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Sources of calcium, vitamin D, fiber, and potassium in American fast food

Meghan Pearson

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Sources of Calcium, Vitamin D, Fiber, and Potassium in American Fast Food

by

Meghan Pearson

Thesis

Submitted to the School of Health Sciences

Eastern Michigan University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

in

Dietetics

Thesis Committee:

Judi Brooks, Ph.D., R.D., Chair

Alice Jo Rainville, Ph.D., R.D., C.H.E., S.N.S., F.A.N.D.

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Abstract

Calcium, vitamin D, fiber, and potassium are widely underconsumed in the U.S. This study analyzes nutrition information from quick service restaurants to determine the fast-food industry's contribution of these nutrients to the American diet. The menu offerings of top-grossing quick-service restaurants in each of seven categories, McDonald's® (burger), Subway® (sandwich), Taco Bell® (Mexican), Pizza Hut® (pizza), Chick-fil-A® (chicken), Panda Express® (Asian), and Long John Silver's® (seafood), were analyzed for calcium, vitamin D, fiber, potassium, and calories. The highest mean values of key nutrients were found at Pizza Hut (256.4 mg calcium), McDonald's (0.509 mcg vitamin D), Taco Bell (4.4 g fiber, foods only), and Chick-fil-A (375.5 mg potassium). Significant differences among restaurants were found for all nutrients at a p-value of < 0.01 for calcium, fiber and potassium, and < 0.05 for vitamin D. McDonald's and Subway provided the most nutrient-dense menu items with 303 and 238 items, respectively.

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Chapter 1: Introduction

Negative Associations with Fast-Food Consumption

Fast-food consumption has been correlated with a multitude of negative consequences, including increased energy intake, higher fat and saturated fat consumption, and the rising obesity trend among Americans.¹⁻³ In one study, frequency of fast-food consumption was positively associated with both weight gain and insulin resistance.⁴ These consequences, particularly the increased intake of saturated fat and the upward trend of obesity, are, in turn, associated with the prevalence and exacerbation of several conditions, including type 2 diabetes, coronary heart disease, sleep apnea, osteoarthritis, and certain types of cancer.⁵ Fast food may not be directly responsible for these diseases, but there is a correlation between the rise in these conditions and the upward trend of fast-food consumption that is worth exploring.

It is important to note that while the average fast-food purchase includes excessive amounts of calories, fat, and sodium per meal, some fast-food outlets offer healthier options. Consumers are, however, ultimately responsible for the purchases they make.^{6,7} These studies' findings reflect the choices of the average fast-food consumer. Schmidt et al.⁸ demonstrated positive associations between frequency of fast-food consumption and total caloric intake, caloric intake from fat, saturated fat intake, and sodium intake among girls ages 9 to 18. There is also evidence to suggest that high-fat, high-calorie, and high-sodium options may be displacing the intake of fruits, vegetables, and dairy products in the diets of fast-food consumers.^{3,9} It should be noted, however, that just because a food is sold by a quick-service restaurant, it is not inherently bad from a nutrition standpoint. While definitely fewer in number, more nutritious options such as grilled entrées, fresh fruit, and low-fat milk and yogurt are available at some quick-service restaurants in addition to traditional offerings. The calorie, fat, and sodium content

of meals made up of these “healthier” items are much lower than those of the average fast-food purchase. If consumers began choosing these items more frequently, future research on this topic would likely yield much different results than the negative effects of fast-food consumption found in the studies mentioned above.

Barriers to “Healthy” Fast Food

If nutritious options are available, why are consumers not choosing these healthier items more often? Drewnowski¹⁰ reviewed several studies and surveys to determine some of the reasons that fat and sugar are so appealing to humans. One reason is that fat and sugar appeal to the human’s innate instincts for energy-dense foods. Consumption of fat and sugar also evoke a physiological response that manifests itself through natural opiate and endorphin stimulation, resulting in feelings of pleasure and happiness; this mechanism is thought to be involved in food cravings and food addiction.

Another potential reason that consumers forego the healthier items on fast-food menus is advertising. Children are frequently the target of fast-food advertising and, in 2009, children aged 2 to 11 saw an average of 10 to 12 advertisements for food each day, with approximately one quarter advertising fast food.¹¹ Overall, 86% of the food-related advertisements seen by children in 2009 were for food items high in saturated fat, sodium, and sugar.

In a national study by Bowman and Vinyard¹², the average fast-food purchase provided over one-third of an individual’s daily calories, fat, and saturated fat. This study¹², and the study referenced above¹¹ regarding food and beverage advertising to children, defined “high” as greater than 10% of calories derived from saturated fat and greater than 25% of calories derived from sugar. Considering this combination of influences, it is not surprising that the average fast-food purchase is abundant in calories, fat, and sugar.

Interviews with 41 senior-level marketing executives and menu developers in fast-food and casual-dining restaurants in the United States identified some key difficulties in incorporating healthy food items into fast-food establishments, including relatively low sales, the lack of demand, and the quick spoilage rate of fruits and vegetables.¹³ The bottom line, however, is money. Low demand results in low sales and high spoilage rates lead to waste, which reduces company profits. In the casual-dining and quick-service restaurant industries, profit calculations include the cost of food and/or ingredients, preparation or labor cost, and the selling price. Healthier items, such as fresh produce, often incur higher food and labor costs but must still be sold at competitive prices. This decreases the overall profit margin and, as one interviewee stated, “We’re concerned about cannibalization. We don’t want to serve an item that’s going to take dollars away from a more profitable item.”¹³

When considering potential additions to a menu, these same executives first consider consumer demand, actual sales, and profit margin.¹³ Preparation was a secondary justification, indicating that if the demand is great enough, companies will find a way to supply the product. This is evident by the small number of healthy options currently offered in fast-food establishments. Marketing executives and menu developers take into consideration the “veto vote.” This occurs when a group of people who would normally choose a particular restaurant are swayed by one particularly health conscious person who feels the restaurant cannot meet his or her needs. In order to avoid losing the entire group, the restaurant offers a small number of nutritious items to appease the health promoter, and by meeting the needs of one, the restaurant retains the business of many.¹³

Interestingly, what the executives and menu developers considered healthy is first and foremost low-calorie and low-fat.¹³ Much research has already been performed on the calorie

and fat content of fast food. Calorie labeling has become required in many restaurants, but studies¹⁴⁻¹⁶ have yielded mixed results as to the effect of calorie labeling on consumer choices. When a consumer considers the calorie content of menu items in making a food choice, the individual is restricting his or her intake of calories, which may result in feelings of deprivation or self-denial. A restrictive approach is difficult to sustain long term and has in fact been linked to overeating.¹⁷ Dietary restraint has also been positively correlated to binge eating, with individuals reporting feeling “out of control” with their eating habits both during and after periods of dietary restriction.^{17,18} Consumers are likely to return to old habits such as buying large portion sizes with increased number of calories and greater fat content.

Why, then, does the quick-service restaurant industry continue to grow? This question can be answered with a number of responses, one of which is the ever decreasing amount of time spent at home preparing meals.¹⁹ This shift can be attributed to the increasing number of single-parent homes, dual-income homes, and demanding work schedules.¹⁹ Jabs and Devine²⁰ suggested a link between food choices and feelings of time scarcity—the feeling that there is not enough time to accomplish everything that needs to be done. Fast food is quick, inexpensive, and tasty. It fills a need, and as demand has increased over the last several decades, so has supply.

Ideally, Americans would combat the fast-food epidemic by abstaining from fast food altogether and preparing meals at home from scratch. However, that seems unlikely considering the growing dependence on quick-service restaurants. Another option, and a more realistic one, is to educate consumers regarding how to incorporate fast food into a healthy lifestyle. “Healthy,” however, is defined differently depending on whom one asks. As mentioned above, according to quick-service restaurants, healthy means low-calorie and low-fat, which implies

restriction, limitation, and a general emphasis on *less*.¹³ There are many foods, however, that Americans should be choosing *more* of, such as fruits, vegetables, low-fat dairy, whole grains, seafood, and legumes.²¹ This approach requires the prioritization of reaching minimum intake levels (i.e., for vitamins and minerals) as opposed to staying within maximum intake levels (i.e., for calories, fat, and sodium). For the purpose of this study, healthy eating is defined as choosing nutrient-dense foods over energy-dense foods.

