The Effect of Plant-Based Diets on Dietary Recommendation Trends In The U.S.

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction: Plant-Based Diets and Dietary Guidelines

In recent years, climate change has emerged as a pressing issue that demands attention from governments, organizations, and individuals worldwide. Evidence shows that the consequences of climate change have led to Earth warming by 1.90˚F since the industrial revolution (Lindsey & Dahlman, 2023). This warming trend has had far-reaching effects, impacting food sources, instigating natural disasters, and raising numerous ethical dilemmas that demand our immediate attention and action (NOAA, 2021).

As the United States (U.S.) grapples with the impacts of climate change, an increasing number of individuals are actively seeking ways to help the environment. Research conducted by the Pew Research Center reveals that 83% of U.S. adults are making conscious efforts to reduce the impacts of climate change (Funk, 2016). One approach gaining popularity is the transition from a carnivorous to a plant-based diet, with 6% of people in the U.S. now identifying as vegetarian, a significant increase from the 1% who did in 1994 (Visé, 2022).

Vegetarian and vegan diets stand out as prominent options in the realm of plant-based dietary choices. These choices offer benefits to the environment, including a significant reduction in greenhouse gas emissions and land use, both important considerations in the environment's well-being (Fresán & Sabaté, 2019). In addition to the environmental benefits, plant-based diets can help reduce diet-based health issues. One study found that vegetarian diets correlate with lower obesity rates, high blood cholesterol, and hypertension which are common ailments in the U.S. with serious impacts (Agnoli et al., 2023).

Dietary guidelines serve as a crucial framework that individuals and larger entities, such as schools, rely on to enhance the overall health of diets. In the U.S., dietary guidelines tend to

evolve alongside shifts in dietary trends and emerging research findings. Despite their foundation in scientific evidence, these guidelines have shown susceptibility to corporate interests (Callahan, 2023). Specifically examining the dietary guidelines set forth by the United States Department of Agriculture (USDA) and the Health and Human Services (HSS), there is controversy surrounding the appointment of board members, particularly those with affiliations to external entities (Heid, 2016). Additionally, the perpetual scientific debate surrounding the 'ideal diet' further complicates the guideline formulation.

There are numerous influences that can affect the dietary guidelines formulation in the U.S., including political, economic, and social movements that cause both positive and negative impacts on U.S. dietary guidelines. This thesis examines how these influences have impacted the role of plant-based diets in U.S. dietary guidelines.

Plant-Based Diets Background

While the plant-based diet has gained popularity as a recent trend in the U.S., it is essential to consider its historical background for a more comprehensive perspective. Plant-based diets have roots dating back centuries, with many cultures worldwide consuming them for religious or food availability reasons (Leitzmann, 2014). In the pre-industrial revolution U.S., before advancements like refrigeration and faster food transportation, meat consumption was lower than it is today (Coyle & McKinstry, 2023).

Leitzmann (2014) provides a thorough background of plant-based diets in more recent times. His research indicates that plant-based diets gained traction in the 1960s when researchers globally explored dietary patterns to identify an ideal diet. According to the article, there was

initially skepticism about plant-based diets contributing to malnutrition, stemming from the fact that poverty-stricken individuals were forced to rely solely on plant foods that did not supply enough nutrients. Despite this initial concern, research persisted, shedding light on the true potential and benefits of plant-based diets (Leitzmann, 2014).

By the 1980's, scientists were continuing to research plant-based diets and found evidence to support the idea that plant-based diets can improve the health of some people (Leitzmann, 2014). This research continued through the 1990's, and at same time, people in the U.S. started to accept vegetarian diets and reduce their red meat consumption (Daniel et al., 2011). While research in the field persists, the initial excitement has tapered off as most diet-based studies have been concluded. The ongoing exploration, however, highlights the enduring importance of this research.

In the present day, plant-based diets encompass diverse types, each with its own set of restrictions. Among the most popular are vegetarian, also known as lacto-ovo-vegetarian, excluding meat and fish; vegan, eliminating all animal products; pescatarian, similar to vegetarianism but incorporating fish; and flexitarian, a diet limiting but not eliminating meats. In the context of this paper, the term "plant-based diets" refers to the spectrum of diet types, encompassing vegetarianism predominantly.

