Meat's Role as a Staple Food and the Opportunity to Improve Dietary Patterns in America

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Abstract: Many Americans choose to eat meat, with beef and poultry being their top protein choices. The best available evidence indicates that most Americans consume meat in amounts at, or near, levels modeled in the 2020 Dietary Guidelines for Americans. There is an opportunity, however, for many Americans to improve how they consume meat, including selecting leaner cuts and using healthful preparation and cooking methods. Despite economic pressures, environmental attention, and public health messages promoting reduced meat consumption, meat remains a staple food in the American diet. Meat is a nutrient-dense food, and its nutrient profile complements other nutrient-rich food groups when included in balanced meals. For Americans who choose meat, especially vulnerable population subgroups, meat helps close nutritional gaps and is a foundational food that supports improved nutrient adequacy which can lead to improved health outcomes. The widespread U.S. consumer preference for meat coupled with its nutrient advantages offers an opportunity to enhance overall diet quality in America. Meat-containing meals can serve as vehicles for improving nutrition through increased intake of under-consumed food groups and nutrients, which, in turn, can help support healthier dietary patterns and ultimately, the improved health of Americans.

Keywords: red meat; beef; poultry; nutrient adequacy; dietary patterns; staple foods; food based dietary guidelines; Dietary Guidelines for Americans

1. Introduction

The United States Department of Agriculture (USDA), which provides leadership on issues related to food, agriculture, and natural resources, defines staple foods as those that make up a significant portion of a person's diet, are usually prepared at home, and are eaten as part of a meal. Staple food categories include vegetables or fruits, dairy products, meat, poultry or fish, and breads or cereals. They do not include prepared foods or accessory foods [1]. Staple foods are well-adapted to regional growth conditions often representing centuries of agricultural resilience and adaptation and, as such, cultural tradition [2]. In the United States (U.S.), the evolution of meat as a staple food began with the availability of wild buffalo, elk, and deer herds and persists today with domesticated herds and flocks of cattle, pigs, and sheep introduced from Europe and the British Isles [3]. Improving the quality of the American diet while honoring "diverse communities and cultural foodways" is increasingly recognized as a key consideration for advancing health equity in the U.S. [4]. For example, the Food as Medicine initiative in the U.S. represents a federal strategy to reduce nutrition-related chronic diseases and increase food security to improve health and racial equity [5]. Evidence suggests a significant majority of Americans currently consume meat, valuing what it adds to their diets, and share a willingness to maintain their

frequency of meat intake in the face of global economic, environmental and societal pressure [6]. Meat and animal source proteins provide unique nutrients and value to dietary patterns, when consumed in a balanced diet. The continued popularity of meat in the American diet presents an opportunity to maintain the nutrient adequacy of those populations that currently rely on meat for key nutrients. Meat also may help further to improve diet quality by serving as a bridge to increase consumption of complementary food groups including vegetables. The current review focuses on meat consumed in the U.S., i.e., beef, pork, and poultry, and how it contributes to nutrient adequacy and food security while serving as a foundational part of American culture and cuisines, supporting healthier dietary patterns for Americans across life stages.

2. Meat is a Staple Food Preference for Americans across Demographics

Meat eating is a significant part of American cultural identity [7]. Many quintessential American cuisines feature meat, like steaks, burgers, pork chops and roasts Meat is popular as the centerpiece during many social activities like family and community gatherings, holidays traditions and celebrations. According to the 2024 Power of Meat Report, 80% of Americans describe themselves as meat eaters and 98% of households purchase meat [8]. [9] The majority of U.S. consumers eat meat (chicken, beef and pork) at least once per week (Figure 1) with the number of consumers seeking to decrease their meat consumption falling by 20% since 2020 [9].

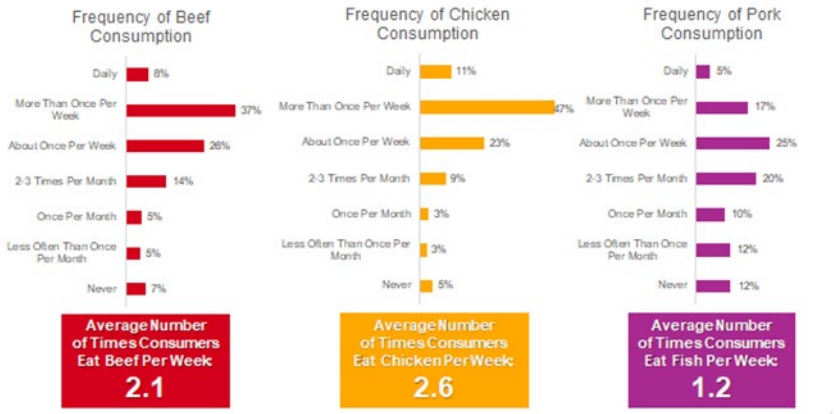


Figure 1. Frequency of meat consumption in the United States.
N = 23,720 surveyed – 50% male; 77% education beyond high school; 74% ages 25-44; 50% employed full-time, 48% live in suburban areas; 43% annual income less than $50,000; 79% identifying as white/Caucasian including Hispanic; 10% identifying as Hispanic/Latino. Survey margin of error ± 0.52%.
Source: Consumer Beef Tracker. January 2020 - August 2023. Analysis provided by National Cattlemen's Beef Association, a contractor to the Beef Checkoff.

In a recent survey, about 15% of U.S. consumers report eating either meat (beef/pork/chicken) daily with most indicating they feel they eat" the right amount" of beef (78%), pork (80%), and chicken (83%), based on their purchases in the previous month [10]. Data further indicates 79% of U.S. consumers rank either beef or poultry as their top protein choice [10].

Even with public attention on plant-source protein alternatives and meat substitutes, most U.S. consumers prefer animal protein. (Figure 2). It is estimated that only 5% of Americans eat

peas/beans/lentils on a given day and approximately one third of the population did not consume them in the last month [11]. Only 1% of households buy meat alternatives solely and only 20% of new alternative protein purchasers make multiple repeat purchases [12]. Additionally, consumers who choose meat alternatives at least weekly are more likely to choose to eat other animal protein foods as well (Figure 2). The belief that meatless meals are incomplete is one of the top reasons why meat consumers report maintaining their meat intake [13]. Moreover, among parents of children under 18 years of age, the importance of meat in a healthy diet may play a greater role in their decision making than non-parents [13].

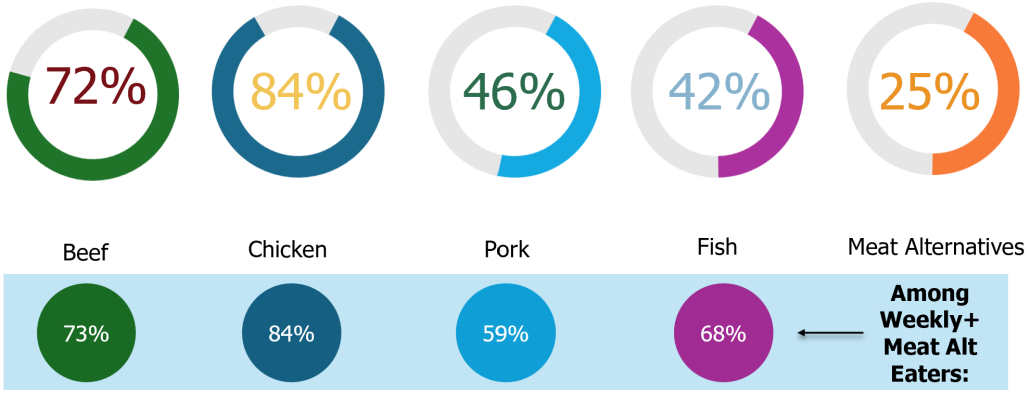


Figure 2. Frequency of protein consumption by type in the overall U.S. population vs. those reporting consumption of meat alternatives in 2024. N = 694 surveyed. Margin of Error 0.52%. Note: Open circles are total populations, filled circles represent meat alternative eaters. Source: Consumer Beef Tracker, January 2024 – June 2024. Q1: "Thinking about all of your meals – breakfast, lunch, dinner, and snacks – how frequently do you eat each of the following types of food?" Analysis provided by National Cattlemen's Beef Association, a contractor to the Beef Checkoff.

American meat consumption trends are similar across income levels (Figure 3). Frequency of weekly beef and pork consumption stays relatively constant among households earning less than $20,000 U.S. dollars (USD) compared to those earning $150,000+ USD at 2.1 to 2.2, and 1.2 to 1.3 times per week, respectively. Frequency of poultry consumption slightly increases with income from 2.4 to 2.9 servings per week from those earning less than $20,000 USD compared to those earning $150,000+ USD. The prevalence of chicken and beef consumption is similar for individuals reporting income levels lower than $50,000 USD but begins to diverge over this earning level with higher income individuals consuming more poultry. In contrast, meat alternative consumption remains low across all income levels, although more marked increases are seen by those with the highest income.

