American Nutritional Differences

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## Abstract

This paper examined the anecdotal evidence and research concerning the relative health of American foods to that of non-American foods. With advancements in nutrition science over the past century and the rapid introduction of synthetic and other less nutritious ingredients in foods around the globe, the United States has been singled in media and research as particularly unhealthy. Due to limited restrictions and regulations on food quality and additives, the average American diet has been linked to serious long term nutritional health problems for those who frequently consume it.

The goal of this study was to statistically demonstrate the nutritional differences of American & Non-American foods using commonly observed nutritional factors as proxies for overall health. Sodium, Sugar, Calorie, and Additive measurements per 100g of food were analyzed utilizing a large open-source database of nutritional information from around the globe. Results argued significant differences between the averaged aforementioned measurements when comparing American to Non-American foods. More specifically, all measurements were shown to support the popular argument that American foods contain higher average amounts of Sodium, Sugar, Calories, and Additives and discredited the assumptions that there was no difference between them, or that non-U.S. foods had higher amounts of these measurements.

*Keywords*: nutrition, American food, additives, sugar, sodium, calories, food quality

## Introduction

Throughout the history of humanity there has been a variety of thoroughly recorded instances of nutrition and its effects on civilization. Unfortunately, most of these records denote the harmful impacts malnutrition has had on our societies where a rapidly changing and growing globalized world has consistently resulted in large portions of people being starved of food and resources. Modern day stability and technological improvements have come a long way in alleviating limited access to food throughout society, but has also introduced new risks in the area of nutrition.

Most historically noteworthy instances of nutrition have been linked to people’s suffering from famine, drought, and events relative to malnutrition. Primarily as a result of the negative impacts of world expansion & imperialism, when outside of what could be considered an ‘act of God’, most victims have had a tendency to be either less affluent or have been dominated by another culture or civilization. Outcomes from the disease transmission from trade, war, and socio-economic disparity related to the nationalist and imperialist factors are issues that permeate almost every known society to some extent.

Today, things have significantly improved for many people due to increases in food production, availability, and the interconnectedness of communities – though we are now beginning to face another problem. A rise potential food borne illness is being considered and observed in some economically affluent nations, where lax laws, poor food standards and even poorer dietary standards are beginning to exacerbate the difference between food and nutrition.

The concept of nutrition and how it relates to the health and well-being of human life has been a focal point of both medical communities as well as pop culture over the past few decades. Instances of nutrition-borne illnesses, upticks in diabetes and obesity throughout many parts of the world, increases in certain types of cancer, and reoccurring trends in dieting and nutrition advice has generated a lot of data and controversy. One of the large themes surrounding the topic of nutrition from the American perspective around the globe is that American foods are unhealthier than their counterparts. This notion is due to a variety of reasons and it is widely accepted, with supporting research, as the primary culprit in United States citizen health degradation relative to other 1st world countries.

Recent research has elaborated on how “the American diet has changed dramatically since 1958, when Congress gave the United States Food and Drug Administration (FDA) the authority to ensure the safety of chemicals in food. Since then, thousands of chemicals have entered the food system” (Maffini et al., 2017). Today, there are more than 10,000 food additives utilized in American food production, each of which has a variety of association with significant health risks for consumers, particularly when consumed in critical developmental timeframes such as pregnancy and childhood.

Other research has shown how significant outcomes were observed with increased organic food intake and reduced processed food intake. These outcomes include “reduced incidence of infertility, birth defects, allergic sensitization, otitis media, pre-eclampsia, metabolic syndrome, high BMI, and non-Hodgkin lymphoma”. One important concept to take into consideration is the focus on nutrition at the micro level as “the notion that organic food may be healthier has some support. Although there appears to be little variation between organic and conventional food products in terms of macro nutritional value (protein, fat, carbohydrate and dietary fibre)” (Vigar et al., 2019). This is an important factor when it comes to laws and regulations as the added complexity of micronutrients allows for increased misunderstandings and miss-leadings in the considerations of governing entities such as the Food and Drug administration.

Unlike the United States, other areas of world display more stringent protections on what can be added to their food products. For example, in the European Union, “the European Food Safety Authority (EFSA) has the daunting task of aligning and enforcing food regulations for all 27 member nations of the European Union. That’s a key differentiator between organizations; the US relies on a federal entity, while the EFSA isn’t strictly associated with a single government” (Tilly Distribution, 2023). The fundamental difference between these two organizations is that the FDA operates on the basis that most ingredients may be included unless proven harmful while the EFSA requires that all additives be proven safe prior to use.

