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The Price of a Healthy Diet: For Whom is it Affordable?

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THE PRICE OF A HEALTHY DIET

For Whom Is It Affordable?

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Capstone requirement for the Master in Public Policy & Management

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University of Southern Maine

The Muskie School of Public Service

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INTRODUCTION

Project Context

The prevalence of obesity in the United States has increased dramatically in the last twenty years to the point where it is now considered an epidemic (“Obesity,” 2011). Current statistics show that more than one in every three adult Americans is obese¹ (“Facts: Overweight and obesity,” 2012). Simultaneously, this obesity epidemic is linked to the occurrence of many health conditions and diseases such as heart disease, stroke, Type 2 diabetes, and certain cancers (“Obesity,” 2011). These statistics are familiar to most, as is the reality that obesity and obesity-related diseases are to a large degree preventable – or at least manageable – through an improved diet and better nutrition (“The growing crisis of chronic disease in the United States,” n.d.).

There is a broad awareness that the health of Americans is in decline. That improving the population’s eating habits can reverse this decline is a key motivator for strengthening this country’s food security. *Food security*, according to the United Nations Food and Agriculture Organization, “*exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life [emphasis added]*” (Searchinger et al., 2013, p. 12). Although the U.S. is certainly not failing at its attempts to create a food secure nation, neither is it flourishing, especially in the realm of economic access to food. Despite being one of the wealthiest nations on the planet, in 2012, reports show that 46.5 million Americans lived in poverty and 49 million Americans lived in food insecure households (“Hunger statistics, hunger facts & poverty facts,” 2014). In other words, millions of people in this country struggle daily to put *any* food on the table, let alone safe and nutritious food, which is equally as necessary for creating a food-secure country.

Eating healthy food – food that is *nutritious* (fruits, vegetables, whole grains, etc.)² and *safe* (foods free of chemicals and other additives)³ – is vital to improving both national food security and the health of Americans. A healthy diet has been proven to reduce the risk of obesity and obesity-related diseases (U.S. Department of Agriculture and U.S. Department of

¹ Obesity is defined as having a Body Mass Index (BMI) of 30 or greater. BMI is calculated using weight and height (“Overweight and obesity statistics,” 2012).

² As defined by the author.

³ As defined by the author.

Health and Human services, 2010). Unfortunately, nutritious and safe foods typically are – or are perceived to be – more expensive than less healthy and processed foods (Rao, Afshin, Singh, & Mozaffarian, 2013). The higher price (perceived or real) of healthy food contributes to fewer people consuming a nutritious diet needed for improved health. Government programs such as the Supplemental Nutrition Assistance Program (SNAP), in conjunction with nonprofit organizations (e.g. soup kitchens and food banks) provide programmatic support to ensure that most of those living in poverty have *something* to eat. Unfortunately, “maximizing the nutritional value of meals is often secondary...to providing calories” (Lyles, Drago-Ferguson, Lopez, & Seligman, 2013, p. 1).

Even with outside assistance, there is no guarantee that individuals living in poverty have access to “sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (Searchinger et al., 2013, p. 12). Unless these issues are directly addressed, health inequalities will continue to increase, food security will not fully exist in the U.S., and the nation’s overall health will continue to deteriorate.

The Research Problem

The United States Department of Agriculture (USDA) has worked over the years to define “nutritious” and “sufficient” in order to help people create a healthy diet. The most recent version of this Federal dietary guideline is called *ChooseMyPlate* and can be found at www.choosemyplate.gov (2011). While these federal nutrition guidelines help individuals learn how to make healthy diet decisions, the guidelines lack any specific cost data associated with that healthy diet. On the other hand, the price data for meal plans in the *Official USDA food plans: Cost of food at home at four levels* (2014) report is based on nutrition guidelines that have not been revised since 2006.⁴ This makes it difficult to accurately assess the affordability of *today’s* nutritious diet. Consequently, this means it is impossible to determine the difference between what those in poverty have available to pay for food and what healthy food actually costs.

⁴ The USDA’s Thrifty Meal Plan (TFP) 2006 Report states that “the TFP is the basis for the maximum food stamp allotment. This study shows it is possible to eat a nutritious diet at the maximum allotment” (Carlson, Juan, Hanson, & Basiotis, 2007, p. 35). In conjunction with the report, the USDA created a TFP recipe book of “healthy” meals (U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2000). Regrettably, many of those meals are based on foods that are now debated as to their health benefits: potatoes and corn (vegetable), fruit juices/lemonade (fruit), and white bread products (grain) (Harvard School of Public Health, 2014).