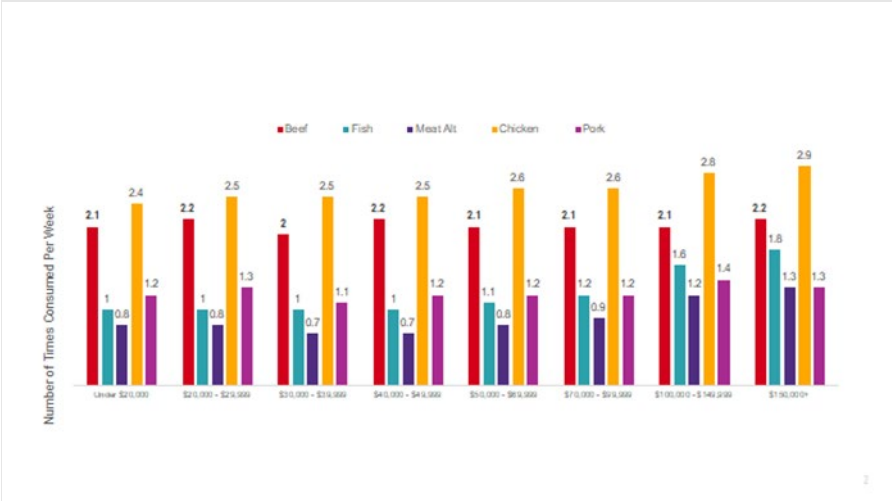
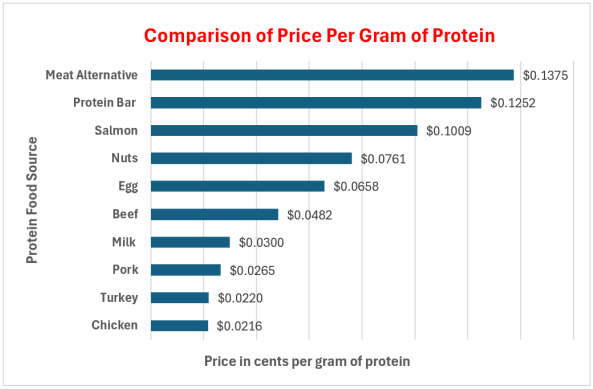


Figure 3. Frequency of U.S. consumer protein consumption by type and household income. N = 23,720 surveyed – 50% male, 77% education beyond high school; 74% ages 25-44; 50% employed full-time, 48% live in suburban areas; 43% annual income less than $50,000 U.S. dollars (USD); 79% identifying as white/Caucasian including Hispanic; 10% identifying as Hispanic/Latino. Survey margin of error ± 0.52%. Source: Consumer Beef Tracker. January 2020 - August 2023. Analysis provided by National Cattlemen's Beef Association, a contractor to the Beef Checkoff.

Lower income Americans face disproportionate nutrient-dense food selection pressures [14]. Even for those who use dietary supplements, those with lower incomes have lower nutrient intake and experience higher nutrient inadequacies than those with higher incomes [15]. Lean ground beef is the top protein food sub-commodity by expenditure for Supplemental Nutrition Assistance Program (SNAP) households, totaling just over 7% of all protein foods expenditures, followed by "primal" beef cuts, such as steaks and roasts [16]. Comparing SNAP and non-SNAP households, lean ground beef and beef primal cuts both rank in the top five protein foods along with boneless chicken breast [16]. Pork products, including enhanced boneless pork loin, bacon, and pork ribs also contribute to the top 10 protein foods consumed by SNAP and non-SNAP households alike [16]. A recent modeling exercise designed to compare pork, beef and poultry in the USDA's Thrifty Meal Plan found fresh pork to be an economical source of high-quality protein [17].

Across all levels of income, a recent survey indicates the number one reason Americans report reducing meat consumption is cost; however, when faced with this decision, lower income families preferentially reduce poultry and seafood over red meat [13]. SNAP estimates that if recipients were given more money, they would spend it on meat, poultry and vegetables [18]. By comparison, frozen meatless burgers rank 754 among food sub-commodity expenditures for SNAP recipients [16].



2024 Average Retail Cost	
Protein Food	Price ($) per Pound
Meat Alternative	$9.79
Protein Bar	$16.70
Salmon	$11.26
Nuts	$6.73
Egg	$3.76
Beef	$6.54
Milk	$0.45
Pork	$3.31
Turkey	$2.90
Chicken	$3.04

Figure 4. Meat compared to other protein food sources, price per gram protein Source: Price data: Nielsen IQ (Meat alternatives, Beef, Pork, Chicken, Turkey); Bureau of Labor Statistics (Milk, Egg); Amazon Marketplace (Protein Bar, Nuts); Protein per 100 gram of protein food data: USDA Food Data Central

In terms of dollars per pound of protein food, the most current 2024 consumer average retail cost data shows that retail prices for meat and poultry tend to be higher as compared to other protein foods like eggs or milk (Figure 4). Meat also is more expensive compared to some plant protein sources like beans (per Bureau of Labor Statistics which, for 2024 averaged $1.70 per pound [19]) but less expensive than other sources, such as nuts (Figure 4). However, in comparing prices of these popular protein food sources in terms of the cost per gram of protein for each of these foods (Figure 4), meat and poultry including chicken, turkey, pork, and beef are among the most economical food sources of protein.

In a recent diet modeling study examining the effects of adding pulses to a USDA Style healthy dietary pattern in replacement of varying amounts of protein foods and/or refined grains, researchers found that replacing eight protein ounce-equivalents per week with two cups of pulses resulted in a cost savings of up to $0.30 per day. The authors note, however, that for some consumers this modeled increase in pulse intake may not be achievable given the degree of dietary behavior change necessary [20]. Furthermore, notably, the USDA's Beans and Peas composite food sub-group used for this cost savings exercise predominately assumes the use of dry beans, peas, and lentils without added fat compared to the use of more convenient and higher priced canned versions of these foods [18]. A recent report finds that willingness to purchase and prepare dry beans varies by race/ethnicity with non-Hispanic white shoppers more likely to purchase canned beans compared to Hispanic shoppers noting the time needed to cook dry beans as a reason for not eating them [21]. When taken together, these market considerations reflect that, for most Americans, meat has a role to play in balanced, healthful diets not only for the flavor it brings but also for its nutritional and economic value.

3. Meat is a Staple Food Affording Nutrient-Density to Vulnerable Populations

Beef, pork, and poultry are significant sources of nutrients for Americans, contributing to under-consumed nutrients across all life stages like iron, choline, and potassium and components to limit, such as saturated fat and sodium [22-25]. Public health initiatives have successfully helped to reduce saturated fat intake to within 1.5% of the DGA target [26,27] as guidance to consume fresh, lean meats in favor of higher fat, fried, and processed meats continues to encourage Americans and nudge them

closer to meeting DGA goals. Vulnerable sub-populations of Americans including older adults, pregnant and lactating women, children, and adolescents exhibit nutrient gaps in protein, iron, vitamin B12, and choline; evidence in support of nutrient adequacy among meat consumers in these sub-populations is particularly relevant and compelling in addressing nutrient gaps seen in these groups.

3.1 Older Adults

The number of Americans aged 65 and older is projected to reach 82 million by 2050 [28], making now a critical time to address diet quality and nutrient adequacy. The 2020 U.S. Dietary Guidelines Advisory Committee (DGAC) noted, "Older adults may benefit from protein intakes above existing DRI recommendations given the high prevalence of sarcopenia, and may have differential energy and nutrient needs based on presence of chronic disease, polypharmacy, changes in oral health and tooth loss, among a myriad of other potential factors that influence needs [29]." An estimated 70% of lower-income older adults living in the U.S. do not meet protein food group intake recommendations made by the DGA [30]. Only an estimated 30% of older women in the U.S. meet DGA protein food group intake recommendations [30].

A high percentage of all older American adults do not meet daily recommendations for other nutrients available in meat, such as choline (96%), potassium (70%), magnesium (60%), zinc (21%), and vitamin B6 (19%) [31]. Older adults who consume fresh meat including beef are more likely to meet essential nutrient recommendations and have lower nutrient inadequacies. On any given day about 60% of older adults (60+ years) are estimated to be consumers of fresh beef, with a corresponding mean intake of 54.7 g/day (1.93 ounces/day)[31]. Recent dietary intake research shows that, for older adults 60+ participating in NHANES 2011-2018 cycles, a higher percentage of these older Americans who report eating beef meet nutrient recommendations for protein, calcium, copper, iron, phosphorus, selenium, sodium, zinc, and vitamin B12 as compared to non-beef eaters; many of these nutrients like protein, iron, zinc, phosphorus, selenium and vitamin B12 are nutrients inherent in beef [31]. Consistent with this evidence, programs like the National Council on Aging include red meat in their sample grocery basket recommendations for older adults in support of the provision of maximum nutritional value and overall health value of SNAP benefits for this age group [32]. Research examining other forms of meat and poultry similarly suggests that meat and poultry contribute to older adults' meeting nutrient intake recommendations as compared to non-consumers [24,25,33].

3.2 Pregnant and Lactating Women

Pregnancy and lactation are associated with increased energy and nutrient requirements due to physiological changes and metabolic demands accompanying them. While existing data on pregnant and nursing women is limited in the U.S. National Health and Nutrition Examination Survey (NHANES), a recent study reported that the prevalence of nutrient inadequacy was high in this group with over 50% of this sub-population falling below the estimated average requirement (EAR) for several nutrients [34]. Pregnant and lactating women who consume beef are more likely to meet nutrient recommendations and have lower inadequacies as compared to those who did not consume beef, particularly in regard to nutrients of public health relevance; in this study, in comparing pregnant beef non-consumer to beef consumers, 20% of beef non-consumers were estimated to fall below the EAR for protein, and

13% below the EAR for iron, compared to only 1% and 4.2% of pregnant and nursing women beef consumers, respectively [34]. On any given day it is estimated that 67% of pregnant and nursing women in the U.S. consume beef (49 g/day; 1.7 ounces) [34]. Further research studies indicate that pregnant and nursing women who include fresh beef in a Mediterranean-style dietary pattern can significantly reduce the risk of maternal iron deficiency anemia [35].