Statement of the Problem

Currently, there is a lack of research on the micronutrient content of fast food. Most fast-food nutrition research has focused on calories, fat, sodium, and the correlation between fast food and obesity. Marketing executives and menu developers have expressed a need for good examples of healthy food items and ranking of restaurant “healthfulness” in order to attract health seekers to their businesses.¹³

The Dietary Guidelines for Americans 2010 encourage greater consumption of fiber, calcium, vitamin D, and potassium.²¹ These four nutrients have been deemed “nutrients of concern” by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services due to low intake among Americans.²¹ With the exception of fiber, each of these are micronutrients that play important roles in the human body.²² Fiber is technically a macronutrient; however, due to its important roles in human digestive health and its status as a commonly underconsumed nutrient in the U.S., it was included in this study.

Fiber is also the only one of these nutrients for which food content is legally required to be disclosed to consumers at restaurant chains in the U.S.; other required nutrients are calories, carbohydrates, protein, fat, saturated fat, cholesterol, sodium, and fiber.¹⁴ In order for restaurants

to adhere to federal standards, they must post calorie content on menus if they operate more than 20 locations, and the rest of these values must be available upon consumer request.¹⁴

In preliminary research for this study, the researcher found that many quick-service restaurants publish these nutrient values on their websites, and some restaurants voluntarily list additional nutrition information such as percent daily calcium, vitamin C, iron, and vitamin A. This was rare, however, and the majority of micronutrient content of fast food was not available on restaurant websites. If consumers knew the fiber, calcium, vitamin D, and potassium content of fast-food options, they might make more nutritious decisions when ordering.

In a 2008 study on the effects of the nutrition facts panel on diet quality, Variyam²³ concluded that individuals who consulted the nutrition facts panel for food purchases consumed more fiber and iron than individuals who did not read the nutrition facts panel. Differences in fat, saturated fat, and cholesterol intake between nutrition fact users and non-users, however, were not found to be statistically significant. Label users also consumed better quality diets when eating out even though the study data was taken from 1994-1996, before nutrition information was required or common in restaurants. The results of this study demonstrated a positive correlation between awareness and consumption of micronutrient content in food. It also suggested that consumers who are nutritionally conscientious at home may benefit from knowing the micronutrient content of fast food. However, since calories are the only nutrient currently required for menu display, it is difficult for Americans to know how much of these other nutrients they are consuming and, on a more basic level, which foods are good sources of these nutrients.

Purpose of Study

The purpose of this study was to identify fast-food options that meet the nutrition needs of consumers and fit into a healthy lifestyle. This was accomplished by determining which quick-service restaurant chains and food options provided the best sources of calcium, vitamin D, fiber, and potassium. This study answers the following research questions:

- 1) How much calcium, vitamin D, fiber, and potassium are available from selected fast-food menu items in the U.S.?
- 2) Which quick-service restaurants (of the seven analyzed) are best meeting Americans' needs for these nutrients?
- 3) Is there a correlation between calorie and micronutrient content in fast-food items?

Justification

This research is needed in order to identify fast-food items that Americans can incorporate into a healthy lifestyle. It is not realistic to expect every American family to make every meal at home or to purchase only healthy meals from more expensive restaurants. Fast food is readily available, inexpensive, and convenient, and if consumers increase the demand for nutritious options, it is possible that the quick-service restaurant industry will respond with an increased supply of healthy offerings.

This research is relevant to the fast food consumers who may prefer to eat nutritiously but, for reasons outside their control, find themselves purchasing fast food. This population includes travelers and business people who find themselves in hotels and airport terminals that offer few options besides fast food. It also includes busy individuals, couples, and families on a budget. The “veto-vote,” described earlier as a person who stands out among his group in terms of his desire to eat nutritiously despite the abundance of energy-dense options, also falls into this

population. Finally, this research is particularly important for individuals living in food deserts, where grocery stores and access to fresh, healthy foods are sparse, but quick-service restaurants and convenience stores may be more plentiful.²⁴

This research has the potential for indirect health effects as well. Educating consumers about the micronutrient content of fast-food options may also translate into more nutritious food choices when consumers shop at the grocery store, prepare meals, or make other food decisions (e.g., the consumer's ability to note that a bean taco is a good source of fiber may influence his decision to buy beans at the grocery store).

Collecting data on this topic will also serve as a baseline against which future studies may benchmark to assess the change in healthfulness in the fast-food industry. To date, no studies have been performed specifically on the micronutrient content of fast food. Certain studies have included information on calcium and fiber, but to the researcher's knowledge, no studies have analyzed the potassium or vitamin D content of fast food.

Finally, the casual-dining and fast-food executives who were interviewed by Glanz and colleagues¹³ regarding menu planning and health called for the rating of restaurants according to healthfulness in addition to the recognition of good examples of healthy fast foods. As described above, this study begins this process and points out what is being done well and which areas need improvement.

Research Method

This study analyzed the calorie, calcium, vitamin D, fiber, and potassium content of food and beverage items for the top-selling quick-service restaurants in each of seven categories. The restaurants are McDonald's[®] (burgers), Subway[®] (sandwich), Taco Bell[®] (Mexican), Pizza Hut[®] (pizza), Chick-Fil-A[®] (chicken), Panda Express[®] (Asian), and Long John Silver's[®] (seafood).

Statistical analysis was performed on the data from each restaurant to include mean and median micronutrient content, correlation between calorie and micronutrient content, and ANOVA among the restaurant categories.

Definition of Terms

In order for a restaurant to be considered a quick-service establishment, its food must be purchased prior to consumption, the restaurant must not employ a waitstaff, and food must be available to eat on-site, or for purchase as takeout or delivery. These criteria meet the guidelines for limited service eating places (7222, 72221) and limited service restaurants (722211) as defined by the North American Industry Classification System (see Appendix A: NAICS Codes, Titles, and Descriptions for “Limited-Service.”)²⁵

The term “energy-dense” refers to foods that have a high number of calories but provide few or low amounts of nutrients. The energy provided by energy-dense foods is casually referred to as “empty calories.”²⁶ The term “nutrient-dense” refers to foods that provide a high amount of nutrients for a relatively low number of calories.²⁶

Conclusion

Ultimately, this study determines whether fast food, in its current state, is suitable for incorporation into a healthy lifestyle. This is important to determine because, despite the negative health effects that have been associated with fast food intake and frequency of consumption, Americans are consuming fast food in greater amounts than ever before. If fast food is not suitable for a healthy lifestyle, the next step would be to determine whether the fast-food industry is heading in a direction that would make it a viable provider of nutrition in the future.

The following study was approved by Eastern Michigan University's Human Subjects Review Committee (see Appendix B: EMU Human Subjects Review Committee Approval Notice) and utilized the Nutrition Data System for Research (NDSR) Database Version 45 © Regents of the University of Minnesota.

Chapter 2: Literature Review

Americans are more dependent upon fast food than ever before; therefore, the idea of eliminating it from one's diet would be unrealistic for many. With this understanding, it may be more practical to educate consumers regarding nutritious fast-food options and how to incorporate them into a healthy lifestyle, as opposed to recommending complete abstinence from fast foods. In order to best meet the consumers' needs, it is important to understand how and why our culture became fast-food dependent in the first place.

The purpose of this review of literature is twofold. First, in order to best meet the needs of the consumer, it is imperative to gain understanding into the evolution of our culture's fast-food dependency. Second, it is necessary to explore the current nutrition content of fast food in order to determine the types and amounts of nutrients Americans are obtaining from fast food and how those amounts compare to the recommended dietary intakes for Americans.