Overview of Peer-Reviewed Literature on the Cost of Healthy Eating

Despite the critical threat of our nation's declining health – coupled with strong evidence that dietary changes could reverse the problem – there remains a discouraging lack of data related to specific monetary costs of eating a healthy diet. More often than not, research studies focus on determining the cost of food in relation to its nutritional value. While this provides important data on the cost of healthy eating, it fails to provide practical information for those who have a limited food budget and who need to know the bare minimum they can spend while still maintaining a healthy diet.

Of the several relevant studies relating to the specific costs of healthy eating, one was over 15 years old, only one was a U.S. study, and no studies included organic or local food as a component of “healthy.” Two of the studies, a 1999 United Kingdom (UK) study on the costs of a healthy diet (Cade, Upmeier, Calvert, & Greenwood) and a 2011 U.S. study on the association between diet quality and cost (Rehm, Monsivais, & Drewnowski), both analyzed existing diets of cohorts. A 2009 Australian study on the “costs of healthy food habits for welfare-dependent families” (Kettings, Sinclair, & Voevodin, p. 566), created fictitious families and calculated the cost for those families to eat according to a governmental eating guide.

Both Rehm et al. (2011) and Cade et al. (1999) found that a higher-cost diet was strongly associated with increased servings of fruits and vegetables and decreased calories from solid (or saturated) fat and added sugars. These findings are unsurprising and coincide with the common perception that healthy food is more expensive than less healthy food. These studies, however, only observed the cohorts' existing eating patterns, rather than measuring the cost of specific meal plans.

It is a possibility that the high costs associated with eating a healthy diet could be reduced by utilizing several strategies: following a dietary guideline, limiting the consumption of fruits and vegetables to their *minimum* recommended serving amounts, and purchasing the most economically efficient foods, especially fruits and vegetables (e.g. not buying fresh produce out of season). In addition, Rehm et al. (2011) acknowledges that making changes to ones' eating patterns – such as consuming less meat – has the ability to change the association between higher-quality and higher-priced diets.

In a third study, Kettings et al. (2009) created a meal plan based on a specific governmental eating guideline and sourced the price data for each food item from two major supermarket chains in Australia. While Kettings et al.'s (2009) study is more closely related to this study, the primary difference is that Kettings et al. (2009) did not use organic or locally-grown food items for their meal plans, likely resulting in a less-expensive meal plan than had it been organic. Nevertheless, the authors determined that following the Australian government's nutrition guidelines was financially unfeasible for families on welfare, even when buying generic-brand food items whenever possible. At \$8 AUD per person per day, the cost of a healthy diet would require welfare-dependent families to spend 30% to 40% of their budget on food (p 571). Furthermore, vegetables were the most expensive food items of all the food groups, (vegetables, fruits, proteins, grains, and pantry items). Results of the Kettings et al. (2009) study indicate that, even when following a strict dietary guideline, it appears a healthy diet is too costly for people living in poverty.

Overview of the USDA's Report on the Cost of Healthy Eating

In 2012, the USDA published a report entitled "Are Healthy Foods Really More Expensive? It Depends on How You Measure the Prices." (Carlson & Fazão). The purpose of the report was to "compare the price of healthy and less healthy foods using three price metrics: the price per calorie, per edible gram, and per average portion" (Carlson & Fazão, 2012, p. III). The authors asserted that all previous studies on the cost of eating a healthy diet measured food prices using the price per calorie metric, a metric developed in the 1890s. Their study found that "the metric used to measure the price of food items [had] a large effect on which foods [were] more expensive" (p. III). Only the price per calorie metric (the most commonly-used metric) determined healthy food to be more costly than less healthy food. When healthy food items in the grains, vegetables, fruit, and dairy food groups were measured per edible gram or per average portion, they tended to be less expensive than most protein food items and processed foods (e.g., "foods high in saturated fat, added sugars, and/or sodium" [p. III]).

