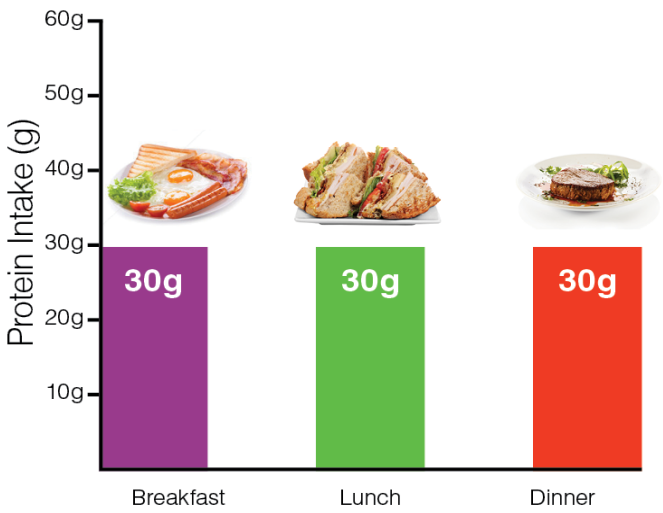
Calculate the Amount of Protein Needed

- Use the AMDR (10-35% of calories) and/or absolute amounts of protein ranging from 0.8 to 1.6 g/kg/day to design practical diets to optimize protein intake based on health outcome goals

25-30 GRAMS

Aim for this amount (according to new research[3]) in each breakfast, lunch and dinner meal to:

- Improve daily muscle maintenance
- Protect against muscle loss
- Help with growth and repair
- Increase satisfaction and fullness



Emphasize a Balanced Intake Approach

- Spread protein intake throughout the day at meals to increase the body's use of protein and optimize protein's health benefits

Take the Protein Challenge!