Furthermore, data shows that Americans are far more likely to sustain a less-healthy diet when it comes to food choices at the macronutrient level. Due to the manner in which food products prepared, increased portion sized, economic limitations, as well as the general pallet developed by the typical American they are far more likely to make less than optimal nutritional choices. These choices typically manifest as a high-fat high-sodium diet with minimal vegetable consumption (Wallace et al., 2019; Nestle, 2003). Sustained diets of these types, consisting of relatively high average caloric, sodium and sugar levels, have been increasingly linked to severe diseases that have been prolific in modern day America.

The general consensus of most current research supports the claim that the American food supply tends to be less nutritious and healthy than its foreign alternatives. Due to the increased availability of foods with high concentrations of synthetic chemicals as well as higher economic pressure to consume foods with excessive and unbalance macronutrients, it is becoming more and more difficult for Americans to make better choices. Unfortunately, research is also beginning to show that sustained consumption of these foods may mean that Americans may be eating themselves to death.

## Objectives

This research with aims to break down key differences between nutrition statistics from a variety of foods around the world in order to answer a variety of questions considering the relative health of American foods. The ultimate goal is gaining insight through hypothesis tests on whether or not American food is objectively less healthy and nutritious based on modern research definitions.

## Overview of Study

The primary task of this study is to review and analyze a large batch open-source food data, retrieved from Open Food Facts, and take an explorative approach as to the differences between foods on an international level. Open Food Facts is a collaborative project that seeks to compile nutritional data, comprised via their open-source database, from people around the world (Open Food Facts). At present, a vast majority of data, outside of raw food information, is anecdotal or heuristic in nature due to the scarcity of complete long-term research on the health effects of food additives and nutrient consumption. Hypothesis questions will be constructed and tested based on this more qualitative information to outline parameters for statistical work. Analytics will be conducted in conjunction with assumptions supported by modern research in an effort to support causal relationships.

Moving forward, it is my hope that the research conducted will address controversies surrounding the inclusion of a variety of chemicals in food production as well as the risks associated with sustained malnutrition in the United States food supply. It is also my hope that any findings may not only be used in efforts to revise laws and regulation enforced by governing bodies such as the FDA, but help people make better food choices when possible by understanding what long term risks may or may not be present.

From an academic perspective, this research might aid in comparing and contrasting how food impacts or is impacted by things such as culture, medicine, diseases, natural and man-made catastrophes, as well as socio-economics climates. A thorough understanding of these topics would allow health experts and nutritionists to better advise and warn about certain short and long-term health risks associated with people’s diets as they are impacted by environmental factors. This would make it easier to predict and take preventative measures in mitigating nutrition related ailments from factors outside individuals’ control.

## Research & Hypothesis Questions

In order to establish difference in nutritional value and lay the foundation for future research, four hypothesis questions have been posed based on current research consensus:

1. American food has a higher count of additives, on average, than non-American foods.   
   *H0: μ(Average Count U.S. Food Additives) ≤ μ(Average Count Non-U.S. Food Additives)  
   HA: μ(Average Count U.S. Food Additives) > μ(Average Count Non-U.S. Food Additives)*
2. American food products are sold in higher caloric quantities than non-American foods.   
   *H0: μ(Average U.S. 100g Serving Caloric Count) ≤ μ(Average Non-U.S. 100g Serving Caloric Count)  
   HA: μ(Average U.S. 100g Serving Caloric Count) > μ(Average Non-U.S. 100g Serving Caloric Count)*
3. American food products are higher in sodium than non-American foods.   
   *H0: μ(Average U.S. 100g Serving Sodium Count) ≤ μ(Average Non-U.S. 100g Serving Sodium Count)  
   HA: μ(Average U.S. 100g Serving Sodium Count) > μ(Average Non-U.S. 100g Serving Sodium Count)*
4. American food products are higher in sugar than non-American foods.   
   *H0: μ(Average U.S. 100g Serving Sugar Count) ≤ μ(Average Non-U.S. 100g Serving Sugar Count)  
   HA: μ(Average U.S. 100g Serving Sugar Count) > μ(Average Non-U.S. 100g Serving Sugar Count)*

## Literature Review

Consideration of current research and pop culture indicates a growing emphasis on human health and nutrition in recent decades. Though media and society at large is, arguably, driven by more vain notions of physical appearance and comparative senses of self-worth, a large amount of highly impactful and important research for the sake of marketing, investment, pharmaceutical, and medical research is driven by these societal views. Since the early 1900s research into nutrition and the long-term effects of food on the human body has increased in scope. Stemming from a time when “medical education was under scrutiny… in 1902, W.G. Thompson, a professor of medicine at Cornell University Medical College, expressed concern about the absence of nutrition in medical education” (National Research Council (US) Committee on Nutrition in Medical Education, 1985). Thompson stated how

The subject of the dietetic treatment of disease has not received the attention in medical literature which it deserves, and it is to be regretted that in the curriculum of medical colleges it is usually either omitted or is disposed of in one or two brief lectures at the end of a course in therapeutics. One cannot fail to be impressed with the meager notice given to the necessity of feeding patients properly, and the subject is usually dismissed with brief and indefinite phrases such as: ''the value of nutritious diet requires more mention, .... a proper but restricted diet is recommended,” or “the patient should be carefully fed" (Thompson, 1902).