3.3 Children and Adolescents

The stages of life spanning birth throughout adolescence are characterized by tremendous periods of growth and development requiring energy and essential nutrients as fuel. During the first 1,000 days of life, the American Academy of Pediatrics highlights the importance of nutrients like protein, zinc, and iron – nutrients inherent in meat and beef in particular -- for early brain development [36]. Within the first-ever U.S. dietary guidance for older infants and young children, meat, in particular beef, is included as an important complementary food helping to "make every bite count" because of its nutrient density; notably, beef is highlighted as higher in iron, zinc, and choline than a variety of other plant and animal-protein sources [4,29,37]. In contrast, data from the 2016 Feeding Infants and Toddlers Study (FITS) indicate that iron intakes among older infants and young children in the U.S. have been on a declining trajectory since 2002, in part, because of low consumption of iron-rich foods, specifically declining intake of iron-fortified cereal and limited consumption (~5% of the participants) of iron-rich puréed baby-food meats, including beef, an important source of bioavailable heme iron [38]. A recent systematic review further finds that vegetarian and vegan diets during complementary feeding increase the risk of micronutrient deficiencies and insufficiencies that may impair growth and development [39]. Given that an estimated one in four toddlers in the U.S. are not consuming sufficient iron, dietary guidance favoring use of iron-rich foods, such as meat,during complementary feeding is important for all older infants and young children [40].

Meanwhile, many U.S. school-age children and adolescents have poor diet quality and nutrient adequacy as evidenced by declining Healthy Eating Index (HEI) measurements throughout childhood and adolescence. It is estimated that more than half of U.S. adolescents fall below the EAR for calcium, magnesium, and vitamins A, C, D, and E and over 70% below the AI for potassium and total choline [41]. In a recent assessment of dietary intake data of adolescents 14-18 years of age from NHANES 2001-2018 cycles, regular beef consumption was shown to help a greater percentage of the adolescent population, especially adolescent females who are particularly vulnerable to nutrient inadequacy, meet nutrient requirements for iron, folate, riboflavin, thiamin, vitamins B12 and B6, zinc, calcium, copper, niacin, and phosphorus [41]. Among teens that are reported to have consumed beef in this analysis, the average beef intake of male and female adolescent beef consumers is estimated to be 57.9 g (2.0 ounces) and 46.8 g (1.6 ounces), respectively[41]. Further, as a valuable source of nutrients, additional NHANES analysis supports red meats like beef and pork contribute to meeting nutrient requirements and improved nutrient adequacy during adolescence, most notably for adolescent females [24,41].

4. The Relationship between Meat Intake and Health-related Outcomes

The role of meat and poultry in the diet has been a focal point of controversy related to chronic disease risk [42]. Observational evidence of dietary patterns higher in red and processed meat linked

to adverse health outcomes are often confounded by higher intakes of sugar-sweetened foods, beverages, and refined grains making it difficult to disentangle benefits of meat intake. Due at least in part, to methodologic limitations the evidence supporting associations of red meat with chronic disease risk has been chracterized as low certainty [43-50].

Evidence from randomized controlled trials (RCTs) often do not corroborate findings from observational studies with regards to the role meat intake on various disease risk factors, including those related to cardiovascular disease, Type 2 diabetes (T2D), and overweight and obesity [51,52]. Specifically, RCTs of meat interventions consistently suggest little or no effect of red meat on these outcomes [49,53-56] while observational studies suggest a weak negative effect or no impact of meat consumption on these outcomes [48,57-59]. As further discussed below, the assessment of meat intake (i.e. types, amounts, degree of processing) is less easily discerned and more highly prone to misclassification bias in observational studies than in RCTs.

4.1 Meat Intake and Cardiovascular Risk Outcomes

A systematic reivew and meta-analysis (SRMA) of RCTs of red meat consumption recently aimed to determine if the comparison diet influences results for markers of cardiovascular risk [54]. The results of this meta-analysis represents over 1,800 participants. Red meat interventions ranged up to 500 g/day (~17.6 oz/day) as part of either the participants' habitual diets or in fat- and energy-modified diets. More specifically, one-third of the studies included red meat in dietary patterns averaging less than 30% of energy as total fat; eight studies limited saturated fat intake to 10% of energy or less; and five reported energy intake of ≤1,800 kilocalories per day. All studies compared red meat interventions to control diets devoid of, or greatly reduced in, red meat with many further including plant-sourced protein substitutions such as legumes, whole grains, or tofu. Despite a wide range of red meat consumption, including both lean and non-lean red meat interventions, the meta-analysis found that "there were no significant differences between red meat and all comparison diets combined for changes in blood concentrations of total, low-density lipoprotein, or high-density lipoprotein cholesterol, apolipoproteins A1 and B, or blood pressure." Evidence from RCTs is useful for examining the effects of red meat intake, future interventions should consider appropriate comparison foods when examining the effects of red meat intake to further understand food sources that promote optimal health and prevent chronic disease [54]". [54] Similarly, O'Connor et al completed an SRMA of 24 RCTs comparing dietary patterns with ≤0.5 servings/d to ≥0.5 servings/d of red meat [51]. Roughly half of the studies included red meat interventions with most, but not all, providing lean meat, ranging from one to seven servings per day (average two servings per day), in weight loss or heart-healthy dietary patterns. The meta-analysis found no difference in blood lipid profiles or blood pressure. In fact, among all subjects blood lipids and diastolic blood pressure decreased over time regardless of treatment group. The authors concluded: "These results are inconsistent with much of the observational evidence related to red meat consumption and CVD, which prompts the need for future research to reconcile the apparent disconnect between RCT and observation-based conclusions [53]." Similar findings are reported for beef in a recently published SRMA of 20 RCTs. In this study, authors report that diets containing more beef (i.e. average of 161 g/day or approximately 2 servings/day) compared to less or no beef (e.g. 0g or an average of 24 g/day or less than 1 serving/day) did not effect key blood lipids associated with CVD risk [60].

4.2 Meat Intake and Type 2 Diabetes Risk Factors

An SRMA of 21 RCTs of those at risk for or with T2D provides insight into the effect of red meat on risk factors for T2D, specifically fasting glucose, fasting insulin, insulin sensitivity (all measures), homeostatic model assesment for insulin resistance (HOMA-IR), and postprandial glucose, among others [56]. There was no significant impact of diets containing red meat, compared to diets with less or no red meat intake, on insulin sensitivity, HOMA-IR, or fasting insulin (heterogeneity I^2 = 79-84.0%). In the subset of individuals with T2D, a small and marginally significant improvement in insulin sensitivity with red meat intake was noted compared with those consuming less red meat. Small effect size increases (i.e. standard mean difference (SMD): 0.20-0.34) in fasting glucose were noted in studies with higher red meat particularly for those subjects with metabolic dysfunction, i.e. metabolic syndrome. However, in subjects with T2D, higher red meat intake significantly decreased fasting glucose (i.e., SMD: -0.47). The results suggest red meat intake does not impact most glycemic and insulinemic risk factors for T2D, but further investigations are needed.

4.3 Meat Intake and Overweight and Obesity

While the consumption of red meat in the U.S. has continued to decline the prevalence of overweight and obesity has continued to increase [61]. [62,63]A recent SRMA examined the effect of reducing meat and/or dairy consumption on protein intake, anthropometric values, and body composition as measured in 19 RCTs with adults aged 45 years and older [64]. Participants consuming a reduced meat/dairy diet did not significantly differ from those consuming the control diet for body weight, body mass index, waist circumference, body fat, or lean body mass. The authors concluded that evidence suggests no effect of a reduced meat/dairy diet on anthropometrics or body composition. ,In summary, while RCTs provide valuable insights into the effects of dietary patterns, it should be noted that they do have limitations, such as potential issues with generalizability dependent upon participant demographics, variation in participant compliance, and a much shorter duration of intervention compared to the follow-up period of most observational studies. Nonetheless, consistent evidence from SRMA of RCTs supports public health recommendations to encourage healthy and balanced diets with lean meat and poultry consumption.

5. Using Meat as a Bridge to Improve Diet Quality in America

The overall context of meat consumption including the amounts and types of meats consumed, the other foods that accompany meat on the plate, and the co-existence of other lifestyle factors like physical activity and the time available to plan, purchase, and prepare meals—is important when considering how meat can improve diet quality and reduce chronic disease risk. There are opportunities for more healthful dietary patterns where consumer preference for meat and its nutritional quality can help improve overall dietary quality.

5.1 Meat Consumption

Longstanding perceptions regarding overconsumption of meat have led to “eat less red meat” guidance.[22]. Data sources for the calculation of meat intake are varied and contribute to discrepancies in the published literature [65]. Using a combination of loss-adjusted agricultural supply data and NHANES dietary recall data Fehrenbach et al. [66] estimates that per capita total meat consumption (beef, pork, poultry, fish – fresh or processed) in the U.S. ranges between 4.4 to 5.9 ounces per day for ages two years and older with 22% consumed as processed meat [66]. More recently, Zeng et al. [67] estimates Americans consume on average 3.5 ounces per day of fresh beef, pork, and poultry. As regards beef intake, NHANES data indicates that on average, Americans 2 years and older consume 1.5 oz of total beef each day, below the 1.8 oz of red meat modeled in the Healthy U.S.-Style Dietary

Pattern (HUSS) of the DGA. Evidence also indicates that Americans who eat beef favor fresh lean beef, typically consuming above the DGA dietary pattern modeled amount of 1.8 ounces of red meat, but below the modeled amount of 3.7 ounces combined for lean meat, poultry, and/or eggs. Collectively, Americans consume moderate amounts of meat at or near amounts modeled for total protein foods in the DGA at 5.5 ounce equivalents per day [22].