The Shift from Home Cooking to Eating Out

At the turn of the 20th century, nutritionists began recommending lighter, simpler meals instead of traditionally heavy, hot meals three times per day.¹⁹ Because of this, good nutrition became associated with simplicity. This philosophy was a drastic change for the average woman who, in 1900, spent 44 hours per week preparing and cleaning up after meals.¹⁹ At that time, only 20.6% of all women and 5.6% of married women worked outside the home.¹⁹ Over the next century, however, the number of hours women spent on tasks in the home decreased drastically, and the number of women working outside the home increased dramatically. By 1975, the average time spent on food preparation and cleanup had dropped to 10 hours weekly, and by 1999, 60.2% of women and 61.9% of married women worked outside the home.¹⁹

These social changes did not happen overnight. Throughout the 20th century, women slowly cut back on time spent in the kitchen as electrical advances made kitchen appliances the norm and as pre-packaged, canned, and frozen goods became more popular and readily available for purchase.¹⁹ These advancements freed up much of the time that women spent preparing and cleaning up after meals. As the baby boom came to an end, the 1960s and 1970s saw a decrease in the average size of families.¹⁹ Having fewer children to care for also led to increased free time for women. These factors contributed to the influx of women into the workforce, which, in turn, spurred a demand for even quicker meals. The 1960s and 1970s also saw an increase in divorce rates and subsequently, an increase in single parent homes.¹⁹ This further contributed to the appeal of fast food as the traditional roles of women at home and in the kitchen gave way to dual-income families and working, single-parent homes.

The influx of immigrants during this time also brought a variety of flavors and food cultures that were not well known in America before.¹⁹ Coming off the bland (albeit convenient) TV dinner era of the 1950s, this new food culture was very welcome, and families now viewed restaurants and eating out as an opportunity to sample exciting new cuisines.¹⁹ As America's appreciation of ethnic foods broadened, a demand for higher food quality began.

The 1980s and 1990s saw an increase in the average number of hours worked by Americans, and as the U.S. approached the millennium, individuals found themselves expecting higher quality food while having less time to put into meal preparation.¹⁹ Suddenly, good nutrition was no longer simple but was instead considered more time consuming. These reasons, along with a generational loss of knowledge on cooking, ultimately resulted in Americans' dependence upon professional cooks and chefs to provide them with high-quality food. These circumstances set the stage for restaurants to flourish, and the fast-food industry found its niche.

Upward Trend of Fast-Food Consumption in the U.S.

Changes in the U.S. social structure, such as those discussed above, are largely responsible for the rising trend of food consumption outside the home.²⁷ Fast food in particular is a growing part of our culture, and it impacts the majority of Americans. In the 1960s, Americans spent over 20% of their food budgets on eating out, and about 13% of those dollars were spent on fast food.²⁸ In 2004, over 40% of Americans' food budgets were spent on eating out, and over 30% of those dollars were spent on fast food.²⁸ In short, U.S. consumers are spending more money eating out than ever before, and more of that money is being spent at fast-food establishments.

Studies on the frequency of fast-food consumption among all Americans are scarce; however, regional surveys have been performed in recent years.²⁹ A survey of fast-food consumers in New York City performed in 2007 found that quick service restaurant patronage accounted for 74% of all restaurant patronage.³⁰ In a 2005 survey taken in the state of Michigan, 80% of adults had purchased fast food in the month prior to the survey, and 28% of adults had eaten fast food at least twice per week.²⁹ Finally, in a 2008–2009 study of young adults in Minneapolis and St. Paul, Minnesota, 95% of participants admitted to eating fast food at least once per week.³¹

Working adults and single parents are not the only consumer groups to include fast food in their diets. Adolescents are also prone to fast-food consumption and are establishing eating patterns with the inclusion of fast food at an early age. In a focus group of adolescents, time and convenience were noted as two of the top reasons for fast-food consumption.³² Parents' work schedules leave them too busy to prepare meals, so teenagers become responsible for their own meals and resort to fast food. Other students noted that they chose to get a few more minutes of

sleep rather than wake up in time to make and eat breakfast.³² When they did take time to eat breakfast, they preferred foods that were easy to make, easy to pack in a backpack or for the school bus, or convenient to purchase at a drive through window.³² Even when time is not an issue, however, some students and parents admitted to choosing convenience foods to avoid dishes or other time consuming activities related to meal preparation.³² Fruits and vegetables were noted as specific examples of foods that take more time to prepare.

Caloric Intake Associated with Fast Food

Although research on the energy content of fast food is still limited, the studies that have been performed yielded data that warranted additional research. For example, in 1977–1978 fast-food consumption made up 4% of the American caloric intake, and that percentage rose to 15% in 2003–2004.^{27,33} A study performed in New York City in 2007 showed that the average fast-food customer purchased 827 calories in a single meal; 34% of consumers participating in the study bought over 1000 calories, and 15% purchased over 1250 calories per meal.³⁰ The greatest number of calories were purchased at quick-service chicken restaurants such as Kentucky Fried Chicken[®] and Popeye's[®], and the fewest calories were purchased at sandwich restaurants like Subway[®] and Au Bon Pain[®].³⁰ Quick-service restaurants often bundle the entrée with a side and a drink for a slight cost savings. These “combo meals” made up about one-third of consumer purchases at quick-service chain restaurants, and about 12% of all orders were made up entirely of sides.³³

Many studies have attempted to assess whether posting calorie information for customers has an effect on the amount of calories ordered. These studies have yielded mixed results. For example, in one study that included 11 fast food chains in New York City in 2007 and 2009, the overall calories purchased at lunch did not change after implementation of the required calorie

posting.¹⁵ Some individual chains did have significant reductions in average calories purchased, but one chain had a significant increase.¹⁵ Many restaurants are now providing other nutrition information in addition to calorie content although most of them do not give consumers comprehensive information. Most nutrition information available is limited to calories, fat, saturated fat, carbohydrate, protein, sodium, and sometimes additional micronutrients.³³

Nutrient Content in Fast Food

In addition to the energy content of fast food, large gaps exist in the research and analysis of the macro- and micronutrient contents of fast food.³³ To remedy this, a recent collaborative effort was organized to begin tracking fast-food nutrition data across the world.³⁴ This collaboration will collect and analyze the energy, fat (saturated, poly- and monounsaturated, and trans), protein, carbohydrate, sugar, sodium, and fiber content of fast food.

The vitamin and mineral content of fast food are still of great importance, however, and past studies have indicated associations between fast-food consumption and inadequate micronutrient intake.³⁵ Adults and children who eat fast food were also shown to consume fewer servings of vegetables, particularly dark green vegetables, than those who do not eat fast food.³ The only exception to this is the consumption of fried potatoes, which are a common fast-food side dish such as french fries and hash browns.³ Fruit, milk, and legume consumption of those who eat fast food was also less than that of individuals not consuming fast food.³

Specific micronutrient research regarding fast food is scarce, and this researcher found no information regarding the vitamin D or potassium content in fast food. Fiber and calcium have been studied very little, but the amount of fiber consumed by adults was found to be lower among adults who reported eating fast food as compared to adults who reported not eating fast food.³ Calcium intake was higher in individuals who reported fast-food consumption than in

those who did not.³ Paeratakul and colleagues³ suggested that the higher calcium intake may be due to increased consumption of fast-food products containing cheese such as pizza, cheeseburgers, and tacos.

The Health Trend

As the demand for healthier foods increased, the quick service restaurant industry attempted to expand its supply. In 2012 Bauer and colleagues³³ found that the number of salads sold as entrées in quick-service restaurants increased between 1997 and 2010, from 11 entrée salads to 51 entrée salads. They concluded that quick-service restaurants as a whole have not reduced the calorie content of their menu items, even though many claimed to be moving toward offering a greater selection of healthier foods. They assessed the change in energy provided by fast food from 1997 to 2010 and found that while calorie content in condiments and dessert increased, entree and beverage calories remained fairly constant, and side dish calories decreased. Overall, the average calories provided by fast food remained approximately the same despite a 53% increase in food options.

In 2011, McDonald's announced a plan to expand its number of healthy options and reduce nutrients that Americans are known to consume in excess, such as sodium, saturated fat, sugar, and total calories, by 2020.³⁶ Although vague as to the amounts by which most of these nutrients will be reduced, the plan did specify a 15% average reduction in sodium by 2015.

The Happy Meal had a specific target: a calorie reduction of 20%.³⁶ This goal was implemented in 2012 in all McDonald's restaurants through the inclusion of apple slices as a part of every Happy Meal and through a reduction in french fry size. Overall, however, kids' menus have not benefited very much from the trend of offering healthier fast-food options. In 2008 O'Donnell and colleagues³⁷ analyzed the nutrition of kids' meals offered by quick-service

restaurants in Houston, Texas by comparing the nutrient content to the criteria set forth by the National School Lunch Program (NSLP). Of the 51,010 possible food combinations available, only 3% met all of the NSLP criteria.