The following century underwent a massive boon in nutritional research and visibility. Through the discovery of vitamins, macro & micronutrients held within foods, how processing altered these features, as well as how each of these impacted the human body after consumption, many dimensions for how society should perceive food were unveiled. Previously limited to the measure of the energy held within a food, otherwise known as a “calorie”, an entire industry was born through the realization that foods and how they operate with the human body was much more complex previously observed (Hargrove, 2006).

Recent decades have seen an increase in health concerns, in spite of advances in nutritional research and human health data. A variety of illnesses linked to nutrition and lifestyle have been a cause for concern and the call to action for many nutritionist and activist, citing the increased chemical infusions and unbalanced nutrient intakes due to some nations’ long term dietary trends (Saksena et al., 2018). The general consensus is that some segments of the global population maintain a diet that includes overconsumption of calories and harmful additive chemicals while being deficient in all the nutrients needed to ensure long term health. As a result of this, we are seeing spikes in disease such as cancer, heart disease, type II diabetes, obesity, muscle & fat wasting, osteoporosis, and chronic fatigue depending on the particular nutritional issue (Kiani et al., 2022; Heilbronn et al., 2006).

These observations are a mixed result of the effects of globalization in the modern world, creating accessible international health and lifestyle data for study, alongside efforts to both economize and provide cheap and accessible food sources across the world. A direct result of the latter has been the rampant use of additives and processed foods in certain countries that aid in lowering food costs, increasing shelf life, and enhancing taste at the expense of quality and safety (Steele et al., 2017). In this vein, one of the most common references and anecdotes in the United States used to describe this scenario is how poor the food quality and societal health throughout the country is relative to our global neighbors. Many sources speak on the topic of obesity, sugar intake, process foods and chemicals within United States food products, positing that they exist at extreme and unsafe levels (Rakhra et al., 2020).

## Design & Methodology

As mentioned previously, the primary data used for this study will be sourced from the Open Food Facts database. This data exists as an 8+ gigabyte file or API, accessible to the public for any purpose. Raw Open Food Facts data consist of approximately 2 million individual records of nutrition data for foods around the globe, each with up to 200+ variables to analyze. These variables range from demographic and origination information to micro nutritional data and ingredient compositions. For the purposes of this study, the dimensions utilized for answering the hypotheses questions have been drastically reduced, now including approximately 65 of those 200+ columns for explorative consideration and 5 columns specific to answering the hypothesis questions.

The data itself consists of a mix bag of qualitative and quantitative information sourced from user across the world. Integers, strings, floats, and binaries are all used within the dataset, thought he bulk analytical work will center around integer data. Utilizing Python for analysis, the primary goal is to do as much quantitative analysis and transformation as possible, leaving qualitative interpretation and inferencing to future suggested works. Results will be attained through use of t-tests or the like for the determination of statistical significance and consideration for model use. Our four hypotheses questions have been designed with intent of (1) providing an answer to the statistical significance of a difference between American & Non-American food based on nutritional composite amounts; and (2) establish attributes of nutrition as a proxy for assumptions for general nutritional value that can be used as a basis for future research.

In order to answer each question there are several parameters that need to be enforced with the data:

1. Null data and columns need to be purged. As such, different levels of n will occur for each hypothesis a missing data is removed for each test attribute.
2. Remaining data needs to be separated into two groups of categorical data. This denotes American vs non-American.
3. Any data with notes in the database column for “data\_quality\_errors\_tags” are to be purged to mitigate data integrity risks.
4. Data is partitioned via random sample by American vs non-American category. Steps must be taken to ensure sample sizes are the same across out two categorical groups.
5. Each measurement analyzed that is relative to macro composition utilizes the 100-gram standardized measurement to ensure consistent product amount comparisons.
6. Foods Categorized as ‘American’ or being from the ‘United States’ have to have solely been sources from the United States. Otherwise, they are categorized as non-American.
7. The Hypotheses Tests will be conducted using an alpha (type I error) rate of .1 for gauging a rejection of the Null Hypothesis.

Once these are complete, significance tests can be ran based on the need for parametric & non-parametric approach requirements. As there are no statistical models being generated directly from this analysis there is no inclusion of predictive statistical models. The output here is the potential nutrition distinction between American and Non-American food.

### Limitations

Validation of data and its integrity will be a point of scrutiny given the collection source. It should be made aware, and is even stated by the providers, that “no guarantees can be made for the accuracy, completeness, or reliability of the information provided” (Open Food Facts API Documentation). This is to be expected based on the fact that the data source exists solely as a product of open-source contribution.