5.2. Meat in Popular Meals

The most common consumption of meat in America falls into two primary categories, mixed dishes and sandwiches [68-75]. Mixed dishes include a variety of meal types including sandwiches, casseroles, and soups and stews. "Mixed dishes" is the top consumed category at both lunch and dinner for children and adults [68-75]. As a frequently consumed meal in the U.S., sandwiches are a foundational foodway of the American diet [76]. There is an opportunity to use popular American meal types to improve on diet quality. On any given day it is estimated that one in five Americans (21.4%) ages two years and older consumes a beef sandwich meal [76]. For many Americans "sandwiches, including burgers, are…an integral part of the American food context and culture" and represent a convenient and economical way to increase consumption of many under-[29]. Recent deliberations of the 2025 DGAC note that this category is a top contributor to several key food groups, including total vegetables, dairy and fortified soy, protein and total grains[OBJ][OBJ]. As such, on a per consumer basis, total beef sandwiches (all types) collectively (including beef and non-beef sandwich components) accounted for 39% of vitamin B12, 38% of protein, 32% of iron , 26% choline, and 23% potassium total dietary intake for U.S. beef sandwich consumers ages two years and older, with the beef component responsible for the majority of key nutrients, contributing 22%, 18%, and 32% of total dietary intake of protein, choline, and vitamin B12, respectively, by beef sandwich consumers [76]. While contributions of "nutrients to limit" found in "burgers and sandwiches" are often highlighted (e.g., sodium, excess energy, and saturated fat) the specific contribution made by the predominant protein filling versus other components of the sandwich is often not distinguished. In fact, evidence indicates that the non-beef components of beef sandwiches (e.g., cheese, bun, condiments such as ketchup and salsa) are the primary contributors to "nutrients to limit" [76].

This evidence indicates that Americans can enhance nutrient contributions from meat meals by selecting lean cuts and limiting use of saturated fat- or sodium-rich components and condiments [4,76]. Practical advice regarding lean meat selections might include, "look for 95% lean ground beef", "choose loin or round cuts", or "consider steaks such as strip steak, sirloin, and flank steak". In addition, using herbs and spices to flavor popular meat dishes has also been shown to reduce energy, sodium, and saturated fat content while maintaining or improving consumer acceptabililty [77]. Advice to remove the skin from poultry and avoid fried chicken serves as practical advice for selecting/preparing poultry. In an effort to disseminate positive eating behavior messages across the food supply chain, consideration of promotion and accessibility of healthful food pairings is also necessary. Marketing practices could embrace this approach with meat industry marketing consistently showcasing closely trimmed beef and pork cuts and skinless poultry, in recommended portion sizes, paired with other nutrient-dense under-consumed foods. Private and public sectors can collaborate to publish and promote a complete list of lean cuts of meat, while at the same time educating consumers that while meat substitutes may be produced to mimic meat, nutritionally they are not the same [78-80]. With a collective effort, simple educational strategies can significantly improve the ability of Americans to recognize and choose healthy, balanced meals.

5.3. Meat in Plant-Based Eating Patterns

Popular eating patterns considered to be "gold standard" and/or "plant-sourced" often contain meat at average levels consumed in the U.S. diet and consequently contribute positively to nutrient status. For example, it is often thought that adoption of a Mediterranean-style diet requires reduction in the amount of red meat consumed, but red meat consumption in Mediterranean countries has been reported as similar or higher than in the U.S. [35,81,82]. Consistent evidence suggests that additional pork and beef, or beef alone, in Mediterranean-style and DASH diets maintains or improves the cardiometabolic benefits of these healthy dietary patterns for adults with and without existing chronic disease risk factors [83-85].

Systematic review evidence further suggests that emphasizing recommendations to increase fiber and fruit/vegetable intake rather than advising reduction of red meat intake positively impact mood and stress outcomes in study participants [86]. Behavioral research also suggests that when shifting dietary habits, it is easier to create behavior change by reinforcing positive, rather than penalizing, negative behaviors. Personal, positive education campaigns, for both individuals and the general public, that "meet people where they are" offer an opportunity to shift dietary habits. A recent study found positive messages coupled with reference to a dynamic descriptive norm (e.g. more and more people are enacting the suggested behavior), especially when people strongly identify with the group described, are more persuasive and have a better chance of creating long lasting behavior change [87]. Familiarity is also a driver of consumer acceptance [90] so in utilizing the preference for meat, a message construct to increase vegetable intake could be, "Meat eaters are eating more vegetables like broccoli, cauliflower and carrots to help balance their diets." Consumers can also be advised to use lentils and legumes, such as chickpeas, as protein substitutes for rice in grain-source casseroles. Topping casseroles and other mixed dishes with chopped nuts and/or seeds can increase the amount of these plant-proteins, and related fiber intake, while reducing refined grains. Advice to switch higher-fat, creamy sauces for lower-fat and/or lower-sodium versions or to use pureed vegetables as sauce represent options to further improve on the quality of grain source mixed dishes. Varying the ratio of grains to meat and vegetables to favor vegetables/meat is another option to provide more nutrient-dense meals with fewer calories.

5.4. Dietary Flexibility with Meat in Higher Protein Patterns

Data collected by the International Food Information Council from 3,000 Americans further suggests that consumers are actively seeking higher-protein diets. Specifically, "the number of consumers trying to consume protein continues to rise: 59% in 2022, 67% in 2023, to 71% in 2024, with more than half of Americans reporting consumption of a specific dietary pattern in the past year with a higher-protein pattern reported as the most popular [88]. Increased meal satisfaction may be one of the reasons higher-protein diets are sought after. A recent study comparing eucaloric, isonitrogenous diets (15% of daily intake as protein) containing either two servings/d of fresh lean beef or plant equivalents for seven days/pattern found no difference in satiety between the diets but the consumption of the beef-based diet was more well-liked and resulted in voluntary reductions in total carbohydrate and sugar intake [89].

Evidence supports the ability to successfully model higher-protein diets that increase the intake of both high-quality plant and animal protein, improve contributions of shortfall nutrients, and reduce nutrients of concern such as sodium [90,91]. Modeling the DGA HUSS dietary pattern to include 30% of calories as protein primarily derived from animal sources, while maintaining fruit and vegetable food group levels, resulted in a pattern with less total fat and saturated fat and higher iron, zinc, and selenium than the typical HUSS pattern [90]. Similarly, Murphy et al. [91] found modeling the HUSS pattern to

contain 20% or 25% of calories as protein from any source resulted in significant reductions in refined grains and starchy vegetables while increasing protein from beans and peas, seafood, and soy products along with meat, poultry and eggs. Dividing meat and poultry groups into fresh versus processed, and targeting step-wise reductions in processed meat and processed poultry, also lowered sodium and saturated fat in these higher-protein patterns [91].

6.0 Sustainability Considerations for the Production and Consumption of Meat

This discussion assumes the continued availability of sufficient and affordable meat to support the role of meat as a staple food. However, the sustainability of livestock production is a key consideration for our food system's future.

Sustainable food production is a global challenge requiring local solutions that consider environmental, economic, and social factors [92]. Food production is necessary to sustain human life, particularly for staple foods like meat; however, food production has an environmental cost. Livestock production, particularly cattle, is resource-intensive and impacts the environment through resource use, ecosystem services, and greenhouse gas emissions [93-95]. In 2022, U.S. agriculture contributed 9.4% of total direct greenhouse gas emissions, with livestock accounting for 4.3% [96]. Removing all livestock would reduce total emissions by an estimated 2.6% [97]. While meat may not be defined as essential for human nutrition, it is a preferred protein source, necessitating sustainable livestock production practices.

6.1 Ruminant Livestock

Cattle, as ruminant animals, play a unique role in food systems as they are capable of converting human-inedible plant materials and by-products into high-quality protein and essential nutrients [98]. Continued innovations in cattle feeding, management, and genetics have improved beef production sustainability, with the U.S. producing 20% more beef using 15% fewer cattle than 50 years ago [99]. The U.S. Roundtable for Sustainable Beef (USRSB) provides a framework for evaluating and enhancing beef sustainability [100].

6.2 Monogastric Livestock

As monogastric animals, poultry and swine are less resource-intensive and more efficient in converting feed into nutrient-rich protein foods; however, as monogastrics, they rely on water-intensive grains and soybeans as sources of their own feed and use more feed sources that could otherwise be consumed by humans [93,94]. Poultry production has a lower environmental impact than ruminants but faces challenges like waste management, antibiotic use, as well as transmission of zoonotic and panzootic diseases [94]. The U.S. Roundtable for Sustainable Poultry and Eggs (US-RSPE) and the U.S. pork industry have set goals for continuous improvement of sustainability metrics and efforts to reduce greenhouse gas emissions [95].

6.3 Food Waste

One of the greatest opportunities for the continuous improvement necessary to achieve more sustainable food systems involves a collective effort to reduce food waste; according to recent estimates, approximately 30-40% of the U.S. food supply is wasted [101]. While meat tends to be one of the least wasted foods, reducing food waste can significantly lower environmental impacts,

improve efficiency and enhance food security [102]. A recent comprehensive environmental assessment of beef production and consumption in the U.S. highlighted that decreasing food waste related to beef, particularly at the consumer level, could lead to an 11% overall reduction in environmental impact, positioning food waste reduction as a critical strategy for enhancing the sustainability of beef [103]. Minimizing waste across all meat categories optimizes the efficiency of the overall food system, conserves resources and aligns with sustainability goals.

7.0. Research Gaps and Future Considerations Regarding Meat in Healthy Dietary Patterns

Expansion of higher quality evidence to better understand the amounts/ranges of meat that can support healthier dietary patterns is needed. Evidence is also needed to better understand the contribution of meat to nutrient adequacy and security in lower income populations in America. Consumer behavior research to improve our understanding of how to shift suboptimal dietary behaviors could provide insight on how to optimize dietary patterns in America for improved health outcomes.