Since the NSLP was formulated specifically for children's nutrition needs, the overall nutrition content of quick-service restaurant menu offerings for adults is better analyzed using the Healthy Eating Index (HEI). The HEI-2005 and HEI-2010 are algorithms created by the United States Department of Agriculture (USDA) to measure nutrition content of food according to the 2005 and 2010 Dietary Guidelines for Americans, respectively.³⁸ Higher HEI scores indicate higher nutrition quality.

Using the HEI-2005, Hearst and colleagues³⁹ assessed the health trend in eight fast-food restaurants from 1997 to 2010. Six of the restaurants increased their HEI-2005 scores, and two decreased their scores. The mean score for the restaurants was 48 out of 100, which was an average increase of 3 points in 12 years. While this study³⁹ was not representative of the entire quick-service restaurant industry, it does indicate progress toward healthier fast-food options, even if that progress is very small. From 2003 to 2004, the HEI-2005 for the U.S. population overall was 57.5.⁴⁰ From 2007 to 2008, a retrospective study applied the HEI-2010 (the HEI algorithm correlated to the 2010 Dietary Guidelines for Americans) to the U.S. population for data from 2007 to 2008; the score was 53.5 out of 100.⁴¹ Overall, fast food is still less healthy than the normal diet of the average American.³⁹

Nutrients of Concern in the American Diet

The Dietary Guidelines for Americans, 2010, determined four nutrients for which Americans' intake is chronically low. These nutrients are potassium, vitamin D, calcium, and fiber.²¹ Potassium helps to lower blood pressure and may assist the body in retaining bone mass;

the adequate intake (AI) level for potassium is 4700 mg daily for adults.²¹ Potassium is found in highest concentrations in fruits, vegetables, and dairy products.²¹

Consumption of vitamin D at the recommended amounts can help prevent broken bones, rickets, and osteomalacia.²¹ The recommended dietary allowance (RDA) of vitamin D is 600 IU or 15 mcg for both children and adults alike, and it increases by about 25% for older Americans.²¹ Vitamin D naturally occurs in fatty fish and egg yolks, although fortified foods such as milk and yogurt, cereal, and orange juice are also good dietary sources.²¹

In addition to being important for bone mass, calcium is utilized by muscles, blood vessels, and nerves.²¹ The RDA for calcium varies according to age, but ensuring adequate calcium intake is important for all age groups.²¹ Dairy products are the best sources of calcium although today many food items are fortified with calcium.²¹

The benefits of fiber include lowered cholesterol and blood glucose levels, increased satiety, and a healthy colon.²¹ Women are advised to consume 25 g per day, and men should aim for a daily intake of 38 g per day.²¹ In reality, however, the average American consumes roughly 15 g of fiber each day, well under the AI.²¹ The best sources of fiber are legumes and peas, whole grains, fruits, and vegetables.²¹

Conclusion

Overall, the last decade or so has seen an increase in the number and variety of healthy options available in the fast-food industry, but there is clearly still room to improve. One could argue both sides of supply and demand, but the bottom line remains that a consumer cannot purchase something that is not offered.⁴² Although research emphasis has primarily been placed upon the energy content and macronutrient profiles of fast-food meals, research on micronutrient profiles is imperative to create a baseline against which future research may be benchmarked.

This research analyzed the nutrients of concern (as set forth in the Dietary Guidelines for Americans, 2010) available in fast-food menus to determine whether certain fast-food categories offer more nutritious options than others and whether there is a correlation between the amount of calories and micronutrients in fast food. Specifically, this research looked at calcium, vitamin D, fiber, and potassium to determine how much of these nutrients Americans can obtain from fast food and which restaurant categories are the best sources. Finally, fast food is known for offering energy-dense foods; this study concluded whether there are nutrient-dense foods available to quick-service restaurant patrons as well.

Chapter 3: Methodology

Research Questions

The purpose of this pilot study was to determine the amount of calcium, vitamin D, fiber, and potassium served in American fast food and whether the quantity of these micronutrients is sufficient enough to contribute to a healthy diet. The methodology in this study is designed to meet three research goals: 1) to establish baseline research on the amount of calcium, vitamin D, fiber, and potassium in fast food; 2) to determine which quick-service restaurants (of the seven analyzed) are best meeting Americans' needs for these nutrients; and 3) to determine whether there is a correlation between calories, and micronutrient content in fast-food items. In order to answer these questions, the calories, and the amounts of calcium, vitamin D, fiber, and potassium were analyzed for food items at the top-selling quick-service restaurant chains in each of seven categories.

Hypotheses

Calcium is the most widely available of the four micronutrients, mostly from dairy products such as milk, yogurt, cheese, and ice cream-based desserts and beverages. Alternatively, potassium is the least available due to a lack of fruits and vegetables at quick-service restaurants. Fiber is found in the highest amounts in Mexican restaurants due to bean dishes. A positive correlation between fiber content and total calories is due to the fact that few fiber-rich foods (such as whole grains, fruits, and vegetables) are staples in American fast food. Therefore, in order to consume more fiber, a restaurant patron would simply need to eat more. Overall, there will be nutrient-dense food items in the current offerings of the quick-service restaurant industry from which Americans could choose to supplement their healthy lifestyle; however, these options would be few in number and lacking in variety.

Study Population

The 2012 Quick Service Restaurant 50⁴³ will serve as the pool of fast-food chains for this analysis. The restaurants on this list are ranked annually according to U.S. sales. The pool was then narrowed to the highest-selling restaurant from each of seven categories. The final pool of restaurants and their respective categories can be found in Table 1.

Table 1: Restaurants Included in Study

Restaurant	Category	Overall Rank (2012 U.S. Sales)
McDonald's [®]	Burger	1
Subway [®]	Sandwich	2
Taco Bell [®]	Mexican	6
Pizza Hut [®]	Pizza	8
Chick-fil-A [®]	Chicken	9
Panda Express [®]	Asian	21
Long John Silver's [®]	Seafood	34

Research Design

Nutrient data was collected for every food and beverage item listed on the menus posted on the restaurants' websites. The researcher collected calorie, calcium, vitamin D, fiber, and potassium content for these items. Unavailable nutrient values were recorded as such. The restaurants' websites were the primary source for nutrient data collection. Other means of data collection were online nutrient databases, particularly those displaying micronutrient values. The data were sorted by restaurant (e.g., McDonald's, Subway) and analyzed for mean and median micronutrient content, correlation among calorie and micronutrient content, and Kruskal-Wallis one-way analysis of variance on ranks among all seven restaurant categories.

Data Collection, Procedure, and Tools

The sources of nutrient data for this study were restaurant websites, the University of Minnesota Nutrition Data System for Research (NDSR)⁴⁴, and the USDA National Nutrient Database for Standard Reference (NND). The nutrient data was collected for each of the food and beverage items listed on the restaurants' websites and then supplemented by the NDSR and the USDA. Any food or beverage items found in nutrient databases that were not on the restaurant website menus were excluded. If a nutrient database contained a food or beverage from the restaurant website but the calorie value in the nutrient database differed more than 10% from the calorie content listed on the restaurant website, the nutrient database values were excluded. The final data set was then analyzed using SigmaPlot⁴⁵ statistical analysis software.

Statistical Analysis

The researcher calculated the mean and median fiber, calcium, vitamin D, and potassium content for each restaurant. The total datasets for each restaurant category were compared by nutrient using Kruskal-Wallis one-way analysis of variance on ranks. Dunn's Method was then used to compare all restaurant pair combinations to determine among which restaurants the statistical significance exists. In the final dataset, the calorie content of each food item was compared to the micronutrient content and correlation for each micronutrient was calculated.

Study Limitations

This study was limited by the nutrient data available for restaurants' food items. For example, if a restaurant did not provide the nutrient content for a particular food item and the food item was not found in other nutrient databases, then the nutrient content for that particular food item was recorded as unavailable.

Chapter 4: Data Analysis

Overview of Available Versus Missing Nutrient Data

The restaurants' websites served as the primary source of nutrient data for menu items and were supplemented with data from the NDSR and the USDA's NND. Of all of the menu items, values for fiber content were most widely available, followed by calcium, potassium, and vitamin D.