It is important to keep in mind that this USDA study calculated the prices for over 4,000 food items, all of which had been consumed by adults as reported in a previous study. In other words, the measured food items were based on their universal purchase rather than on their economic efficiency. This means that while the findings presented the *average* costs of *many*

food-group items (including expensive food items), the findings were still not relevant to discovering the *least expensive* diet that follows the USDA's nutrition guidelines.

Purpose of Study

This exploratory study addressed the gaps that current research has ignored. What have been missing are studies that focus on tangible costs of realistic, practical, and healthy meal plans. This study was not intended to measure a national average cost of eating a healthy diet. Rather, its focus was to examine the cost of healthy diet in a specific location. With this in mind, the purpose of this exploratory research was twofold:

1. To determine the minimum annual cost for an average individual to eat a meal plan in Portland, Maine that was “sufficient, safe, and nutritious” (Searchinger et al., 2013, p. 12). *Sufficient* was operationalized by following a 2,000 calorie-per-day diet. *Nutritious* was operationalized by following the USDA's *Choose MyPlate* healthy eating guidelines. *Safe* was operationalized by using ingredients that were predominately organic and were purchased locally (primarily at the Farmers' Market), with prices based on Maine Organic Farmers and Gardeners Association (MOFGA) price data and a regional grocery store chain.
2. To assess the affordability of this meal plan for a Maine resident who received the average SNAP benefit(s) by determining the discrepancy between the cost of the diet and the average amount of SNAP benefits received.

Relevance of this Exploratory Study to Public Policy

The decisions people make regarding what they eat or do not eat may seem like personal ones. Yet, the repercussions from those decisions affect many more people than just the individual making the decisions. Since cost dictates many of one's food choices, the affordability of healthy food is a relevant issue to multiple areas of public policy, both directly and indirectly including the following:

- *Environmental Policy*: Indirectly, this study pertains to environmental policy issues because the diets designed for this study were based on the affordability of *organic* food. Although a highly emotionally charged issue, evidence suggests that organically grown

food is often better for the planet and more environmentally sustainable than conventionally grown/raised food (“FAQ: What are the environmental benefits of organic agriculture,” 2014). Determining whether organic food is affordable for all will help shape future environmental policy decisions.

- *Health Policy:* This study is extremely relevant to health policy as diet and nutrition directly affects health (“The growing crisis,” n.d.). It is a logical extension, therefore, to conclude that the choices an individual makes in the present about what to eat can significantly impact the type and amount of healthcare services that person will need in the future. Indeed, if it is economically unfeasible for millions of Americans to eat a healthy diet right now, the entire country will pay for it in the future through the (increasing) cost of healthcare.
- *Poverty and Welfare Policy:* Obesity and obesity-related health problems affect people from all socioeconomic backgrounds. Unfortunately, “due to the additional risk factors associated with poverty, food insecure and low-income people are especially vulnerable to obesity” (“Why low-income and food-insecure people are vulnerable to overweight and obesity,” 2010). This is, in part, due to the relatively cheap price of less healthy, energy-dense foods (“Why low-income,” 2010). Unfortunately, this contributes to a negative cycle, where low-income people lack financial resources to purchase healthy food to eat, which correlates with poor nourishment and increased sickness, which interferes with their job performance (often risking job loss), making increased reliance on the government for financial assistance more of a necessity. If these habits are passed on to the next generation, this negative cycle is further reinforced.

Studies such as this one will provide invaluable information to better measure the gap between what low-income people currently have available to spend on food and what they need to have available if they are to eat a healthy diet. Unless welfare programs are redesigned to close this gap so that the poor can afford healthy food, poverty will continue to be a downward spiral for far too many people.

- *Agriculture/ Food Policy:* The U.S. Government heavily subsidizes four edible crops: corn, wheat, soy, and rice (“The United States summary information,” 2012). These agricultural

subsidies reduce the price that food companies have to pay for these four foods which are used as ingredients in processed foods (e.g. sodas and sweets) (“The United States summary,” 2012). Inexpensive ingredients translate to relatively inexpensive processed foods for consumers. Agriculture policy is effectively creating a situation where less healthy foods are also the cheapest foods.