Additional food pattern modeling research is needed, aiming not only to achieve nutrient intake levels but consider the bioavailability of nutrients, which is lacking in the current DGAC modeling approach [42]. Development of dietary intake assessment tools that allow for appropriate classification of meat based on meat type (e.g., beef vs. pork rather than "red meat"), meat processing level (e.g., separation of processed poultry from processed beef and pork; minimally processed vs. ultra-processed), and fat content (e.g., poultry with or without skin) is needed. A better understanding of poultry consumption as fresh or processed, lean or higher fat, is necessary to tailor consumption advice for consumers of this popular meat in America.

Research questions further arise from the concept of complete or partial replacement of animal-source proteins with plant-source alternatives and substitutes in the context of the American diet. For example, what is the consequence of a shift toward plant-source protein and substitutes on U.S. food security? Does increasing the amount of plant-source protein substitutes/alternative increase the risk for micro-nutrient deficiencies, particularly in vulnerable subpopulations who currently rely on animal-source protein for these nutrients? As regards to beef, specifically, the question has been asked "is the combination of beef's nutrients and bioactive food components in its whole food matrix uniquely synergistic (or antagonistic) and beneficial for specific health outcomes?" and do the bioactive and nutrients of beef complement those of fruits, vegetables and whole grains increasing absorption in the context of a balanced diet [103]. Identifying and expanding the evidence base for meat in healthy dietary patterns represents a critical next step in public health recommendations designed to improve nutrient adequacy and security in the United States.

A recently published analysis confirms that heterogeneity in meat food group terminology and subsequent misclassification is of a degree sufficient to challenge reported associations between meat intake and chronic disease risk from observational studies, particularly, cancer and cardiovascular disease [104,105]. The 2015 DGAC noted this concern, indicating that "lean meats were not consistently defined or handled similarly between studies " and the 2020 DGAC noted that "In identifying the dietary components, the Committee used the terminology in the papers evaluated and a limitation is that terms such as lean meat, red meat, processed meat were not always defined clearly or differentiated from each other" and that "when information is limited or inconsistent, it is difficult to draw strong conclusions for what types and amounts of foods and beverages to consume or avoid such as "processed meat" vs. "red and processed meat" vs. "meat" [29,82]. Given the propensity for the

misclassification of meat in observational evidence and often diverging results between observational studies and RCTs, it is essential to critically evaluate the methodologies and terminologies used in this research. By examining these factors, we can better assess the impact of meat consumption on health outcomes and make informed dietary recommendations.

8.0. Strengths and Limitations of this Review

The strength of this review includes the use of existing scientific evidence to develop practical insights and recommendations for health professionals and consumers looking to maintain or increase their consumption of animal-source protein to support nutritionally sound dietary patterns. The primary authors of this review are Ph.D. nutrition scientists and registered dietitians, with expertise in protein and animal-source foods and their relationship to health and consumer behavior regarding meat consumption. The current review is narrative in nature and, consequently, does not represent an exhaustive review of the available evidence. The range of topics for the variety of meat foods covered in the current review would require conducting a series of systematic reviews with more narrow research questions. Importantly, however, a narrative approach offers the opportunity for a broader discussion, integration, and synthesis of key topics related to meat consumption. The intent is to provide fresh insights on a frequently debated topic and help build reasonable hypotheses for future testing. Evidence is also limited in certain areas. Data are limited regarding nutrient intake and adequacy contributed by poultry, as such, this review is limited in detail regarding poultry. While lower income Americans are consistent consumers of beef, pork and poultry the contribution of these foods to the nutrient adequacy of this vulnerable subgroup is not fully understood.

9. Conclusion

Meat is a staple food that has contributed high-quality protein and bioavailable micronutrients to the diets of most Americans for centuries. Contemporary American meat consumption is moderate, being at or near levels modeled in the Dietary Guidelines for Americans although there are further opportunities for improving the way meat is consumed, including encouraging consumption of leaner and unprocessed forms. Observational evidence has identified associations with higher meat consumption in unhealthy dietary patterns. On the other hand, evidence from RCTs evaluating meat consumption in the context of healthy dietary patterns is supportive of meat's role for health. For those who choose to consume it, meat can serve as a bridge for Americans of all ages to build more accessible, culturally relevant, and nutrient-dense foodways.

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References

1. U.S. Department of Agriculture. What Are Staple Foods? (for SNAP Retailers). Available online: https://ask.usda.gov/s/article/What-are-staple-foods-For-SNAP-Retailers (accessed on 24 July 2024).
2. Food and Agriculture Organization of the United Nations. Staple Foods: What Do People Eat? In *Dimensions of Need: An Atlas of Food and Agriculture*, FAO: Rome, Italy, 1995; pp. 21-24.
3. Bray, R.W. History of Meat Science. Available online: https://meatscience.org/about-amsa/history-mission/history-of-meat-science (accessed on 24 July 2024).
4. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020-2025. 2020. Available online: https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf.
5. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. Food Is Medicine: A Project to Unify and Advance Collective Action. Available online: https://health.gov/our-work/nutrition-physical-activity/food-medicine (accessed on 24 July 2024).
6. Ederer, P.; Leroy, F. The Societal Role of Meat—What the Science Says. *Anim. Front.* **2023**, *13*, 3-8. https://doi.org/10.1093/af/vfac098
7. Chiles, R.M.; Fitzgerald, A.J. Why Is Meat So Important in Western History and Culture? A Genealogical Critique of Biophysical and Political-Economic Explanations. *Agric. Hum. Values* **2018**, *35*, 1-17. https://doi.org/10.1007/s10460-017-9787-7
8. FMI and the Foundation for Meat and Poultry Research and Education. *The Power of Meat 2024. An in-Depth Look at the Meat Department through the Shoppers' Eyes*; 2024.
9. Meat Institute. 19th Annual Power of Meat Reports Strong Meat Consumption, Evolving Consumer Trends. Available online: https://www.meatinstitute.org/press/19th-annual-power-meat-reports-strong-meat-consumption-evolving-consumer-trends (accessed on 24 July 2024).
10. Consumer Beef Tracker, January 2024 - June 2024.
11. Perera, T.; Russo, C.; Takata, Y.; Bobe, G. Legume Consumption Patterns in Us Adults: National Health and Nutrition Examination Survey (NHANES) 2011-2014 and Beans, Lentils, Peas (BLP) 2017 Survey. *Nutrients* **2020**, *12*, 1237. https://doi.org/10.3390/nu12051237
12. National Academies of Sciences, Engineering, Medicine. *Alternative Protein Sources: Balancing Food Innovation, Sustainability, Nutrition, and Health: Proceedings of a Workshop*; The National Academies Press: Washington, DC, 2023; doi:10.17226/26923.
13. Neff, R.A.; Edwards, D.; Palmer, A.; Ramsing, R.; Righter, A.; Wolfson, J. Reducing Meat Consumption in the USA: A Nationally Representative Survey of Attitudes and Behaviours. *Public Health Nutr.* **2018**, *21*, 1835-1844. https://doi.org/10.1017/S1368980017004190
14. Daniel, C. Economic Constraints on Taste Formation and the True Cost of Healthy Eating. *Soc Sci Med* **2016**, *148*, 34-41. https://doi.org/https://doi.org/10.1016/j.socscimed.2015.11.025

15. Bailey, R.L.; Akabas, S.R.; Paxson, E.E.; Thuppal, S.V.; Saklani, S.; Tucker, K.L. Total Usual Intake of Shortfall Nutrients Varies with Poverty among Us Adults. *J. Nutr. Educ. Behav.* **2017**, *49*, 639-646.e633. https://doi.org/10.1016/j.jneb.2016.11.008
16. Garasky, S.; Mbwana, K.; Romualdo, A.; Tenaglio, A.; Roy, M. Foods Typically Purchased by SNAP Households. Prepared by Impaq International, LLC for USDA, Food and Nutrition Service. 2016. Available online: https://www.fns.usda.gov/research/snap/foods-typically-purchased-supplemental-nutrition-assistance-program-snap-households.
17. Poinsot, R.; Maillot, M.; Drewnowski, A. Fresh Pork as Protein Source in the USDA Thrifty Food Plan 2021: A Modeling Analysis of Lowest-Cost Healthy Diets. *Nutrients* **2023**, *15*. https://doi.org/10.3390/nu15081897
18. Center on Budget and Policy Priorities. SNAP Helps Struggling Families Put Food on the Table. Available online: https://www.cbpp.org/research/food-assistance/snap-helps-struggling-families-put-food-on-the-table-0 (accessed on 24 July 2024).
19. Federal Reserve Bank of St. Louis. Average Price: Beans, Dried, Any Type, All Sizes (Cost Per Pound/453.6 Grams) in U.S. City Average (Apu0000714233). Available online: https://fred.stlouisfed.org/series/APU0000714233 (accessed on).
20. Agarwal, S.; Fulgoni, V.L. Effect of Adding Pulses to Replace Protein Foods and Refined Grains in Healthy Dietary Patterns. *Nutrients* **2023**, *15*, 4355.
21. Winham, D.M.; Tisue, M.E.; Palmer, S.M.; Cichy, K.A.; Shelley, M.C. Dry Bean Preferences and Attitudes among Midwest Hispanic and Non-Hispanic White Women. *Nutrients* **2019**, *11*. https://doi.org/10.3390/nu11010178
22. Lau, C.S.; Fulgoni, V.L., 3rd; Van Elswyk, M.E.; McNeill, S.H. Trends in Beef Intake in the United States: Analysis of the National Health and Nutrition Examination Survey, 2001-2018. *Nutrients* **2023**, *15*, 2475. https://doi.org/10.3390/nu15112475
23. Agarwal, S.; Fulgoni, V.L., 3rd. Contribution of Beef to Key Nutrient Intakes in American Adults: An Updated Analysis with NHANES 2011-2018. *Nutr. Res.* **2022**, *105*, 105-112. https://doi.org/10.1016/j.nutres.2022.06.009
24. Agarwal, S.; Fulgoni, V.L. Association of Pork (All Pork, Fresh Pork and Processed Pork) Consumption with Nutrient Intakes and Adequacy in Us Children (Age 2–18 Years) and Adults (Age 19+ Years): NHANES 2011–2018 Analysis. *Nutrients* **2023**, *15*, 2293.
25. Agarwal, S.; McCullough, K.R.; Fulgoni, V.L., 3rd. Nutritional Effects of Removing a Serving of Meat or Poultry from Healthy Dietary Patterns-a Dietary Modeling Study. *Nutrients* **2023**, *15*. https://doi.org/10.3390/nu15071717
26. Federal Data Analysis Team and 2025 Dietary Guidelines Advisory Committee. Usual Intakes of Nutrients and Dietary Components and Comparison to Recommendations: Individuals Ages 1 Year and Older: Supplementary Data Analysis for the 2025 Dietary Guidelines Advisory Committee. U.S. Department of Health and Human Services, Office of the Assistant Secretary for Health, Office of Disease Prevention and Health Promotion. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, November 2024. Available online: https://www.dietaryguidelines.gov/sites/default/files/2024-12/DA_Supplement_Usual_Intakes_of_Nutrients_PSC.pdf.
27. Federal Data Analysis Team and 2025 Dietary Guidelines Advisory Committee. Usual Intakes of Food Groups, Subgroups, and Components and Comparison to Recommendations: Individuals Ages 6 Months and Older: Supplementary Data Analysis for the 2025 Dietary Guidelines Advisory Committee. U.S. Department