Dietary Recommendations Background

For over a century, the USDA and HHS have played a pivotal role in shaping dietary guidelines. As our understanding of diets' impact on health advanced over the years, more substantial reports on diets were published, although they were simplistic by today's standards.

In response to growing concerns about overconsumption leading to diseases, the Senate Select Committee on Nutrition and Human Needs was established in 1977 (USDA & HHS, 2021). This laid the groundwork for the USDA and HHS to introduce the first of many regular guidelines in the U.S. in 1980, with the explicit goal of mitigating diet-related diseases and fostering a healthy eating culture (USDA & HHS, 2021).

Initially, these guidelines were concise visual aids, serving as practical tools for the general population to make informed dietary choices. As years passed, there was a transformative shift, and the guidelines evolved into comprehensive insights meant for professionals in the dietary field. This evolution also gave rise to more accessible guides, such as the food pyramid and MyPlate, specifically designed for the general public. Additionally, in later iterations, there was a notable change in emphasis from promoting specific nutrients and food groups to prioritizing overall dietary patterns, reducing the focus on individual food types (USDA & HHS, 2021).

Infrastructure Aspects of Dietary Guideline Transitions

When examining the infrastructure aspects of these dietary guideline transitions, Star's (1999) concept of infrastructure becomes instrumental. This concept provides a framework to understand the connections between the technical, human, and social dimensions during the transition to plant-based diets and its impact on dietary recommendations. Infrastructure, as defined by Star, is an intricate system housing technologies that are shaped by both human and other technologies influences. Star's concept of infrastructure highlights the connection between established and informal practices within the creation of dietary guidelines, shedding light on

how knowledge, social norms, and power dynamics influence the implementation of plant-based diets in dietary recommendations.

In Star's paper, she points out nine aspects of infrastructure, one of which is *links with conventions of practice*, which indicates that infrastructure is shaped by our traditions and customs while also influencing them (Star, 1999). In this scenario, where the infrastructure revolves around diets and dietary recommendations, there are numerous instances where the application of *links with conventions* of practice becomes relevant, including the conventions contained within the dietary guidelines themselves. Take, for example, the food pyramid created in 1995 which had "meat and bean" as one of its main categories (USDA & HHS, 1995). People in the U.S. have been taught that meat is a primary food group and is important for a healthy diet. U.S. diets have reflected this guidance, and the U.S. continues to be one of the highest consumers of meats in the world, consistently remaining in the top five countries for meat consumption per capita (*OECD*, 2023). This, in turn, creates a loop where the people making these guidelines maintain the convention that meat is an essential part of a healthy diet.

Another facet of infrastructure relevant to the transition to a plant-based diet is its *embeddedness.* According to Star (1999), embeddedness is the quality of infrastructure being deeply intertwined with and housed within other structures and technologies. *Embeddedness* is evident in the ingrained political component in the plant-based transition. Every governmental organization operates within a political framework, and the USDA and HHS are no different. The intertwining of dietary guidelines with our political system introduces an additional layer of complexity to the issue. Understanding that dietary guidelines are part of a larger political system is imperative for breaking down the reasoning behind plant-based trends in dietary guidelines.

By integrating Star's framework and examining trends in the context of *links with conventions of practice* and *embeddedness*, a comprehensive understanding of dietary guidelines within the context of the plant-based transition has emerged.

Research Question & Methods

A focal point in the transition to plant-based diets centers on dietary health. People in the U.S. rely heavily on dietary recommendations from government organizations and research journals as sources of information to understand diets and adopt healthy eating habits. Given that these recommendations undergo regular updates and are influenced by trends in information, a pressing question emerges: How has the surge of plant-based diets influenced U.S. dietary guidelines?

To assess this impact, a comprehensive review of USDA and HHS dietary guidelines since 1980 was conducted, employing thematic coding to discern shifts in perspectives. This analysis encompassed quantitative methods, including keyword frequency analysis, facilitating the assessment of the USDA's and HSS's evolving stance on plant-based diets over the years. The keywords were selected based on the applicability to the analysis and the commonality of these words outside these guidelines. Additionally, keywords were exclusively counted within the body of the reports to ensure consistent comparison across editions. By correlating these findings with the surge in plant-based diet trends, the goal was to understand how trends and outside entities influence dietary guidelines. To support this analysis and provide context, specific quotes will be excerpted from the dietary guidelines to demonstrate how they utilize the keywords. Star's infrastructure concepts will be applied to this thematic coding, with a focus on

aligning themes to the two concepts of infrastructure mentioned previously: *links with conventions of practice* and *embeddedness*.