METHODS

This exploratory study on the cost of eating a healthy diet was conducted by first using “desk research techniques and economic modeling” (Ketting et al., 2009, p. 567) to create meal plans and source food price data, and second, by using quantitative analysis to compare the meal plan prices to the average SNAP benefits received by Maine residents. Meal plans were created for a single individual who ate a 2,000-calorie-per-day diet. This hypothetical individual had no dependents, was not pregnant, had no food allergies or dietary restrictions, and had no food preferences. It was assumed that this individual had access to a kitchen with a refrigerator, a stove, an oven, and storage.

Four one-week meal plans were created: two in the month of August and two in the month of February. By creating summer and winter meal plans, a more accurate assessment of meal plan costs was possible by accounting for any seasonal changes in produce price or accessibility. Within each season, one of the weekly meal plans included only animal-based protein (beef, chicken, fish, and eggs), while the other plan included only non-meat-based protein (nuts, legumes, and eggs). This differentiation was offered not for vegetarians, but rather because much of the data on diet costs suggest that a majority of the average food budget is spent on meat (Cade et al., 1999; Carlson & Frazão, 2012). The high percentage spent on meat is due to the tendency of meat to be more expensive than other foods, especially when it is organic. Measuring the cost of a meat diet as well as a meat-free diet helped determine an *actual* minimum cost of a healthy diet as well as a *realistic* minimum cost of a healthy diet (i.e. most Americans would be unlikely to remove meat from their diet).

Creating the Meal Plans

Each weekly meal plan was divided into seven days, with each day broken down into three main daily meals and one or more snacks. The total food intake for each day had to fit within two parameters: total calories and total food group servings. The USDA's food tracker was used to measure food calories ("Food tracker," 2014). Daily calorie totals were kept slightly *below* 2,000 calories for two reasons. First, it was unrealistic to create menus that were precisely 2,000 calories per day. Second, it was important to create a small buffer to compensate for hidden calorie intake (e.g. large eggs were used instead of the allotted medium-sized eggs). The food group parameters were set by the USDA's *ChooseMyPlate* guidelines (2011). The recommended daily food groups and target serving amounts for a 2,000-calorie diet were:

- Fruits (2 cups)
- Vegetables (2 ½ cups)
- Grains (6 ounces)
- Dairy (3 cups)
- Protein Foods (5 ½ ounces)

In addition to these five food groups, the category of "other" was added for miscellaneous food items such as oils, condiments, and spices.

Within the caloric and food group parameters, simple daily meals were created based on four additional guidelines defined by the author:

1. Which organic foods were expected to be least expensive at the Farmers' Market (primary) or at the grocery store (secondary).⁵
2. Of those foods, which were most likely to be familiar to a typical individual (e.g. using carrots instead of celeriac root).
3. What meals/foods would present enough variety to be realistically consumed for several days/weeks.
4. What foods needed to be "used up" throughout the week to minimize food waste (e.g. making use of either 12 or six eggs per week since eggs are purchased in dozen and half-dozen cartons).

An example of the resulting daily menus can be seen in Figure 1, which shows the daily menu for one day in the meatless summer weekly meal plan.

⁵ With the exception of lime juice, spices and winter chicken, every ingredient of every meal plan was organic (or, in the case of the fish, wild caught). At both the Portland Winter's Farmers' Market and the grocery store, only "all natural" chicken was available meaning the chicken contained no antibiotics and no added growth hormones.