Tables 2 and 3 display the number of menu items listed on the restaurant's websites and the breakdown of menu items for which nutrient information was available or missing. Fiber was the most widely available nutrient, with 100% of the values provided by the restaurants' websites. Three of the seven restaurants (Long John Silver's, McDonald's, and Subway) provided calcium information for 100% of menu items, and it was posted on their websites. The remaining four restaurants' calcium information was obtained primarily from the NDSR with a few values supplemented by the USDA's NND.

Table 2: Number of Menu Items with Calcium and Vitamin D Information Available

	<i>Menu Items</i>	Calcium		Vitamin D	
		<u>Included</u>	<u>Missing</u>	<u>Included</u>	<u>Missing</u>
Chick-fil-A	126	58 (46%)	68 (54%)	56 (44%)	70 (56%)
Long John Silver's	114	114 (100%)	0 (0%)	10 (9%)	104 (91%)
McDonald's	258	258 (100%)	0 (0%)	117 (45%)	141 (55%)
Panda Express	121	19 (16%)	102 (84%)	19 (16%)	102 (84%)
Pizza Hut	164	56 (34%)	108 (66%)	55 (34%)	109 (66%)
Subway	208	208 (100%)	0 (0%)	91 (44%)	117 (56%)
Taco Bell	202	66 (33%)	136 (67%)	66 (33%)	136 (67%)

Table 3: Number of Menu Items with Fiber and Potassium Information Available

	<i>Menu Items</i>	Fiber		Potassium	
		<u>Included</u>	<u>Missing</u>	<u>Included</u>	<u>Missing</u>
Chick-fil-A	<i>126</i>	126 (100%)	0 (0%)	58 (46%)	68 (54%)
Long John Silver's	<i>114</i>	114 (100%)	0 (0%)	10 (9%)	104 (91%)
McDonald's	<i>258</i>	258 (100%)	0 (0%)	120 (47%)	138 (53%)
Panda Express	<i>121</i>	121 (100%)	0 (0%)	19 (16%)	102 (84%)
Pizza Hut	<i>164</i>	164 (100%)	0 (0%)	56 (34%)	108 (66%)
Subway	<i>208</i>	208 (100%)	0 (0%)	91 (44%)	117 (56%)
Taco Bell	<i>202</i>	202 (100%)	0 (0%)	66 (33%)	136 (67%)

Potassium and vitamin D were nutrients whose values were the least available for menu items, with neither nutrient being disclosed on the restaurants' websites. The NDSR was the sole source of vitamin D values, as the USDA's NND did not provide information on the vitamin D content of menu items. Potassium was slightly more represented than vitamin D due to a few items being supplemented with information from the USDA's NND for this nutrient.

Mean and Median Micronutrient Values per Restaurant

Of the nutrient values that were available from the NDSR and the USDA's NND, mean and median calcium were found in the highest amounts at Pizza Hut, with 256.4 mg and 265 mg, respectively (see Table 4). Thirty-four percent of Pizza Hut's menu items were represented in the mean and median analyses. The highest mean vitamin D was found at McDonald's at 0.509 mcg, with 45% of menu items represented. The highest median of vitamin D was found at Taco Bell at 1.47 mcg, with 32% of menu items represented.

Table 4: Mean and Median Calcium and Vitamin D Values per Restaurant

	Calcium		Vitamin D	
	Mean	Median	Mean	Median
Chick-fil-A	158.3 mg	92 mg	0.423 mcg	0.106 mcg
Long John Silver's	28.3 mg*	0 mg*	0.101 mcg	0.0165 mcg
McDonald's	180 mg*	145 mg*	0.509 mcg	0.130 mcg
Panda Express	32.2 mg	31 mg	0.155 mcg	0.0510 mcg
Pizza Hut	256.4 mg	265 mg	0.162 mcg	0.144 mcg
Subway	195.5 mg*	100 mg*	0.46 mcg	0.133 mcg
Taco Bell	155.5 mg	125 mg	0.273 mcg	0.147 mcg
* These values represent 100% of the menu items.				

The highest mean fiber was found at Taco Bell at 2.8 g and supports the initial hypothesis, which expected fiber to be found in the highest amounts at Mexican fast food restaurants (see Table 5). There was a three-way tie among Pizza Hut, Subway, and Taco Bell for the highest median fiber value at 2 g each. Fiber was the only nutrient with 100% of menu items included (see Table 6 for mean and median fiber content excluding beverages and condiments). Finally, mean potassium was found in the highest amount at Chick-fil-A at 375.5 mg, with 46% of menu items represented. Highest median potassium was found at McDonalds at 332 mg, with 46% of menu items represented.

Table 5: Mean and Median Fiber and Potassium Values per Restaurant

	Fiber		Potassium	
	Mean	Median	Mean	Median
Chick-fil-A	1.6 g*	1 g*	375.5 mg	291.5 mg
Long John Silver's	0.5 g*	0 g*	98.8 mg	98.5 mg
McDonald's	1.5 g*	1 g*	352.4 mg	332 mg
Panda Express	0.7 g*	0 g*	173.6 mg	163 mg
Pizza Hut	1.5 g*	2 g*	294.9 mg	274 mg
Subway	2.2 g*	2 g*	249.2 mg	240 mg
Taco Bell	2.8 g*	2 g*	353.7 mg	225 mg
* These values represent 100% of the menu items.				

Because fiber was not often found in beverages or condiments in these restaurants, the mean and median fiber content of food items was analyzed as well, and it yielded higher results

than those in Table 5. By excluding beverages and condiments, each restaurant's mean and median fiber content increased as shown in Table 6. The highest mean fiber content remained Taco Bell but increased from 2.8 g to 4.4 g. The highest median fiber content three-way tie was broken by Taco Bell in this table, whose median fiber content increased from 2 g to 4 g.

Table 6: Mean and Median Fiber in Foods (Excluding Beverages and Condiments) in Quick Service Restaurants

	Mean Fiber	Median Fiber
Chick-fil-A	3.2 g	2 g
Long John Silver's	1.4 g	1 g
McDonald's	2.5 g	2 g
Panda Express	1.6 g	1 g
Pizza Hut	1.7 g	2 g
Subway	2.6 g	2 g
Taco Bell	4.4 g	4 g

Results of Kruskal-Wallis One-Way Analysis of Variance on Ranks and Dunn's Method

Kruskal-Wallis one-way analysis of variance on ranks was utilized to determine whether nutrient values differed significantly among restaurants. A post-hoc Dunn's Method test was then performed to compare all restaurant pair combinations and pinpoint between the restaurants where the differences were significant.

Table 7: Results of Kruskal-Wallis One-Way Analysis of Variance on Ranks by Nutrient

Kruskal-Wallis	Calcium (p ≤ 0.001)	Vitamin D (p = 0.032)	Fiber (p ≤ 0.001)	Potassium (p ≤ 0.001)
p < 0.05	pass	pass	pass	pass
p < 0.01	pass	fail	pass	pass

All four nutrients were found to differ significantly from restaurant to restaurant at a p-value of < 0.05, and calcium, fiber, and potassium were also significant at a p-value < 0.01. Calcium, fiber, and potassium's p-values were < 0.001, while vitamin D's p-value equaled 0.032. The following Table 8 displays the differences among restaurants.

Table 8: All Pairwise Multiple Comparison (Dunn's Method) for Calcium $p \leq 0.01$ in Quick-Service Restaurants

	Chick-fil-A	Long John Silver's	McDonald's	Panda Express	Pizza Hut	Subway	Taco Bell
Chick-fil-A	n/a	significant	no	no	no	no	no
Long John Silver's	significant	n/a	significant	no	significant	significant	significant
McDonald's	no	significant	n/a	no	no	no	no
Panda Express	no	no	no	n/a	significant	no	no
Pizza Hut	no	significant	no	significant	n/a	no	no
Subway	no	significant	no	no	no	n/a	no
Taco Bell	no	significant	no	no	no	no	n/a

Several pairs of restaurants were found to have significant differences in calcium content. Long John Silver's had the lowest mean and median calcium content and differed significantly from every other restaurant except Panda Express, which had the second lowest mean and median calcium content. This suggests that Long John Silver's menu items provide a significantly lower amount of calcium than other restaurants in this study. Panda Express is one of the poorest providers of calcium in this study as it was not found to be significantly different from Long John Silver's, and it was significantly different from Pizza Hut, whose menu items provided the highest mean and median calcium contents.