USDA and HHS Dietary Guidelines Analysis Results

Over time, there has been a consistent suggestion to reduce meat consumption in favor of a more plant-focused diet in the USDA and HHS dietary guidelines, emphasizing the role of vegetables. This gradual shift indicates a growing acceptance of plant-based diets. However, this acceptance has been characterized by fluctuations, with certain editions emphasizing the importance of plant-based diets, only to be followed by subsequent editions that downplayed this emphasis. These fluctuations are indicative of Star's (1999) concepts of *links with conventions of practice,* and *embeddedness* as they show how social aspects within an infrastructure shape the technical aspects.

Analyzing 'meat' and 'vegetable(s)' mentions in dietary guidelines reveals trends in plant-based suggestions. Figure 1 charts their frequency per one thousand words, revealing shifts in suggestions of vegetables and meats in diets. Early editions favored meat, but from 1990 to 1995, vegetable mentions surged, signaling increased emphasis. However, both meat and vegetable mentions declined post-2000, with mention frequency remining close between the two from 2005 to 2020. The latest edition sees a notable upturn in vegetable-related language.

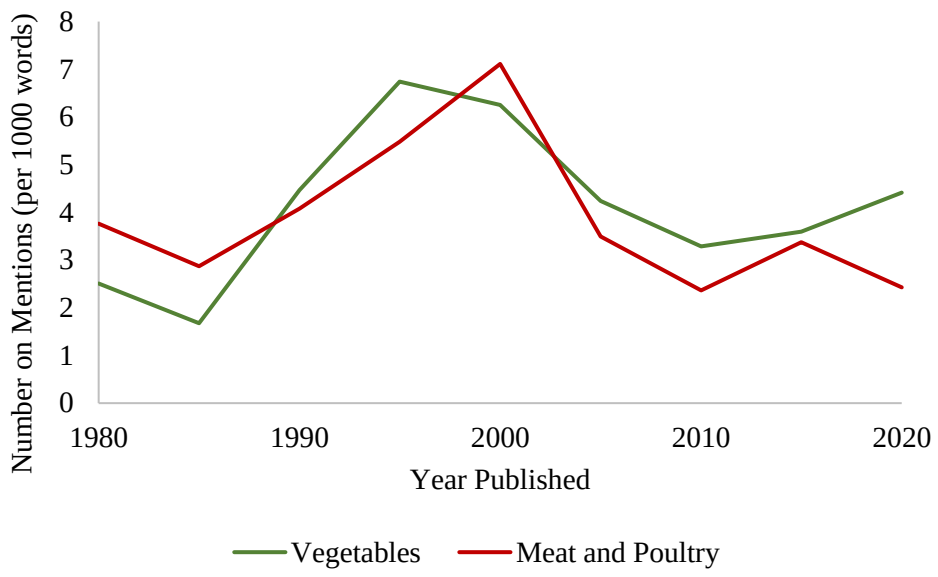

Figure 1. Number of mentions of 'meat' or 'poultry' and 'vegetable(s)' per one thousand words in USDA and HHS dietary guidelines. Source: data aggregated from USDA and HHS Dietary Guidelines 1980-2000

While numerical insights provide a broad understanding of trends, examining the context of these mentions offers a more detailed perspective on the evolving discussion surrounding the shift to a plant-based diet. In the initial editions of the dietary guidelines, meat was defined as its own food group, and non-meat alternatives were not recommended to fulfill that group (USDA & HHS, 1980; USDA & HHS, 1985). The first edition outlined vitamin sources as follows:

> "Fruits and vegetables are excellent sources of vitamins, especially vitamins C and A. Whole grain and enriched breads, cereals, and grain products provide B-vitamins, iron. and energy. Meats supply protein, fat, iron and other minerals, as well as several vitamins, including thiamine and vitamin B12. Dairy products are major sources of calcium and other nutrients." (USDA & HHS, 1980, p. 5)

This highlights the prevailing belief that animal meats were essential in a diet as they were considered the exclusive source of multiple nutrients. The 1985 edition follows a similar approach, emphasizing the view that meats play a pivotal role in maintaining a healthy diet (USDA & HHS, 1985).