of Health and Human Services, Office of the Assistant Secretary for Health, Office of Disease Prevention and Health Promotion. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, November 2024. Available online: https://www.dietaryguidelines.gov/sites/default/files/2024-12/DA_Supplement_Usual_Intakes_Food_Groups_508c.pdf.

28. Population Reference Bureau. Fact Sheet: Aging in the United States. Available online: https://www.prb.org/resources/fact-sheet-aging-in-the-united-states/ (accessed on 24 July 2024).
29. 2020 Dietary Guidelines Advisory Committee. Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC. Available online: https://doi.org/10.52570/DGAC2020.
30. Steinfeldt, L.C.; Martin, C.L.; Goldman, J.D.; Moshfegh, A.J. Meeting Dietary Guidelines Recommendations: Older Adults: What We Eat in America, NHANES 2013-2016. July 2010. Available online: https://www.ncbi.nlm.nih.gov/books/NBK589211/.
31. Agarwal, S.; Fulgoni, V.L., 3rd. Beef Consumption Is Associated with Higher Intakes and Adequacy of Key Nutrients in Older Adults Age 60+ Years: National Health and Nutrition Examination Survey 2011-2018 Analysis. *Nutrients* **2024**, *16*. https://doi.org/10.3390/nu16111779
32. National Council on Aging. Eating Better on a Fixed Income: What You Can Buy for $23 in SNAP Benefits. Available online: https://www.ncoa.org/article/eating-better-on-a-fixed-income-what-you-can-buy-with-snap-benefits (accessed on 24 July 2024).
33. Marangoni, F.; Corsello, G.; Cricelli, C.; Ferrara, N.; Ghiselli, A.; Lucchin, L.; Poli, A. Role of Poultry Meat in a Balanced Diet Aimed at Maintaining Health and Wellbeing: An Italian Consensus Document. *Food Nutr. Res.* **2015**, *59*. https://doi.org/10.3402/fnr.v59.27606
34. Agarwal, S.; Fulgoni, V.L., 3rd. Contribution of Beef to Key Nutrient Intakes and Nutrient Adequacy in Pregnant and Lactating Women: NHANES 2011-2018 Analysis. *Nutrients* **2024**, *16*. https://doi.org/10.3390/nu16070981
35. Christifano, D.N.; Gustafson, K.M.; Carlson, S.E.; Mathis, N.B.; Brown, A.; Onuoha, O.; Taylor, M.K. The Role of Fresh Beef Intake and Mediterranean Diet Adherence During Pregnancy in Maternal and Infant Health Outcomes. *Nutrients* **2024**, *16*. https://doi.org/10.3390/nu16101436
36. Schwarzenberg, S.J.; Georgieff, M.K.; Committee on Nutrition. Advocacy for Improving Nutrition in the First 1000 Days to Support Childhood Development and Adult Health. *Pediatrics* **2018**, *141*. https://doi.org/10.1542/peds.2017-3716
37. Hawthorne, K.M.; Castle, J.; Donovan, S.M. Meat Helps Make Every Bite Count: An Ideal First Food for Infants. *Nutr. Today* **2022**, *57*, 8-13. https://doi.org/10.1097/nt.0000000000000523
38. Roess, A.A.; Jacquier, E.F.; Catellier, D.J.; Carvalho, R.; Lutes, A.C.; Anater, A.S.; Dietz, W.H. Food Consumption Patterns of Infants and Toddlers: Findings from the Feeding Infants and Toddlers Study (Fits) 2016. *J. Nutr.* **2018**, *148*, 1525S-1535S. https://doi.org/10.1093/jn/nxy171
39. Simeone, G.; Bergamini, M.; Verga, M.C.; Cuomo, B.; D'Antonio, G.; Iacono, I.D.; Mauro, D.D.; Mauro, F.D.; Mauro, G.D.; Leonardi, L., et al. Do Vegetarian Diets Provide Adequate Nutrient Intake During Complementary Feeding? A Systematic Review. *Nutrients* **2022**, *14*. https://doi.org/10.3390/nu14173591
40. Van Elswyk, M.E.; Murray, R.D.; McNeill, S.H. Iron-Rich Complementary Foods: Imperative for All Infants. *Curr. Dev. Nutr.* **2021**, *5*, nzab117. https://doi.org/10.1093/cdn/nzab117

41. Fulgoni, K.; Fulgoni, V.L. Beef Intake Is Associated with Higher Nutrient Intake and Nutrient Adequacy in U.S. Adolescents, NHANES 2001-2018. *Nutrients* **2023**, *15*, 4996.
42. Taylor, C.; Abrams, S.; Booth, S.; Byrd-Bredbenner, C.; Eicher-Miller, H.; Fung, T.; Jernigan, V.; Talegawkar, S.; Tobias, D.; Adler, M., et al. What Are the Implications for Nutrient Intakes When Modifying the Protein Foods Group and Subgroup Quantities within the Healthy U.S.-Style Dietary Pattern or Healthy Vegetarian Dietary Pattern? What Are the Implications for Nutrient Intakes When Proportions of Animal-Based Protein Foods Subgroups Are Reduced and Proportions of Plant-Based Protein Foods Subgroups Are Increased?: Food Pattern Modeling Protocol. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion. Nutrition Guidance and Analysis Division, Washington DC. June 2024. Available online: https://www.dietaryguidelines.gov/sites/default/files/2024-06/2025_DGAC_FPM_Q2_Protocol_Protein%20Foods_v3_508c.pdf.
43. Han, M.A.; Zeraatkar, D.; Guyatt, G.H.; Vernooij, R.W.M.; El Dib, R.; Zhang, Y.; Algarni, A.; Leung, G.; Storman, D.; Valli, C., et al. Reduction of Red and Processed Meat Intake and Cancer Mortality and Incidence: A Systematic Review and Meta-Analysis of Cohort Studies. *Ann. Intern. Med.* **2019**, *171*, 711-720. https://doi.org/10.7326/M19-0699
44. Johnston, B.; De Smet, S.; Leroy, F.; Mente, A.; Stanton, A. Non-Communicable Disease Risk Associated with Red and Processed Meat Consumption—Magnitude, Certainty, and Contextuality of Risk? *Anim. Front.* **2023**, *13*, 19-27. https://doi.org/10.1093/af/vfac095
45. Valli, C.; Rabassa, M.; Johnston, B.C.; Kuijpers, R.; Prokop-Dorner, A.; Zajac, J.; Storman, D.; Storman, M.; Bala, M.M.; Sola, I., et al. Health-Related Values and Preferences Regarding Meat Consumption: A Mixed-Methods Systematic Review. *Ann. Intern. Med.* **2019**, *171*, 742-755. https://doi.org/10.7326/M19-1326
46. Vernooij, R.W.M.; Zeraatkar, D.; Han, M.A.; El Dib, R.; Zworth, M.; Milio, K.; Sit, D.; Lee, Y.; Gomaa, H.; Valli, C., et al. Patterns of Red and Processed Meat Consumption and Risk for Cardiometabolic and Cancer Outcomes: A Systematic Review and Meta-Analysis of Cohort Studies. *Ann. Intern. Med.* **2019**, *171*, 732-741. https://doi.org/10.7326/M19-1583
47. Wang, Y.; Pitre, T.; Wallach, J.D.; de Souza, R.J.; Jassal, T.; Bier, D.; Patel, C.J.; Zeraatkar, D. Grilling the Data: Application of Specification Curve Analysis to Red Meat and All-Cause Mortality. *J. Clin. Epidemiol.* **2024**, *168*, 111278. https://doi.org/10.1016/j.jclinepi.2024.111278
48. Zeraatkar, D.; Han, M.A.; Guyatt, G.H.; Vernooij, R.W.M.; El Dib, R.; Cheung, K.; Milio, K.; Zworth, M.; Bartoszko, J.J.; Valli, C., et al. Red and Processed Meat Consumption and Risk for All-Cause Mortality and Cardiometabolic Outcomes: A Systematic Review and Meta-Analysis of Cohort Studies. *Ann. Intern. Med.* **2019**, *171*, 703-710. https://doi.org/10.7326/M19-0655
49. Zeraatkar, D.; Johnston, B.C.; Bartoszko, J.; Cheung, K.; Bala, M.M.; Valli, C.; Rabassa, M.; Sit, D.; Milio, K.; Sadeghirad, B., et al. Effect of Lower Versus Higher Red Meat Intake on Cardiometabolic and Cancer Outcomes: A Systematic Review of Randomized Trials. *Ann. Intern. Med.* **2019**, *171*, 721-731. https://doi.org/10.7326/M19-0622
50. Vorland, C.J.; O'Connor, L.E.; Henschel, B.; Huo, C.; Shikany, J.M.; Serrano, C.A.; Henschel, R.; Dickinson, S.L.; Ejima, K.; Bidulescu, A., et al. 'Shaking the Ladder' Reveals How Analytic Choices Can Influence Associations in Nutrition Epidemiology: Beef Intake and Coronary Heart Disease as a Case Study (Preprint). *medRxiv* **2023**, *12*, 23299578. https://doi.org/10.1101/2023.12.05.23299578
51. Maki, K.C.; Slavin, J.L.; Rains, T.M.; Kris-Etherton, P.M. Limitations of Observational Evidence: Implications for Evidence-Based Dietary Recommendations. *Adv. Nutr.* **2014**, *5*, 7-15. https://doi.org/10.3945/an.113.004929