Table 9: All Pairwise Multiple Comparison (Dunn's Method) for Fiber $p \leq 0.01$ in Quick-Service Restaurants

	Chick-fil-A	Long John Silver's	McDonald's	Panda Express	Pizza Hut	Subway	Taco Bell
Chick-fil-A	n/a	significant	no	no	no	significant	significant
Long John Silver's	significant	n/a	significant	no	significant	significant	significant
McDonald's	no	significant	n/a	significant	no	no	no
Panda Express	no	no	significant	n/a	significant	significant	significant
Pizza Hut	no	significant	no	significant	n/a	no	no
Subway	significant	significant	no	significant	no	n/a	no
Taco Bell	significant	significant	no	significant	no	no	n/a

Significant differences in restaurant pairs were even more prevalent in fiber comparisons than in calcium comparisons. Like calcium, Long John Silver's fiber content was significantly different from every restaurant except for Panda Express. Panda Express was also significantly different from every restaurant except Long John Silver's and Chick-fil-A, suggesting that seafood, Asian, and chicken fast-food restaurants provide less fiber than other types of fast food restaurants. Table 9 suggests that the rest of the restaurants provide similar fiber contents to each other, and this is also evidenced by the mean and median fiber contents as displayed in Table 5. It should be noted that Dunn's Method was applied to each restaurants' entire dataset. The data in Table 6 excludes beverage and condiment fiber values and shows Taco Bell's mean and median fiber values pull farther away from the rest of the restaurants than in Table 5. If Dunn's Method were performed on that data, it might yield different results than those in Table 9.

Table 10: All Pairwise Multiple Comparison (Dunn's Method) for Potassium $p \leq 0.01$ in Quick-Service Restaurants

	Chick-fil-A	Long John Silver's	McDonald's	Panda Express	Pizza Hut	Subway	Taco Bell
Chick-fil-A	n/a	no	no	no	no	no	no
Long John Silver's	no	n/a	significant	no	no	no	significant
McDonald's	no	significant	n/a	no	no	no	no
Panda Express	no	no	no	n/a	no	no	no
Pizza Hut	no	no	no	no	n/a	no	no
Subway	no	no	no	no	no	n/a	no
Taco Bell	no	significant	no	no	no	no	n/a

In the pairwise multiple comparison of potassium content (see Table 10), the two significant differences were found between Long John Silver’s and McDonald’s, and Long John Silver’s and Taco Bell. These significant differences support the conclusion drawn from Table 5 that Long John Silver’s is the poorest provider of potassium, and McDonald’s and Taco Bell are much better providers of this nutrient.

There were no significant differences in vitamin D found in the pairwise comparison of restaurants. Vitamin D content of menu items among the restaurants was found to be significantly different ($p < 0.05$), although no differences were noted by Dunn’s Method.

Restaurants Best Meeting Americans’ Nutrient Needs

The restaurants that are best meeting Americans’ needs for these micronutrients are those with nutrient-dense menu items that are good sources of one or more micronutrients. These are the types of foods that could realistically be incorporated into a healthy lifestyle. According to

the Food and Drug Administration’s (FDA) guide on nutrient content claims, a food must contain 10% to 19% of the daily value (DV) of a nutrient per serving size in order to be labeled a “good source.” A food may be labeled an “excellent source” of a nutrient if it contains at least 20% of the daily value per serving.⁴⁶ The daily values as set by the FDA are as follows: 1000 mg calcium, 400 IU or 10 mcg vitamin D, 25 g fiber, and 3500 mg potassium.^{47,48} The following tables (Table 11 and 12) display the number of menu items considered excellent and good sources of each micronutrient at each restaurant according to the FDA’s guidelines.

Table 11: Number of Menu Items Considered Excellent and Good Sources of Calcium and Vitamin D in Quick-Service Restaurants

	Calcium		Vitamin D	
	<u>Excellent Source</u>	<u>Good Source</u>	<u>Excellent Source</u>	<u>Good Source</u>
Chick-fil-A	18	10	2	12
Long John Silver's	3	9	0	0
McDonald's	106	54	12	12
Panda Express	0	0	0	0
Pizza Hut	36	17	0	0
Subway	95	11	10	4
Taco Bell	19	19	0	3
Total	<i>277</i>	<i>120</i>	<i>24</i>	<i>31</i>

Table 12: Number of Menu Items Considered Excellent and Good Sources of Fiber and Potassium in Quick-Service Restaurants

	Fiber		Potassium	
	<u>Excellent Source</u>	<u>Good Source</u>	<u>Excellent Source</u>	<u>Good Source</u>
Chick-fil-A	8	15	8	15
Long John Silver's	1	8	0	0
McDonald's	12	54	9	44
Panda Express	4	7	0	2
Pizza Hut	1	17	0	17
Subway	37	51	1	29
Taco Bell	50	46	10	20
Total	<i>113</i>	<i>198</i>	<i>28</i>	<i>127</i>

Supporting the initial hypothesis, calcium appears to be the most widely available of the four micronutrients with 277 excellent sources and 120 good sources among all seven

restaurants. Fiber was the second most available nutrient with 113 excellent and 198 good sources. Potassium was originally expected to be the least available of the four micronutrients due to a perceived lack of fruits and vegetables in fast food offerings. In reality, sources of vitamin D were the least common, 24 excellent and 31 good sources, and potassium was found in greater abundance with 28 excellent and 127 good sources.

Of the seven restaurants included in this study, it appears that McDonald’s is doing the best job providing excellent and good sources of calcium (106 and 54 items) and vitamin D (12 and 12 items) with Subway coming in at a close second for number of excellent sources (95 sources of calcium and 10 sources of vitamin D). Chick-fil-A tied McDonald’s for the second highest number of good sources of vitamin D. Taco Bell is providing the highest number of excellent sources of fiber (50 items), with Subway again taking a close second place (37 items). Taco Bell also took the top place for excellent sources of potassium (10 items), with McDonald’s coming in second with 9 items. McDonald’s and Subway had the first and second highest number of good sources of fiber (54 and 51 items, respectively), and McDonald’s and Subway took first and second place for the highest number of good sources of potassium with 44 and 29 items, respectively.

Table 13: Total Number of Nutrient-Dense Menu Items per Quick-Service Restaurant

	<u>Excellent Sources</u>	<u>Good Sources</u>	<u>Total</u>
Chick-fil-A	36	52	88
Long John Silver's	4	17	21
McDonald's	139	164	303
Panda Express	4	9	13
Pizza Hut	37	51	88
Subway	143	95	238
Taco Bell	79	88	167

Overall, McDonald’s provided the highest quantity of total nutrient-dense menu items with 303, followed by Subway with a total of 238. Taco Bell came in third with 167 items.

Chick-fil-A and Pizza Hut tied for fourth with 88, and Long John Silver's and Panda Express were the poorest providers with 21 and 13 items, respectively.

It should be noted that of all the restaurants included in this study, Panda Express had the lowest percentage of nutrient values available. Only 16% of its 121 menu items (see Tables 2 and 3) had values for calcium, vitamin D, and potassium content (100% of menu items in this study had nutrient values available for fiber). Given the variety of ingredients used in Panda Express, it is quite possible that the number of nutrient-dense options at this restaurant would increase as more nutrient values become available. Similarly, Long John Silver's had 114 menu items (see Tables 2 and 3), with 100% of the nutrient values available for calcium and fiber, but only 9% of nutrient values available for vitamin D and potassium. This restaurant had zero nutrient-dense sources of vitamin D or potassium (see Tables 11 and 12), and it is possible that these numbers would increase as additional nutrient information becomes available.

Correlation

Correlation was calculated between calories and nutrient values (see Table 11). Only correlation coefficients with a p-value of < 0.05 were recorded. Pizza Hut had particularly high correlations between calories and calcium, vitamin D, and potassium, with correlation coefficients at 0.899, 0.881, and 0.823, respectively. Taco Bell had the highest correlation coefficient for potassium at 0.839. Taco Bell, Subway, and Pizza Hut had semi-strong correlation coefficients for fiber (0.649, 0.670, and 0.694, respectively).