The 1990 version marks a shift in the dietary guidelines by introducing the concept of food groups, moving from the notion that meat is the exclusive source of proteins and other nutrients. In this edition, one of the food groups is defined as "Meats, poultry, fish, dry beans and peas, eggs, and nuts" (USDA & HHS, 1990, p. 6) – an advancement from previous editions that did not explicitly mention sources of plant-based proteins. Notably, the 1990 guidelines recommend to "Have cooked dry beans and peas instead of meats on occasion" (USDA & HHS, 1990, p. 17). While this represents a departure from earlier editions, the prominence of meat remains substantial, ranking as the third highest in terms of the frequency of mentions of meat and poultry (Figure 1).

The 1995 edition marked another significant shift with the introduction of the food pyramid, adopting a more quantitative approach to dietary suggestions (USDA & HHS, 1995). Figure 2 illustrates the 1995 edition of the food pyramid, highlighting a reduced emphasis on meats. This is evident in the reduced number of servings allocated to meats, which are also smaller than those assigned to other categories. The introduction of the food pyramid reinforces the notion that plant-based foods can adequately meet the requirements of a healthy diet. Notably, the bottom of the pyramid predominantly comprises plant foods, further emphasizing the significance of plant-based components within the context of a healthy diet.

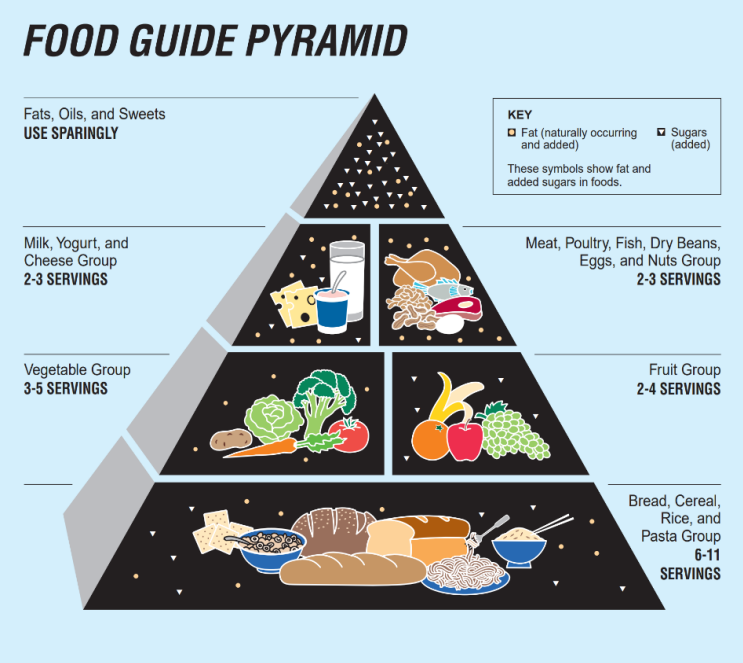

Figure 2. The 1995 Food Guide Pyramid from USDA and HHS dietary guidelines (USDA & HHS, 1995, p.5).

Additionally, the 1995 edition incorporated a new section on vegetarian diets, shown in the substantial increase in mentions of vegetarian and vegan diets in Figure 2. However, this section primarily discussed the adequacy of vegetarian and vegan diets, concluding that while vegetarian diets can align with the guidelines, certain nutrients are difficult to consume adequately with these diets (USDA & HHS, 1995). In contrast, the guidelines do not endorse vegan diets, citing difficulties in obtaining essential nutrients, which contributes to the significant amount of mentions of vegan compared to other guidelines (USDA & HHS, 1995). While this perspective may be viewed negatively, it signals a growing consideration of plant-based diets in mainstream discussions.