Figure 1: Example daily menu from the meatless summer weekly meal plan

DAY ONE									
MEAL	DISH NAME	INGREDIENTS	QUANTITY (Food Group Equivalents)	UNITS	ACTUAL QUANTITIES	FOOD GROUP	CALORIES	PRICE-SOURCE LOCATION	
BREAKFAST	Smoothie	Yogurt, plain, whole milk	1	Cup(s)		Dairy	149	Farmer's Market	
		Strawberries, halved	1	Cup(s)		Fruit	49	Farmer's Market	
		Sunflower seeds, raw	1	oz.	1/2 oz. (= about 1/4 cup)		Protein	83	Grocery Store
		Kale, chopped	1/4	Cup(s)	1/2 cup		Vegetable	16	Farmer's Market
LUNCH	Eggplant Burgers	Eggplant, raw, cubed	3/4	Cup(s)		Vegetable	15	Farmer's Market	
		Basil, fresh	4	Leaves		Other	1	Farmer's Market	
		Tomatoes, raw, sliced	1/2	Cup(s)		Vegetable	16	Farmer's Market	
		Hummus	1	oz.	3 Tbsp		Protein	80	Grocery Store
		Olive Oil	3/4	Tbs			Fat	90	Grocery Store
		Bread, 100% whole wheat	2	oz.	2 slices		Grains	180	Grocery Store
		Vinegar, balsamic	3	tsp			Other	14	Grocery Store
		Mustard	2	tsp			Other	7	Grocery Store
		Cheese, cheddar	1/2	Cup(s)	3/4 oz.		Dairy	86	Grocery Store
DINNER	Asian Fried Rice	Rice, brown, uncooked	3	oz.	1/2 cup	Grains	344	Grocery Store	
		Onion, yellow, chopped	1/4	Cup(s)		Vegetable	16	Farmer's Market	
		Summer squash, sliced	1/2	Cup(s)		Vegetable	18	Farmer's Market	
		Carrots, chopped	1/4	Cup(s)		Vegetable	13	Farmer's Market	
		Egg, medium, fried w/o fat	2	oz.	2 eggs		Protein	130	Farmer's Market
		Soy Sauce, reduced sodium	2	Tbs			Other	17	Grocery Store
		Olive Oil	1/2	Tbs			Fat	60	Grocery Store
		Fruit	1	Cup(s)			Fruit	54	Farmer's Market
Milk	1/2	Cup(s)			Dairy	74	Farmer's Market		
SNACKS	Toast	Bread, 100% whole wheat	1	oz.	1 slice	Grain	90	Grocery Store	
		Peanut butter, no sugar/salt	1 1/2	oz.	1 1/2 Tbs.	Protein	152	Grocery Store	
		Milk	1	Cup(s)			Dairy	149	Farmer's Market
DAILY TOTALS:		Fruits	2	Cup(s)	0	TOTAL CALORIES:	1,903	Total FM Purchases: 13 Total GS Purchases: 12	
		Vegetables	2 1/2	Cup(s)	0				
		Whole Grains	6	oz.	0				
		Dairy	3	Cup(s)	0				
		Non-Meat Protein	5 1/2	oz.	0				

Price Data Collection

Several sources of pricing data were used to calculate the cost of the meal plans. For Farmers' Market items, prices came from one of two sources. Summer food item prices were sourced using the Maine Organic Farmers and Gardeners Association's (MOFGA) 2013 Year-End Organic Price Report (2013). The report provided the low, high, and average prices for every available organic food item at Maine Farmers' Markets for the individual months of May

through September of 2013. The price for each food items was calculated by averaging June, July, August, and September's average prices for those food items.⁶ In order to collect price data for Farmers' Market items in the winter months, visits were made to the Portland Winter Farmers' Market where sellers were asked the prices for all organic food items.⁷ For the remainder of non-farmer's market food items (e.g. peanut butter, olive oil, etc.), prices were sourced from a regional supermarket chain; either online or at a single retail grocery store in Portland ("Browse products," 2014).⁸ Although these prices were collected in the winter, an assumption was made that, for most food items, there would be only a slight price fluctuation throughout the year. Therefore, these food item prices were used for non-Farmers' Market menu items in both summer and winter. The food items included in the summer and winter meal plans, as a comprehensive list, can be seen in Figure 2. The list includes all food items for the given season and their price-sourcing location. The list does not include food quantities, as the food group amounts differed between the meatless and meat weeks. As previously noted, all food items were organic unless otherwise specified.

Economic Modeling (Determining the Weekly Grocery Bills)

The process to transform the price data for food items into weekly grocery bills required implementing a number of steps. In the first step, food items had to be converted from their meal plan amounts (e.g. cups, teaspoons, tablespoons, ounces, etc) to purchasable amounts (e.g. pounds, ounces, gallons, etc). This was achieved using an online cooking conversion calculator ("Grams to cups conversions," 2014).⁹ This calculator allowed any amount of any given food item to be converted to its approximate weight/volume (e.g. one cup of chopped onion weighed 0.35 lbs).¹⁰ The second step required another conversion. Although all food items on the meal plans were in their raw form in order to facilitate pricing, fresh produce still had to be converted from its *edible* portion amounts (i.e. the amounts for the meal plans) to its *purchasable* portion amounts (i.e. the amounts actually purchased, including waste) (Carlson & Frazão, 2012). For

⁶ May was not included as a summer month due to Maine's northern climate. Prices and availability of produce in May tended to correspond more with winter months than summer months.