52. Klurfeld, D.M. What Is the Role of Meat in a Healthy Diet? *Anim Front* **2018**, *8*, 5-10. https://doi.org/10.1093/af/vfy009
53. O'Connor, L.E.; Kim, J.E.; Campbell, W.W. Total Red Meat Intake of ≥0.5 Servings/Day Does Not Negatively Influence Cardiovascular Disease Risk Factors: A Systemically Searched Meta-Analysis of Randomized Controlled Trials. *Am. J. Clin. Nutr.* **2017**, *105*, 57-69. https://doi.org/10.3945/ajcn.116.142521
54. Guasch-Ferré, M.; Satija, A.; Blondin, S.A.; Janiszewski, M.; Emlen, E.; O'Connor, L.E.; Campbell, W.W.; Hu, F.B.; Willett, W.C.; Stampfer, M.J. Meta-Analysis of Randomized Controlled Trials of Red Meat Consumption in Comparison with Various Comparison Diets on Cardiovascular Risk Factors. *Circulation* **2019**, *139*, 1828-1845. https://doi.org/10.1161/CIRCULATIONAHA.118.035225
55. Maki, K.C.; Van Elswyk, M.E.; Alexander, D.D.; Rains, T.M.; Sohn, E.L.; McNeill, S. A Meta-Analysis of Randomized Controlled Trials That Compare the Lipid Effects of Beef Versus Poultry and/or Fish Consumption. *J. Clin. Lipidol.* **2012**, *6*, 352-361. https://doi.org/10.1016/j.jacl.2012.01.001
56. Sanders, L.M.; Wilcox, M.L.; Maki, K.C. Red Meat Consumption and Risk Factors for Type 2 Diabetes: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Eur J Clin Nutr* **2023**, *77*, 156-165. https://doi.org/10.1038/s41430-022-01150-1
57. Zhong, V.W.; Van Horn, L.; Greenland, P.; Carnethon, M.R.; Ning, H.; Wilkins, J.T.; Lloyd-Jones, D.M.; Allen, N.B. Associations of Processed Meat, Unprocessed Red Meat, Poultry, or Fish Intake with Incident Cardiovascular Disease and All-Cause Mortality. *JAMA Intern Med* **2020**, *180*, 503-512. https://doi.org/10.1001/jamainternmed.2019.6969
58. Papier, K.; Knuppel, A.; Syam, N.; Jebb, S.A.; Key, T.J. Meat Consumption and Risk of Ischemic Heart Disease: A Systematic Review and Meta-Analysis. *Crit Rev Food Sci Nutr* **2023**, *63*, 426-437. https://doi.org/10.1080/10408398.2021.1949575
59. Shi, W.; Huang, X.; Schooling, C.M.; Zhao, J.V. Red Meat Consumption, Cardiovascular Diseases, and Diabetes: A Systematic Review and Meta-Analysis. *Eur. Heart J.* **2023**, *44*, 2626-2635. https://doi.org/10.1093/eurheartj/ehad336
60. Sanders, L.M.; Palacios, O.M.; Wilcox, M.L.; Maki, K.C. Beef Consumption and Cardiovascular Disease Risk Factors: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *Curr. Dev. Nutr.* **2024**, *8*, 104500. https://doi.org/10.1016/j.cdnut.2024.104500
61. U.S. Department of Agriculture, Economic Research Service. Loss Adjusted Food Availability (Per Capita) Data System - Meat, Poultry, Fish, Eggs, and Nuts. Available online: https://www.ers.usda.gov/webdocs/DataFiles/50472/meat.xls?v=34.4 (accessed on).
62. Stierman, B.; Afful, J.; Carroll, M.D.; Chen, T.-C.; Davy, O.; Fink, S.; Fryar, C.D.; Gu, Q.; Hales, C.M.; Hughes, J.P., et al. National Health Statistics Reports: National Health and Nutrition Examination Survey 2017–March 2020 Prepandemic Data Files—Development of Files and Prevalence Estimates for Selected Health Outcomes. 2021. Available online: https://www.cdc.gov/nchs/data/nhsr/nhsr158-508.pdf.
63. Ward, Z.J.; Bleich, S.N.; Long, M.W.; Gortmaker, S.L. Association of Body Mass Index with Health Care Expenditures in the United States by Age and Sex. *PLoS One* **2021**, *16*, e0247307. https://doi.org/10.1371/journal.pone.0247307
64. Habumugisha, T.; Engebretsen, I.M.S.; Maren, I.E.; Kaiser, C.W.M.; Dierkes, J. Reducing Meat and/or Dairy Consumption in Adults: A Systematic Review and Meta-Analysis of Effects on Protein Intake, Anthropometric Values, and Body Composition. *Nutr. Rev.* **2024**, *82*, 277-301. https://doi.org/10.1093/nutrit/nuad055
65. Daniel, C.R.; Cross, A.J.; Koebnick, C.; Sinha, R. Trends in Meat Consumption in the USA. *Public Health Nutr.* **2011**, *14*, 575-583. https://doi.org/10.1017/S1368980010002077

66. Fehrenbach, K.S.; Righter, A.C.; Santo, R.E. A Critical Examination of the Available Data Sources for Estimating Meat and Protein Consumption in the USA. *Public Health Nutr* **2016**, *19*, 1358-1367. https://doi.org/10.1017/S1368980015003055
67. Zeng L, R.M., Liu J, Wilde P, Naumova EN, Mozaffarian D, Zhang FF. Trends in Processed Meat, Unprocessed Red Meat, Poultry, and Fish Consumption in the United States, 1999-2016. *J. Acad. Nutr. Diet.* **2019**, *119*, 1085-1098. https://doi.org/10.1016/j.jand.2019.04.004
68. Hoy, M.K.; Sebastian, R.S.; Goldman, J.D.; Moshfegh, A.J. Snack Consumption by U.S. Children and Adolescents. What We Eat in America, NHANES 2017-March 2020. April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/52_Snacks_Consumption_by_Children_1720.pdf.
69. Hoy, M.K.; Sebastian, R.S.; Murayi, T.; Goldman, J.D.; Moshfegh, A.J. Dinner Consumption by U.S. Children and Adolescents. What We Eat in America, NHANES 2017-March 2020 April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/54_Dinner_Consumption_by_Children_1720.pdf.
70. Hoy, M.K.; Sebastian, R.S.; Murayi, T.; Goldman, J.D.; Moshfegh, A.J. Lunch Consumption by U.S. Children and Adolescents. What We Eat in America, NHANES 2017-March 2020 April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/56_Lunch_Consumption_by_Children_1720.pdf.
71. Hoy, M.K.; Sebastian, R.S.; Murayi, T.; Goldman, J.D.; Moshfegh, A.J. Breakfast Consumption by U.S. Children and Adolescents. What We Eat in America, NHANES 2017-March 2020 April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/58_Breakfast_Consumption_by_Children_1720.pdf.
72. Sebastian, R.S.; Hoy, M.K.; Goldman, J.D.; Moshfegh, A.J. Snack Consumption by U.S. Adults. What We Eat in America, NHANES 2017 - March 2020. April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/53_Snacks_Consumption_by_Adults_1720.pdf.
73. Sebastian, R.S.; Hoy, M.K.; Murayi, T.; Goldman, J.D.; Moshfegh, A.J. Dinner Consumption by U.S. Adults. What We Eat in America, NHANES 2017 - March 2020. April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/55_Dinner_Consumption_by_Adults_1720.pdf.
74. Sebastian, R.S.; Hoy, M.K.; Murayi, T.; Goldman, J.D.; Moshfegh, A.J. Lunch Consumption by U.S. Adults. What We Eat in America, NHANES 2017 - March 2020. April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/57_Lunch_Consumption_by_Adults_1720.pdf .
75. Sebastian, R.S.; Hoy, M.K.; Murayi, T.; Goldman, J.D.; Moshfegh, A.J. Breakfast Consumption by U.S. Adults. What We Eat in America, NHANES 2017 - March 2020. April 2024. Available online: https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/DBrief/59_Breakfast_Consumption_by_Adults_1720.pdf.
76. Murphy, M.M.; Anderson, M.M.; Bi, X. Consumption of Beef Sandwiches in the United States and Contributions to Intake of Energy and Select Nutrients. *Front. Nutr.* **2024**, *11*, 1355490. https://doi.org/10.3389/fnut.2024.1355490