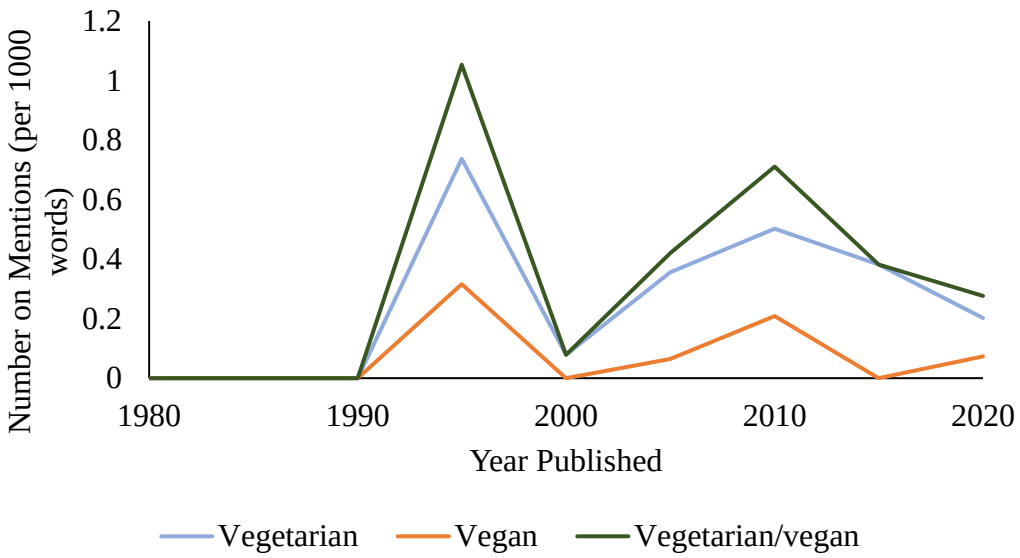

Figure 3. Number of mentions of 'vegetarian' and 'vegan' per one thousand words in USDA and HHS Guidelines. Source: data aggregated from USDA and HHS Dietary Guidelines 1980-2020.

Absent from the 2000 edition were references to vegetarian and vegan diets, except for a single mention of vegetarian diets regarding adequacy (USDA & HHS, 2000). Vegan diets were entirely omitted from this recommendation, indicating a regression from the preceding edition (USDA & HHS, 2000). Additionally, this edition of the guidelines introduced a new section on food safety that led to the increased mentions of meat. Specifically, this section contained thirty-four mentions of meat and poultry, overshadowing the three mentions dedicated to vegetables (USDA & HHS, 2000).

The 2005 edition saw a significant reduction in meat and poultry mentions (Figure 1). While a smaller food safety section played a role in this decrease, it does not account for all the reductions. The 2005 edition had a rise in mentions of vegetarian and vegan diets. Though not reaching the levels seen in 1995, there was a notable shift in focus towards supporting plant-

based diets with healthy eating suggestions (Figure 3). Notably, this version of the guidelines suggested what to eat in deviation from meat in the protein category (USDA & HHS, 2005). Despite maintaining a focus on the adequacy of a meat-free diet, the 2005 edition introduced steps towards endorsing plant-based diets (USDA & HHS, 2005).

The 2010 USDA and HHS dietary guidelines continued the trend of inclusivity towards plant-based diets, featuring one of the highest rates of vegetarian/vegan mentions (Figure 3). It actively encouraged vegetarian diets, stating "Some evidence for beneficial health outcomes for adults also exists for vegetarian eating patterns" (USDA & HHS, 2011, p. 44). This edition went a step further by introducing specific guidelines tailored for individuals adhering to vegetarian and vegan diets, providing recommendations on meeting suggested vitamin intake (USDA & HHS, 2011).

Similarly, the 2015 guidelines followed the trajectory set by the 2010 edition, but with some setbacks. While still inclusive of vegetarian diets, there was an absence of a separate set of guidelines dedicated to vegan diets, indicating a regression in acceptance (USDA & HHS, 2016). The 2020 guidelines also exhibited reduced mentions of vegetarian diets, however, it placed emphasis on plant-based foods. Notably, the recommended intake section outlined specific amounts of plant-based proteins to be consumed weekly, reflecting a continued shift towards acknowledging plant-based proteins can be part of a healthy diet (USDA & HHS, 2020b).

Connections to Star's Infrastructure

Aligning these findings with Star's (1999) infrastructure concept *links with conventions of practice*, these trends can be better understood through a social structure. As a resident of the

U.S., individuals are taught that a well-rounded diet typically includes meat. This perspective is evident in the initial iterations of dietary guidelines, but subsequent versions created a shift towards increased mentions of vegetables, advocating a more balanced approach (Figure 1).