Table 14: Correlation Between Calories and Nutrients in Quick-Service Restaurants

	Calcium	Vitamin D	Fiber	Potassium
Chick-fil-A	0.727	0.615	0.295*	0.503
Long John Silver's	0.245*	nsr	0.224*	nsr
McDonald's	0.515*	0.276	0.543*	0.613
Panda Express	nsr	0.492	0.213*	nsr
Pizza Hut	0.899	0.881	0.694*	0.823
Subway	0.792*	0.527	0.67*	0.525
Taco Bell	0.756	0.456	0.649*	0.839
nsr = no significant relationship indicated by p value > 0.05 *These values represent 100% of menu items				

Alternatively, Panda Express, Long John Silver's and Chick-fil-A had relatively low correlation coefficients for fiber (0.213, 0.224, and 0.295, respectively). An additional correlation coefficient worth noting includes McDonald's lowest vitamin D correlation of 0.276.

Correlation as Indicator of Nutrient Versus Energy-Dense Items

Correlation was calculated with the intent of indicating whether menu items at a restaurant were largely energy-dense or if nutrient-dense items existed. If correlation between calories and a nutrient was positive and very strong, the assumption could be made that one would simply have to consume more food in order to increase intake of that nutrient.

Alternatively, if correlation between calories and a nutrient was weak, it may be an indication of lower calorie items with higher nutrient contents. This method was utilized as an initial analysis technique to highlight potential trends among restaurants and micronutrients. It was imperative to consider the results of this analysis within the context of the actual micronutrient content at

each restaurant, and in doing so, correlation as an indicator of nutrient versus energy-dense menu items proved to be unreliable.

Pizza Hut had particularly high correlations between calories and calcium, vitamin D, and potassium, with correlation coefficients at 0.899, 0.881, and 0.823, respectively, indicating that this restaurant would be a poor provider of these nutrients. While Pizza Hut was in fact a poor provider of vitamin D and potassium, the data demonstrated that one third of this restaurant's menu items were good or excellent sources of calcium according to the FDA's definitions. Finally, Taco Bell had the highest correlation coefficient for potassium at 0.839, which should have indicated this restaurant as a poor source of this nutrient. In reality, the data showed that Taco Bell provided the highest quantity of excellent sources of potassium, and the third highest quantity of good sources.

Taco Bell, Subway, and Pizza Hut had semi-strong correlation coefficients for fiber (0.649, 0.670, and 0.694, respectively), which indicate that they may have a number of items that contain significant fiber content for relatively low number of calories. Taco Bell and Subway turned out to be the best providers of fiber, while Pizza Hut was one of the poorest.

Alternatively, Panda Express, Long John Silver's and Chick-fil-A had relatively low correlation coefficients for fiber (0.213, 0.224, and 0.295, respectively), indicating that there were items with high calories and low fiber as well as items with low calories and high fiber. This turned out to be true, although overall these three restaurants were in the bottom four poorest providers of fiber in terms variety and number of items that were good and excellent sources. An additional correlation coefficient worth noting includes McDonald's low vitamin D correlation of 0.276. This indicates that McDonald's should have nutrient-dense sources of

vitamin D, which it did, and it actually turned out to be the restaurant with the highest quantity of good and excellent sources of vitamin D.

Food Sources of Each Micronutrient

One of the initial hypotheses was that nutrient-dense items would be few in number and lacking in variety. This proved to be true for vitamin D, and one could argue that this hypothesis also holds true for potassium. Vitamin D was found in significant amounts mainly in breakfast sandwiches containing eggs with yolks, tuna sandwiches, and fortified cheese and milk.

Potassium was fairly limited in quantity but was found in a wider variety of foods such as french fries, milkshakes, orange juice, tomato and marinara sauce (in pizza and Subway's Meatball Marinara sandwich), Mexican items with beans, and lettuce-based salads.

This same hypothesis did not apply to calcium or fiber, which were found in an impressive quantity and variety of menu items. Calcium was found in an array of dairy products including cheese (on pizza, sandwiches, breakfast sandwiches, burritos, quesadillas, tacos, and cheeseburgers), ice cream and milkshakes, milk and milk-based coffee drinks, Subway's breads, and Long John Silver's Popcorn Shrimp and Seafood Salad. Fiber was found in starchy and non-starchy vegetables (corn and potato products, salads, and mixed vegetables), grain-based products (oatmeal, breads, biscuits, bagels, tortillas, wraps, and pizza crust), beans (in tacos, nachos, burritos, salads, and soups), and fruit (fruit with yogurt, fruit-based desserts, and fruit smoothies).

Specific Menu Items Suitable for Healthy Lifestyle Inclusion

There were a handful of items that were excellent and/or good sources of multiple micronutrients, making them particularly good candidates for inclusion into a healthy lifestyle. When considering these food items, however, it is important to keep in mind the rest of the food

or beverage item’s nutrient profile. For example, McDonald’s Big Breakfast with Hotcakes (Classic Regular Size) is an excellent source of all four micronutrients included in this study but at 1090 calories, it would be difficult to incorporate this menu item into a balanced diet for most consumers. An Egg McMuffin, on the other hand, is also an excellent source of calcium, vitamin D, and a good source of fiber, and it provides a much more reasonable 300 calories per sandwich. The following Table 14 displays a few menu items from each restaurant that were particularly nutrient-dense while also providing a reasonable number of calories.

Table 15: Nutrient-Dense Items from Each Quick Service Restaurant and % DV Provided

Restaurant	Menu Item	Calories	Calcium % DV	Vitamin D % DV	Fiber % DV	Potassium % DV
Chick-fil-A	Chicken, Egg & Cheese on Sunflower Multigrain Bagel	480	29%	25%	12%	6%
	Waffle Potato Fries (Large)	520	8%	0%	20%	57%
Long John Silver’s	Seafood Salad, Salad	310	25%	unavailable	12%	unavailable
McDonald’s	Premium Southwest Salad with Grilled Chicken	290	14%	1%	28%	19%
	Quarter Pounder with Cheese	520	30%	24%	12%	12%
	1% Low Fat Milk Jug	100	32%	29%	0%	10%
	Bacon, Egg, and Cheese Bagel	620	22%	32%	12%	6%
	Egg McMuffin	300	27%	23%	16%	6%
Panda Express	Mixed Veggies (Side)	70	8%	0%	20%	14%
Pizza Hut	6” Personal Pan Pizza (Cheese)	590	47%	2%	16%	13%
	14” Large Thin N’ Crispy Pizza (1/8 Supreme)	320	27%	2%	8%	10%
Subway	6” Meatball Marinara*	480	35%	2%	32%	16%
	6” Tuna*	480	30%	26%	20%	11%

	Meatball Marinara Salad**	310	10%	2%	24%	20%
	6" Egg White and Cheese (with ham)	350	60%	9%	16%	10%
	6" Steak, Egg and Cheese	430	40%	21%	20%	11%
	Flatizza Veggie	410	70%	unavailable	12%	unavailable
Taco Bell	7-Layer Burrito	430	27%	6%	28%	14%
	Combo Burrito	450	15%	2%	36%	15%
	Cantina Power Bowl- Veggie	460	9%	1%	52%	22%
	Chicken Quesadilla	510	47%	15%	16%	7%
	Express Taco Salad w/ Chips	580	22%	2%	36%	25%
*9 grain whole wheat bread, lettuce, tomatoes, onions, green peppers, and cucumbers						
**Lettuce, spinach, tomatoes, onions, green peppers, cucumbers, olives, no dressing						

In addition to considering calories and micronutrients, it should be noted that all nutrients, as well as an individual's unique nutrition needs, should be taken into consideration when deciding which foods are best suited to an individual's diet.

Chapter 5: Conclusion

Assessment of Results in the Context of Prior Research

To date, no other studies have focused solely on the micronutrient content of American fast food, and to the author's knowledge, this is the first study to include research on vitamin D and potassium content. It has been reported that fast-food consumption is associated with decreased micronutrient intake.³⁵ Although certain quick-service restaurants were better providers of calcium, vitamin D, fiber, and potassium than others, the results of this study suggest that for certain micronutrients (calcium, fiber), decreased intake may be a result of consumer choices as opposed to lack of calcium and fiber-rich menu choices. There were also micronutrients for which rich sources were in poor supply among all restaurants (namely vitamin D), and the few rich sources of vitamin D lacked variety.