77. Petersen, K.S.; Fulgoni, V.L., 3rd; Hopfer, H.; Hayes, J.E.; Gooding, R.; Kris-Etherton, P. Using Herbs/Spices to Enhance the Flavor of Commonly Consumed Foods Reformulated to Be Lower in Overconsumed Dietary Components Is an Acceptable Strategy and Has the Potential to Lower Intake of Saturated Fat and Sodium: A National Health and Nutrition Examination Survey Analysis and Blind Tasting. *J. Acad. Nutr. Diet.* **2024**, *124*, 15-27 e11. https://doi.org/10.1016/j.jand.2023.07.025
78. Church, D.D.; Hirsch, K.R.; Kviatkovsky, S.A.; Matthews, J.J.; Ferrando, A.A.; Azhar, G.; Wolfe, R.R. The Anabolic Response to a Ground Beef Patty and Soy-Based Meat Alternative: A Randomized Controlled Trial. *Am J Clin Nutr* **2024**, *120*, 1085-1092. https://doi.org/10.1016/j.ajcnut.2024.08.030
79. Hernandez, M.S.; Coyle, K.; Siebecker, M.G.; Woerner, D.R.; Brooks, J.C.; Legako, J.F. Nutritional Profiling of Plant-Based Meat Alternatives and Ground Beef. *J. Food Sci.* **2024**, *89*, 9230-9242. https://doi.org/https://doi.org/10.1111/1750-3841.17579
80. American Society for Nutrition. In Brief: Achieving a Transparent, Actionable Framework for Public-Private Partnerships for Food and Nutrition Research. *J. Acad. Nutr. Diet.* **2015**, *115*, 1318-1319. https://doi.org/10.1016/j.jand.2015.06.004
81. Kromhout, D.; Keys, A.; Aravanis, C.; Buzina, R.; Fidanza, F.; Giampaoli, S.; Jansen, A.; Menotti, A.; Nedeljkovic, S.; Pekkarinen, M., et al. Food Consumption Patterns in the 1960s in Seven Countries. *Am. J. Clin. Nutr.* **1989**, *49*, 889-894. https://doi.org/10.1093/ajcn/49.5.889
82. Dietary Guidelines Advisory Committee. Scientific Report of the 2015 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and the Secretary of Agriculture. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC. Available online: https://www.dietaryguidelines.gov/sites/default/files/2019-05/Scientific-Report-of-the-2015-Dietary-Guidelines-Advisory-Committee.pdf.
83. Roussell, M.A.; Hill, A.M.; Gaugler, T.L.; West, S.G.; Heuvel, J.P.; Alaupovic, P.; Gillies, P.J.; Kris-Etherton, P.M. Beef in an Optimal Lean Diet Study: Effects on Lipids, Lipoproteins, and Apolipoproteins. *Am. J. Clin. Nutr.* **2012**, *95*, 9-16. https://doi.org/10.3945/ajcn.111.016261
84. O'Connor, L.E.; Paddon-Jones, D.; Wright, A.J.; Campbell, W.W. A Mediterranean-Style Eating Pattern with Lean, Unprocessed Red Meat Has Cardiometabolic Benefits for Adults Who Are Overweight or Obese in a Randomized, Crossover, Controlled Feeding Trial. *Am. J. Clin. Nutr.* **2018**, *108*, 33-40. https://doi.org/10.1093/ajcn/nqy075
85. Fleming, J.A.; Kris-Etherton, P.M.; Petersen, K.S.; Baer, D.J. Effect of Varying Quantities of Lean Beef as Part of a Mediterranean-Style Dietary Pattern on Lipids and Lipoproteins: A Randomized Crossover Controlled Feeding Trial. *Am. J. Clin. Nutr.* **2021**, *113*, 1126-1136. https://doi.org/10.1093/ajcn/nqaa375
86. Opie, R.S.; O'Neil, A.; Itsiopoulos, C.; Jacka, F.N. The Impact of Whole-of-Diet Interventions on Depression and Anxiety: A Systematic Review of Randomised Controlled Trials. *Public Health Nutr.* **2015**, *18*, 2074-2093. https://doi.org/10.1017/S1368980014002614
87. Kakoschke, N.; Cox, D.N.; Ryan, J.; Gwilt, I.; Davis, A.; Jansons, P.; de Courten, B.; Brinkworth, G. Disrupting Future Discounting: A Commentary on an Underutilised Psychological Approach for Improving Adherence to Diet and Physical Activity Interventions. *Public Health Nutr* **2023**, *26*, 1088-1093. https://doi.org/10.1017/S136898002200252X
88. International Food Information Council. 2024 IFIC Food & Health Survey. Available online: https://foodinsight.org/2024-food-health-survey/ (accessed on).
89. Braden, M.L.; Gwin, J.A.; Leidy, H.J. A Diet Containing Animal Source Protein as Fresh, Lean Beef Is More Well-Liked and Promotes Healthier Eating Behavior Compared to Plant-Based Alternatives in Women with Overweight. *Curr. Dev. Nutr.* **2024**, *104415*. https://doi.org/10.1016/j.cdnut.2024.104415

90. Wolfe, R.R.; Cifelli, A.M.; Kostas, G.; Kim, I.Y. Optimizing Protein Intake in Adults: Interpretation and Application of the Recommended Dietary Allowance Compared with the Acceptable Macronutrient Distribution Range. *Adv. Nutr.* **2017**, *8*, 266-275. https://doi.org/10.3945/an.116.013821
91. Murphy, M.M.; Barraj, L.M.; Higgins, K.A. Healthy U.S.-Style Dietary Patterns Can Be Modified to Provide Increased Energy from Protein. *Nutr. J.* **2022**, *21*, 39. https://doi.org/10.1186/s12937-022-00794-w
92. Bandari, R.; Moallemi, E.A.; Kharrazi, A.; Trogrlić, R.Š.; Bryan, B.A. Transdisciplinary Approaches to Local Sustainability: Aligning Local Governance and Navigating Spillovers with Global Action Towards the Sustainable Development Goals. *Sustain. Sci.* **2024**, *19*, 1293-1312. https://doi.org/10.1007/s11625-024-01494-6
93. Jilo, S.A.; Hasan, L.A. The Importance of Poultry Meat in Medicine: A Review. *J World Poult Res* **2022**, *12*, 258-262.
94. Grzinic, G.; Piotrowicz-Cieslak, A.; Klimkowicz-Pawlas, A.; Gorny, R.L.; Lawniczek-Walczyk, A.; Piechowicz, L.; Olkowska, E.; Potrykus, M.; Tankiewicz, M.; Krupka, M., et al. Intensive Poultry Farming: A Review of the Impact on the Environment and Human Health. *Sci. Total Environ.* **2023**, *858*, 160014. https://doi.org/10.1016/j.scitotenv.2022.160014
95. U.S. Roundtable for Sustainable Poultry & Eggs. The US-RSPE Sustainability Framework. Available online: https://www.us-rspe.org/resources/index.cfm (accessed on 21 August 2024).
96. Environmental Protection Agency. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022. 2024. Available online: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-andsinks-1990-2022.
97. White, R.; Hall, M.B. Nutritional and Greenhouse Gas Impacts of Removing Animals from Us Agriculture. *Proc Natl Acad Sci* **2017**, *114*, E10301-10308. https://doi.org/10.1073/pnas.1707322114
98. Layman, D.K. Assessing the Role of Cattle in Sustainable Food Systems. *Nutr. Today* **2018**, *53*, 160-165. https://doi.org/10.1097/nt.0000000000000286
99. Rotz, C.A. Impact of Beef Cattle on the Environment. American Dairy Science Association Proceedings. 2023. Available online: https://www.ars.usda.gov/research/publications/publication/?seqNo115=402563.
100. U.S. Roundtable For Sustainable Beef. Our Framework. Available online: https://www.usrsb.org/our-work/our-framework (accessed on 04 September 2024).
101. Jaglo, K.; Kenny, S.; Stephenson, J. From Farm to Kitchen: The Environmental Impacts of U.S. Food Waste. Environmental Protection Agency, 2021. Available online: https://www.epa.gov/system/files/documents/2021-11/from-farm-to-kitchen-the-environmental-impacts-of-u.s.-food-waste_508-tagged.pdf.
102. Karwowska, M.; Łaba, S.; Szczepański, K. Food Loss and Waste in Meat Sector—Why the Consumption Stage Generates the Most Losses? *Sustainability* **2021**, *13*, 6227.
103. Klurfeld, D.M. The Whole Food Beef Matrix Is More Than the Sum of Its Parts. *Crit. Rev. Food Sci. Nutr.* **2024**, *64*, 4523–4531. https://doi.org/10.1080/10408398.2022.2142931
104. Hill, E.R.; O'Connor, L.E.; Wang, Y.; Clark, C.M.; McGowan, B.S.; Forman, M.R.; Campbell, W.W. Red and Processed Meat Intakes and Cardiovascular Disease and Type 2 Diabetes Mellitus: An Umbrella Systematic Review and Assessment of Causal Relations Using Bradford Hill's Criteria. *Crit Rev Food Sci Nutr* **2024**, *64*, 2423-2440. https://doi.org/10.1080/10408398.2022.2123778
105. O'Connor, L.E.; Herrick, K.A.; Parsons, R.; Reedy, J. Heterogeneity in Meat Food Groups Can Meaningfully Alter Population-Level Intake Estimates of Red Meat and Poultry. *Front. Nutr.* **2021**, *8*, 778369. https://doi.org/10.3389/fnut.2021.778369

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