This shift, however, took a significant amount of time, with subtle changes in recommendations. Take, for example, mentions of vegetarian and vegan diets. The first three guidelines published contained no mentions of plant-based diets and the subsequent three editions focused on the adequacy of these diets (Figure 3). It was not until the 2010 edition that vegetarian diets were endorsed (USDA & HHS, 2011). This extended shift is indicative of *links with conventions of practice* because meat was so engrained in the dietary recommendation infrastructure, it took many years for members of this infrastructure to adapt. This shift still is going on, with more information coming from researchers suggesting that plant-based diets can be healthier than meat-containing diets and resistance still exists in these guidelines to fully recommend a plant-based diet (Jacobs et al., 2009).

Links with conventions of practice are also present in the structure of the dietary guidelines. The guidelines initially included meat as a stand-alone group in the discussion of food groups, which was due to the thinking at the time that meat was the only source of a few vital nutrients (USDA & HHS, 1980). While there was discussion of other foods being able to fill this gap, with the addition of plant foods in this category, the food group remained as the ‘meat and beans’ group until 2010 when it became the protein group (USDA & HHS, 2011). This shows that these dietary guidelines exist within an infrastructure that has already been set up, and deviating from this convention takes time.

Another crucial factor to consider is the *embeddedness* of carnivorous diets in US culture. While plant-based diets are prevalent in other societies, the historical dietary patterns in the US

have not positioned them as the norm. Instead, the plant-based revolution is emerging within the framework of a meat-centric diet, reflected in the language used. In this transition, individuals in the US commonly categorize their diets as either ‘normal’ or ‘alternative’. This is particularly evident in the 2010 guidelines, where vegetarian/vegan guidelines are separated in the protein category from traditional carnivorous diets (USDA & HHS, 2011)

Embeddedness is also present in the methods by which these guidelines are created. According to the Dietary Guidelines for Americans website, “Each edition of the Dietary Guidelines reflects the current body of nutrition science” indicating that these guidelines are embedded in nutrition science research (USDA & HHS, 2020a). Because of this, each guideline reflects the direction of research at that period. This is evident in the earlier guidelines where plant-based diets are not mentioned, because the research at the time suggested that plant-based diets were causing malnutrition. This evolved as the latest information indicated otherwise and suggestions were made to help those eating plant-based diets and were reflected in the guidelines.

In addition to nutrition research being embedded in the formulation of USDA’s and HHS’s dietary guidelines, politics is also embedded within their creation. While the USDA and HHS attempts to remove influence from corporations, the USDA and HHS are government organizations and are both influenced by politics. One way it is influenced by politics is in the selection of the Dietary Guidelines for Americans (DGA) advisory committee. Each edition of the dietary guidelines requires twenty members of the scientific community, chosen by the USDA and HHS, to analyze current data in nutrition science and synthesize that information to create guidelines. However, the committee selection process can be susceptible to political interests (National Academies of Sciences et al., 2017). A U.S. Right to Know investigation for

the 2025 guidelines revealed that nine out of twenty committee members had serious conflicts of interest, with three having high-risk conflicts in the dairy and meat industry. Interestingly, there was a committee member with ties to the plant-based meat company Beyond Meat, which raised concerns about potential influences favoring plant-based meats (Mensendiek, 2023). Similar conflicts were identified in the 2020 guidelines, with nineteen out of twenty committee members having conflicts of interest (Mialon et al., 2022). The 2015 guidelines faced controversy over including red meats in healthy eating patterns despite evidence linking them to heart disease, raising questions about consistency in dietary recommendations (Heid, 2016). Conflicts of interest within committee members may have contributed to the inconsistent support for vegetarian diets in later versions of the guidelines, particularly in 2015 and 2020.

Discussion

Over the course of the 40 years that these guidelines have been published, acceptance of plant-based diets increased. This was evident through the later editions, as there was a focus shift from the adequacy of the diets to showing support for them. By the latest edition, there was suggestion to reduce meat consumption through an increase in plant-based protein intake (USDA & HHS, 2020b).