Study Limitations

Limitations of this study included limited availability of vitamin D and potassium values for food and beverage items at certain restaurants. Menus also changed throughout the course of this study causing certain food items that were analyzed to no longer be available and additional items not available at the time of this study that are now being offered. The discussion of results in chapter 5 was based primarily on the micronutrient content expressed in percent daily values. This was done for comparison's sake, because as the RDA and AI for nutrients varies significantly according to age and gender.²¹ However, the DV does not meet the needs of 100% of the population and in some cases may be significantly less than the amount recommended for an individual (i.e., the DV for fiber is 25 g, whereas the AI for adult men is 38 g).²¹

Implications for Future Research

The results of this study indicate that it is possible to include some fast food as part of a healthy diet, and certain quick-service restaurants (McDonald's, Subway) are providing a larger variety of nutrient-dense, calorie-controlled items than others. Future research in this area should be expanded to include additional restaurants and micronutrients. A larger sample of restaurants within each category (e.g. burger, seafood, chicken) is needed in order to determine whether the conclusions drawn in this study apply to categories of fast food or if they are chain specific. For example, this study demonstrates McDonald's was the best provider of calcium among all of the restaurants in this study, but more research is needed to determine whether or not this is the case among all burger chains. There is also a need to expand the scope of nutrient analysis to include additional micronutrients underconsumed in the U.S. Examples of such nutrients include vitamin A, vitamin E, vitamin C, folate, magnesium, and iron.⁴⁹

Finally, although the focus of this study was the micronutrient and calorie content of fast food, this alone is not enough information on which to base decisions for a healthy diet. All nutrients should be taken into consideration, and in the case of fast food, special attention should be paid to total fat, saturated fat, trans fat, sugar, and sodium content. This may be of particular importance when considering potassium values, because the balance of potassium to sodium in the body may be just as important as one's total intake of potassium.⁵⁰ Future research in this field should attempt to look at the specific restaurants' and menu items' complete nutritional values in order to provide sound guidance for consumers and examples of nutritious options for the quick-service restaurant industry.

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APPENDICES

Appendix A: NAICS Codes, Titles, and Descriptions for “Limited-Service”

Source:

North American Industry Classification System Staff. Monthly Retail Trade and Food Services NAICS Codes, Titles, and Descriptions. United States Census Bureau.

<http://www.census.gov/retail/mrts/www/benchmark/2012/html/naicsdef.html>. Published 2012.

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Industries in the Food Services and Drinking Places subsector prepare meals, snacks, and beverages to customer order for immediate on-premises and off-premises consumption. There is a wide range of establishments in these industries. Some provide food and drink only; while others provide various combinations of seating space, waiter/waitress services and incidental amenities, such as limited entertainment. The industries in the subsector are grouped based on the type and level of services provided. The industry groups are full-service restaurants; limited service eating places; special food services, such as food service contractors, caterers, and mobile food services, and drinking places. Food services and drink activities at hotels and motels; amusement parks, theaters, casinos, country clubs, and similar recreational facilities; and civic and social organizations are included in this subsector only if these services are provided by a separate establishment primarily engaged in providing food and beverage services.

Excluded from this subsector are establishments operating dinner cruises. These establishments are classified in Subsector 487, Scenic and Sightseeing Transportation because those establishments utilize transportation equipment to provide scenic recreational entertainment.

7221 Full-Service Restaurants

This industry group comprises establishments primarily engaged in providing food services to patrons who order and are served while seated (i.e., waiter/waitress service) and pay after eating. Establishments that provide these type of food services to patrons with any combination of other services, such as carryout services are classified in this industry.

72211 Full-Service Restaurants

This industry comprises establishments primarily engaged in providing food services to patrons who order and are served while seated (i.e. waiter/waitress service) and pay after eating. These establishments may provide this type of food services to patrons in combination with selling alcoholic beverages, providing takeout services, or presenting live non theatrical entertainment.

722110 Full-Service Restaurants

This U.S. industry comprises establishments primarily engaged in providing food services to patrons who order and are served while seated (i.e. waiter/waitress service) and pay after eating. These establishments may provide this type of food services to patrons in combination with selling alcoholic beverages, providing takeout services, or presenting live non theatrical entertainment.

7222 Limited-Service Eating Places

This industry group comprises establishments primarily engaged in providing food services where patrons generally order or select items and pay before eating. Most establishments do not have waiter/waitress service, but some provide limited service, such as cooking to order (i.e., per special request), bringing food to seated customers, or providing off-site delivery.

72221 Limited-Service Eating Places

This industry comprises establishments primarily engaged in (1) providing food services where patrons generally order or select items and pay before eating or (2) selling a specialty snack or nonalcoholic beverage for consumption on or near the premises. Food and drink may be consumed on the premises, taken out, or delivered to customers' location. Some establishments in this industry may provide these food services (except snack and nonalcoholic beverage bars) in combination with selling alcoholic beverages.

722211 Limited-Service Restaurants

This U.S. industry comprises establishments primarily engaged in providing food services (except snack and nonalcoholic beverage bars) where patrons generally order or select items and pay before eating. Food and drink may be consumed on premises, taken out, or delivered to customers' location. Some establishments in this industry may provide these food services in combination with selling alcoholic beverages.

722212 Cafeterias

This U.S. industry comprises establishments, known as cafeterias, primarily engaged in preparing and serving meals for immediate consumption using cafeteria-style serving equipment, such as steam tables, a refrigerated area, and self-service nonalcoholic beverage dispensing equipment. Patrons select from food and drink items on display in a continuous cafeteria line.

722213 Snack and Nonalcoholic Beverage Bars

This U.S. industry comprises establishments primarily engaged in (1) preparing and/or serving a specialty snack, such as ice cream, frozen yogurt, cookies, or popcorn or (2) serving nonalcoholic beverages, such as coffee, juices, or sodas for consumption on or near the premises. These establishments may carry and sell a combination of snack, nonalcoholic beverage, and other related products (e.g., coffee beans, mugs, coffee makers) but generally promote and sell a unique snack or nonalcoholic beverage.

7222131 Ice Cream and Soft Serve Shops

Establishments primarily engaged in selling ice cream and/or frozen custard for immediate consumption.

Appendix B: EMU Human Subjects Review Committee Approval Notice

October 21, 2014
APPROVAL

CHHS-HSRC Initial Application Determination: EXEMPT

To: Meghan Pearson
School of Health Sciences/Dietetics

Re: UHSRC # 670747-1
Category: Approved Exempt Research Project
Approval Date: October 21, 2014
Expiration Date: October 20, 2015

Title: Sources of Calcium, vitamin D, fiber and potassium in the American fast food industry: An in-depth assessment of the micronutrient content of fast food and which restaurants are best meeting the nutrient needs of Americans.

The Eastern Michigan University' College of Health and Human Services' Human Subjects Review Committee (CHHS-HSRC) has completed their review of your project. I am pleased to advise you that **your proposal has been approved** in accordance with federal regulations.

Renewals: Exempt protocols need to be renewed annually. If the project is continuing, please submit the **Human Subjects Continuation Form** prior to the approval expiration. If the project is completed, please submit the **Human Subjects Study Completion Form** (both forms are found on the UHSRC website).

Revisions: Exempt protocols do require revisions. If changes are made to a protocol, please submit a **Human Subjects Minor Modification Form** or new **Human Subjects Approval Request Form** (if major changes) for review (see HSRC website for forms).

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to human subjects and change the category of review, notify the HSRC office within 24 hours. Any complaints from participants regarding the risk and benefits of the project must be reported to the HSRC.

Follow-up: If your exempt research project is not completed and closed after three years, the HSRC office will require a new **Human Subjects Approval Request Form** prior to approving a continuation beyond three years.

Please use the HSRC number listed above on any forms submitted that relate to this project, or on any correspondence with the HSRC office.

Good luck in your research. If we can be of further assistance, please contact us at 734-487-1250 or via e-mail at chhs_human_subjects@emich.edu. Thank you for your cooperation.

Sincerely,

Dr. Jayne Yatzak, Chair
College of Health and Human Services
Human Subjects Review Committee