⁷ Visits to the Portland Farmers' Market were made on February 22 and March 1, 2014.

⁸ Visits to the grocery store were made on March 12 and April 8, 2014.

⁹ The online cooking calculator at www.gourmetsleuth.com had the best average conversions among the five online cooking calculators that were examined.

¹⁰ Unless otherwise noted on a menu, all food ingredients were in their raw, purchasable state. The difference in portion, calorie, and food group amounts varied significantly depending on whether the food was cooked or uncooked. For instance, one real ounce of cooked boneless, skinless chicken breast was 46 calories and was equal to one ounce of protein. One real ounce of raw boneless, skinless chicken breast was 34 calories and equaled half an ounce of protein.

Figure 2: Comprehensive summer and winter weekly food item lists

SUMMER MEAL PLAN INGREDIENT LIST (meat and meatless)		WINTER MEAL PLAN INGREDIENT LIST (meat and meatless)	
Food Group/Ingredient	Price- Sourcing Location*	Food Group/Ingredient	Price- Sourcing Location*
FRUIT		FRUIT	
Strawberries	FM	Apples (2-3/4" across)	GS
Cantaloupe	FM	Bananas (7" to 7-7/8" long)	GS
VEGETABLES		VEGETABLES	
Eggplant	FM	Onion, yellow	GS
Tomatoes	FM	Onion, red	FM
Onions, yellow	FM	Lettuce, green leaf head	GS
Summer Squash	FM	Carrots	FM
Carrots	FM	Squash, butternut	FM
Kale	FM	Tomatoes, canned	GS
Lettuce, red leaf head	FM	Mixed vegetables, frozen	GS
Cucumber	FM	WHOLE GRAINS	
Pepper, green bell	FM	Oats, rolled	GS
WHOLE GRAINS		Bread, 100% whole wheat (3/8" slices)	FM
Bread, 100% whole wheat (3/8" slices)	GS	Pasta, whole wheat, macaroni/elbow	GS
Brown Rice	GS	Quinoa	GS
Popcorn, raw	GS	Popcorn, raw	GS
Pasta, whole wheat, macaroni/elbow	GS	DAIRY	
DAIRY		Milk, whole fat	FM
Milk, whole fat	FM	Cheese, cheddar, whole fat	GS
Cheddar cheese, whole fat	GS	Yogurt, plain, whole milk	FM
Yogurt, plain, whole milk	FM	PROTEINS	
PROTEINS		Eggs, medium-size	FM
Eggs, medium-size	FM	NON-MEAT-BASED PROTEINS	
NON-MEAT-BASED PROTEINS		Sunflower seeds, raw, hulled	GS
Sunflower seeds, raw, hulled	GS	Peanut Butter, no added sugar/salt	GS
Hummus	GS	Black beans, canned	GS
Peanut Butter, no added sugar/salt	GS	MEAT-BASED PROTEINS	
Black beans, canned	GS	Chicken breast, boneless/skinless (not organic)	FM
MEAT-BASED PROTEINS		Ground beef, 90% lean	FM
Chicken breast, boneless/skinless	FM	Fish (Cusk/Hake), wild Atlantic	GS
Ground beef, 90% lean	FM	OTHER	
Fish (Cusk/Hake), wild Atlantic	GS	Olive Oil	GS
OTHER		Mustard	GS
Basil, fresh	FM	Tomato Paste	GS
Olive Oil	GS	Garlic bulb	FM
Vinegar, balsamic	GS	Broth, vegetable	GS
Mustard	GS	Lime juice (not organic)	GS
Soy Sauce, low sodium	GS	Soy Sauce, low sodium	GS
Tomato paste	GS	Curry Powder (not organic)	GS
Garlic bulb	FM	Cinnamon (not organic)	GS

* FM denotes items purchased at the Farmers' Market and GS denotes items purchased at the Grocery Store

instance, three pounds of cubed cantaloupe had to be converted to its whole-cantaloupe equivalent, which included non-edibles such as seeds and rind. These conversions were calculated using a U.S. military-based conversion calculator (“Table of conversion factor for converting ‘edible portion’ weight of foods to ‘as purchased’ weight of food,” n.d.). The final

step in generating a grocery bill for the weekly meal plans took the price data for each food item and applied it to the calculated “purchase” amounts to come up with a total cost to purchase each food item for one week.