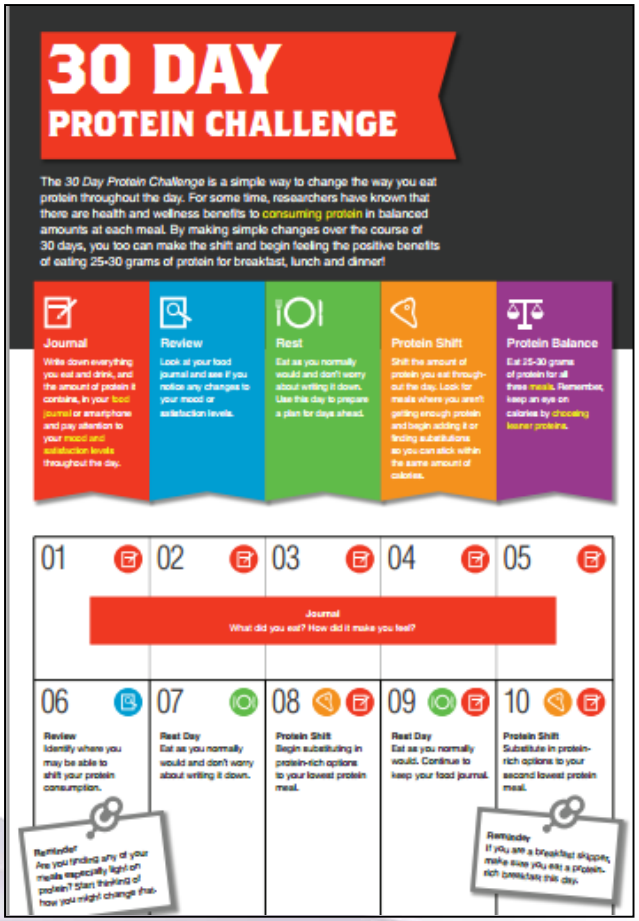
TAKE CONTROL

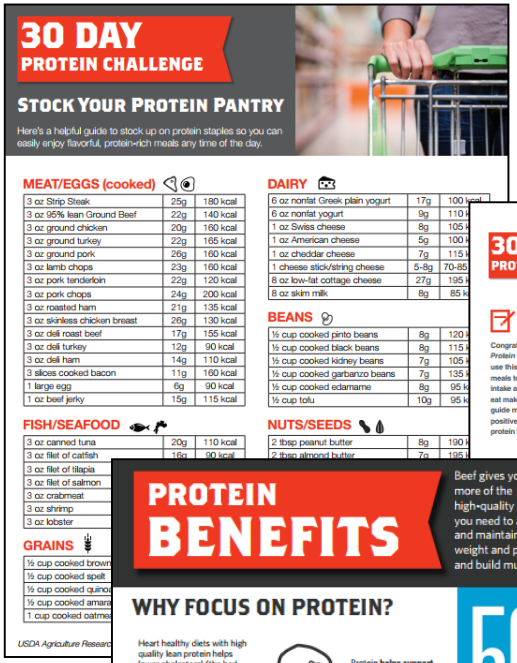
Protein gives you the control you need to take on the day and make the right food choices.

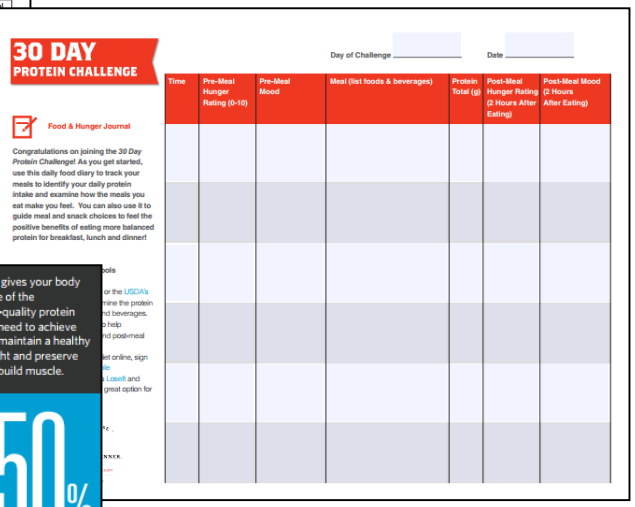
30 DAY Protein CHALLENGE

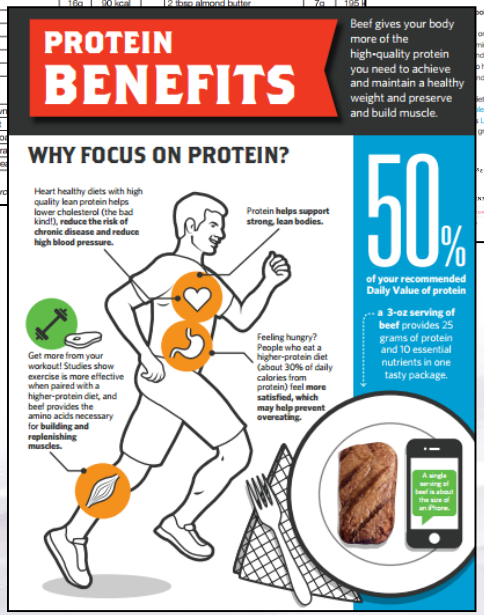
Use Tools and Resources

www.beefitswhatsfordinner.com/proteinchallenge.aspx









Get Recipes for Satisfying Meals Delivering 25-30 grams of Protein

Breakfast

Lunch

Dinner

Optimize protein intake throughout the day

Final Thoughts

- High-quality protein has unique benefits for health, especially to achieve and maintain a healthy body weight, improve the way the body metabolizes food and support healthy aging
- Research shows that health benefits can be achieved by enhancing high-quality protein intake within daily calorie goals and shifting timing of intake more evenly throughout the day
  - The ideal protein intake is approximately 1.0 to 1.6 g/kg/day (above the RDA but well within the AMDR for protein) and distributed throughout the day.
  - Evenly distributing high-quality protein intake throughout the day, or about 20-30 grams at breakfast, lunch and dinner, is optimal to achieve health benefits

Final Thoughts

- Failure to consume nutrient-dense foods, in particular nutrient-dense protein sources, makes it difficult to meet recommended dietary goals for various nutrients.
- Animal proteins provide more and higher quality protein than plant foods, often for fewer calories.
- Protein should be balanced with other nutrient-rich foods on the plate like fruits, vegetables and whole grains.
- Dietitians and health professionals should be encouraged to promote protein as the first choice in meeting energy requirements and to emphasize spreading protein intake throughout the day.

Thank You!

www.BeefNutrition.org

PROTEIN SUMMIT 2.0

Evaluating the Role of Protein on Public Health