Furthermore, food quality, basket of good pricing, income and a multitude of other economic factors are not included in the dataset and are not addressed directly in this study (Mitchell). These attributes would be a natural extension to the topic as well as a necessary inclusion for future functional predictive models. This study is limited to the purpose of determining whether American food is nutritionally different from non-American food or if its composition might be discounted as a cause for American health trends.

### Ethical Considerations

There is limited risk for ethical consideration given the nature of the data source. All data used is free open source information entered from product labels visible to the public. Open Food Facts, the data source, has simply compiled the information in a convenient format for research purposes.

## Findings

Our four hypothesis questions were analyzed based on the design choices listed previously. As mentioned, the analytics and hypothesis tests were carried out against a dataset of 1,900,210 rows and filtered down as necessary. Splitting the data into 4 subsets specific to the hypothesis questions being tested yielded the following results.

**Hypothesis Question 1:** *American food has a higher count of additives, on average, than non-American foods*

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Given Python’s default return of 0.0 for outputs under 2.2251e-308, the p-value in this case can be interpreted is virtually 0 for the sake of the experiment. This is well below the type I error rate defined as .1. As such, we will reject the null hypothesis that the average count of additives in U.S. foods are less than or equal to non-U.S. food alternatives. In the samples observed, the average U.S. food contained 2.6 additives while non-U.S. fare contained 1.5.

**Hypothesis Question 2:** *American food products are sold in higher caloric quantities than non-American foods*

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Concerning caloric counts, our t-test returned a 7.8013e-17 value -significantly lower than the type I error rate of .1. In this case we reject the Null Hypothesis that the average 100g of U.S. food is less than or equal to the average 100g of non-U.S. foods. Our sample displays an average of 266.8 and 269.5 calories per 100g of food respectively for non-U.S. and U.S. foods.

**Hypothesis Question 3:** *American food products are higher in sodium than non-American foods*

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Our t-test for the comparison of average sodium between U.S. and non-U.S. foods returned a p-value of 1.478e-138. Once again this is well under the .1 type I error rate designated. As such, we reject the Null Hypothesis that the average amount of sodium per 100g of U.S. food is less than or equal to that of non-U.S. foods. The average amount of sodium per 100g of food for non-U.S. and U.S. foods are .5 and .59 grams respectively per the sample.

**Hypothesis Question 4:** *American food products are higher in sugar than non-American foods*

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Our final Null Hypothesis test questions whether or not the average sugar in 100g of U.S. food is less than or equal to that of non-U.S. foods. In this case, our Python t-test returned a p-value of .0. As previously stated, this .0 is a default for an incalculable precision in Python and is well under our type I error of .1. We reject the Null hypothesis here that the average sugar in 100g of U.S. food is less than or equal to 100g of non-U.S. food. In our sample we observed an average non-U.S. sugar amount of 12.1g while U.S. foods were at 15.2g.

## Conclusion

In conclusion, utilizing the data from the Open Food Facts database we are able to reject the Null Hypotheses that both the amounts of additives, sodium, calories as well as sugar within United States foods are less than are equal to that of non-United States foods. This supports the anecdotal evidence that, through proxy, United States cuisine is ‘less healthy’ than non-U.S. foods. This, of course, assumes that you might use sugar, sodium, calories and additives as a reliable proxy for the healthiness of foods. It more directly supports the position that, based on the sample, U.S. foods contain more of these items than non-U.S. foods on average though this cannot be proven at this time.

All sets of results here are heavily dependent on the assumptions stated in the design. In both cases our conclusive interpretation requires that we, alongside the current available literature, support the assumption that sugar, sodium, additives, and calorie density might be used as a proxy for food healthiness. We also need to be able to assume that this relationship with health is negative and linear in nature, meaning that as any one of these nutritional factors increases the healthiness of the food decreases. Removing these assumptions, the only statements this research can support is that U.S. foods and their associated diets likely contain higher amounts of additives, sodium, calories, and sugar than non-U.S. alternatives due to the fact that U.S. foods, on average, do not contain less than or equal to the amounts found within non-U.S. foods.

## Recommendations

Moving forward there are a few areas I would suggest complementary research be done in. Firstly, more solid research should be completed that can support or dismiss the use of a variety of nutrients, macro-nutrients, and additives as being harmful to human health. The premise of using proxies for defining something as broad as human health is not uncommon but, nonetheless, a difficult thing to do. Unfortunately, nutrition and statistical research at these levels are relatively young and the research surrounding these topics can take upwards of generations to complete.

Secondly, there are large pieces of data that can still be analyzed from data sets such as Open Food Facts. The code used to generate these research results omitted dozens of potential metrics on nutrients. These should be revisited in an effort to compile differences in cuisine between a variety of different categories. Further research here could go a long way in taking preventative measures against nutrition related disease based on dietary options around the globe.

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