All food purchases were grouped and totaled according to the five food groups or “other” category. The resulting total cost of each food group was then tallied to yield the grocery bill for each weekly meal plan.

Further Economic Modeling (Determining the Monthly and Yearly Grocery Bills)

Because some weekly food purchases did not need to be purchased each week (e.g. a bottle of olive oil), each week’s grocery bill could not simply be multiplied by four to get an accurate cost assessment for a month’s worth of groceries. Based on four identical weekly meal plans, the monthly grocery bill was generated by: 1) Calculating the number of weekly “servings” that would be in one unit of purchase for a food item, 2) Identifying the minimum number of units that needed to be purchased in a month to meet the meal plan requirements, and 3) Multiplying the number of units (of each food item) needed to be purchased in one month by the price of one unit of that food item. For example, the summer meatless meal plan required 24 tablespoons of olive oil to be used weekly, which totaled 96 tablespoons to be used in four weeks. The bottle of olive oil that was priced contained 50 tablespoons of olive oil so, for four weeks, two bottles (100 tablespoons) needed to be purchased to cover the monthly olive oil requirement.

To annualize the price data, the cost of four summer months was added to the cost of eight winter months (keeping meat and meatless months separate). Because the “months” were based on a four-week meal plan, this annual total equaled 48 weeks instead of 52 weeks. To correct for this, the average weekly cost of one summer month and the average weekly cost of three winter months was added to the total. In other words, the total annual cost for groceries was comprised of the cost of 17 summer weekly meal plans and 35 winter weekly meal plans.

FINDINGS

The following annual grocery prices were based on an annual diet that:

- Provided a caloric intake at or slightly below 2,000 calories per day,
- Provided the individual with the precise number of food group servings as recommended by the USDA’s *Choose MyPlate* healthy eating guidelines,
- Consisted of organic ingredients whenever the option was available,
- Was purchased primarily from the local Farmers’ Market or, if unavailable at the Market, purchased at a regional chain grocery store,
- Had enough variety to be reasonable to follow for several weeks.

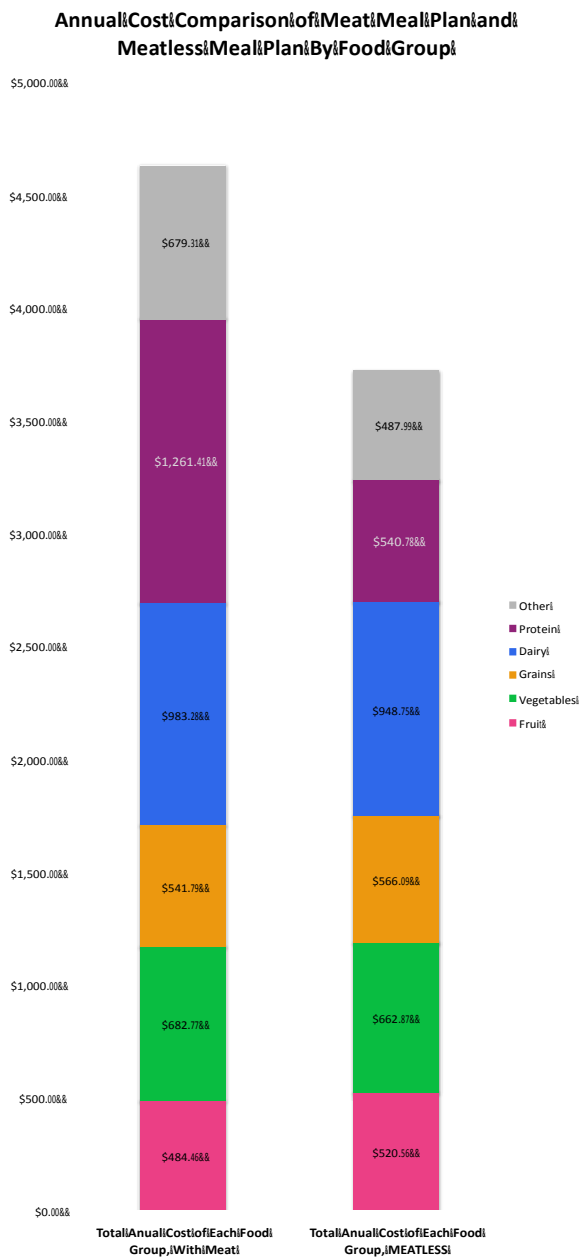
Table 1 shows the total yearly cost for one individual to eat the above-defined meal plan. For a diet that includes animal-based proteins (meat, fish, chicken, and eggs) the total cost was \$4,633. This averaged out to a cost of \$12.69 per day. The highest percentage of the total grocery bill (27%, or \$1,261) was spent on animal-based proteins (meat and eggs) while the lowest percentage of the total grocery bill (11% or \$484) was spent on fruits.