However, this transition was not linear, with significant societal influence incorporated into these guidelines. Star's (1999) concept of infrastructure offered a framework to organize these insights. The initial emphasis on meat in dietary recommendations reflects *links with conventions of practice,* while the slow shift towards a more balanced approach indicates the time needed to challenge established conventions. The emphasis of meat as a separate food group

highlights another established convention in dietary recommendation patterns. Moreover, nutrition science and politics play significant roles in shaping these guidelines, as potential conflicts of interest within advisory committees may impact recommendations, particularly regarding meat-heavy suggestions. The categorization of diets in the U.S., where plant-based diets are positioned as alternatives rather than the norm, reflects the embeddedness of cultural and historical dietary patterns.

This analysis can extend beyond the USDA's and HHS's dietary guidelines to encompass the growing trend towards plant-based diets. Dietary choices have become woven into the fabric of the nutrition infrastructure, creating a complex decision-making process with influences like the guidelines. Factors like corporate influences, peer pressure, and research trajectories contribute to the complexity of individuals' diet choices. Beyond a dietary perspective, there are valuable lessons to learn about the societal impact on daily choices, emphasizing the importance of recognizing outside influences and the impact of learned information in shaping these decisions.

The analysis presented focuses primarily on the transition to plant-based diets in the USDA and HHS dietary guidelines, but this does not gauge the influence of plant-based diets in a wider nutritional context. To gain a comprehensive understanding of the dietary landscape, exploring recommendations from doctors and their evolution over the years would provide valuable insights as this would show how the entire nation is adapting to dietary guidelines.

Additionally, this analysis does not encompass the multitude of other dietary preferences or restrictions that have gained popularity. This includes gluten-free, dairy-free, and allergen-free diets, which a substantial portion of the population has embraced. Integrating these alternative

dietary preferences into the analysis could result in a more detailed insight into the changing landscape of dietary guidelines overall.

Additionally, the five-year intervals between the publication of USDA and HHS guidelines create gaps in trends. Analyzing data from the years between releases could uncover more intricate patterns and lead to different conclusions. Considering the recent rapid growth in interest and adoption of plant-based diets and the evolving nature of dietary guidelines, it offers a significant and relevant aspect to be explored in future assessments, providing a more current and comprehensive reflection of dietary trends.

Reflection to Engineering Practices

This analysis offers insights into the plant-based revolution within the USDA and HHS dietary guidelines, presenting relevance to my engineering career. With a background in the foods industry, particularly in the plant-based meat sector, recognizing the increasing acceptance of plant-based diets becomes a valuable tool in guiding my career decisions, ensuring alignment with the evolving preferences of consumers. My aim is to position myself in a role that resonates with as many consumers' needs as possible, reflecting a forward-thinking approach in response to the changing landscape of dietary choice and a consumer market.

Conclusion

Understanding the USDA and HHS dietary recommendations evolution since 1980 is crucial for grasping dietary choices. While progressively incorporating plant-based diets, these guidelines' trajectory has been complex, influenced by various social factors. Recognizing these influences is vital for holding guideline creators accountable and ensuring alignment with the

latest research on healthy diets. Regarding plant-based diets, understanding these influences helps mitigate bias in future guidelines, guarding against outdated ideas and reducing disinformation. To achieve unbiased guidelines, greater reliance on current research and reduced corporate influence is necessary.

Beyond the USDA and HHS dietary guidelines, the insights gained from this analysis are relevant to governmental guidelines, particularly those designed as educational resources. A prime example is state public education guidelines, which establish annual lesson requirements for teachers. Political influence heavily shapes these guidelines, and utilizing Star's infrastructure could reveal previously unrecognized influences. This awareness enables educational stakeholders to use evidence-based and impartial guidelines, guaranteeing the delivery of high-quality education.

Future research could delve into the evolving landscape of dietary guidelines, given their iterative nature. This warrants continuous analysis to illuminate their formulation processes and the influences at play, leading to a deeper understanding of the dynamics within these guidelines. While this analysis concentrated on the evolution of plant-based diets within USDA and HHS guidelines, extending research to other domains could offer insights into whether observed trends are universal or unique to this case. Examining diverse areas within the guidelines would contribute to a comprehensive understanding of their overall patterns and implications and help to prevent the spread of misinformation.

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