Table 1: Cost comparison of annual meat and meatless menu. Meal plans are broken down by season and presented according to the five food groups and "other" category.

FOOD GROUP	MEAT MEAL PLAN, One Year						MEATLESS MEAL PLAN, One Year					
	Summer Months: June-Sept.	One Extra Summer Week	Winter Months: Oct.-May	Three Extra Winter Weeks	Total Annual Cost of Each Food Group, With Meat	Cost of Each Food Group as % of Total Grocery Bill	Summer Months: June-Sept.	One Extra Summer Week	Winter Months: Oct.-May	Three Extra Winter Weeks	Total Annual Cost of Each Food Group, MEATLESS	Cost of Each Food Group as % of Total Grocery Bill
Fruit	\$246.40	\$15.40	\$203.57	\$19.08	\$484.46	10.5%	\$246.40	\$15.40	\$236.58	\$22.18	\$520.56	14.0%
Vegetables	\$257.70	\$16.11	\$373.91	\$35.05	\$682.77	14.7%	\$252.56	\$15.79	\$360.71	\$33.82	\$662.87	17.8%
Grains	\$168.58	\$10.54	\$331.58	\$31.09	\$541.79	11.7%	\$168.58	\$10.54	\$353.81	\$33.17	\$566.09	15.2%
Dairy	\$270.24	\$16.89	\$636.48	\$59.67	\$983.28	21.2%	\$270.68	\$16.92	\$604.48	\$56.67	\$948.75	25.5%
Protein	\$449.99	\$28.12	\$716.16	\$67.14	\$1,261.41	27.2%	\$187.06	\$11.69	\$312.70	\$29.32	\$540.78	14.5%
Other	\$184.43	\$11.53	\$441.92	\$41.43	\$679.31	14.7%	\$125.67	\$7.85	\$324.08	\$30.38	\$487.99	13.1%
Total Costs	\$1,577.34	\$98.58	\$2,703.62	\$253.46	\$4,633.02	100%	\$1,250.96	\$78.19	\$2,192.36	\$205.53	\$3,727.04	100%
Average Daily Costs	\$13.74		\$12.17		\$12.69		\$10.89		\$9.87		\$10.21	

For the meatless meal plan, the total annual cost was \$3,727, or an average of \$10.21 per day. While the purpose of this study was not to differentiate between meal costs for meat-eaters versus vegetarians, from a cost-savings perspective it is important to note that for the protein

Figure 3



food group, there was an annual savings of \$906 or 24% for a meatless diet over a traditional diet with animal-based proteins. Since the annual cost of proteins decreased by over \$700 from a “meat” meal plan to a meat-free meal plan, protein was reduced to only 15% of the total meatless meal plan cost. Figure 3 illustrates the difference in annual cost between the meatless meal plan and the meat-inclusive meal plan.

Because both the type of food and the food quantities varied across the four meal plans, it is important that one meal plan’s food group cost not be directly compared to another meal plan’s food group cost. For instance, the high price of organic strawberries inflated the cost of fruit for the summer months. To better analyze the data, therefore, relationships and averages need to be examined. Figure 4 shows the daily cost of each of the food groups as averaged between both the meat and meatless annual meal plans (the daily costs for the protein food group are shown in their meatless and meat categories and also

averaged just for reference). Meat-based protein was the most costly food group per day at \$3.46 followed by dairy at \$2.65 per day. Fruit was the least expensive food group, costing \$1.38 per day.

Given that each food group is eaten in different quantities, it is important to examine the average cost *per serving* for each food group, as shown in Figure 5. Per serving, the most expensive food group was dairy at \$0.88, followed by vegetables at \$0.74 per serving. This

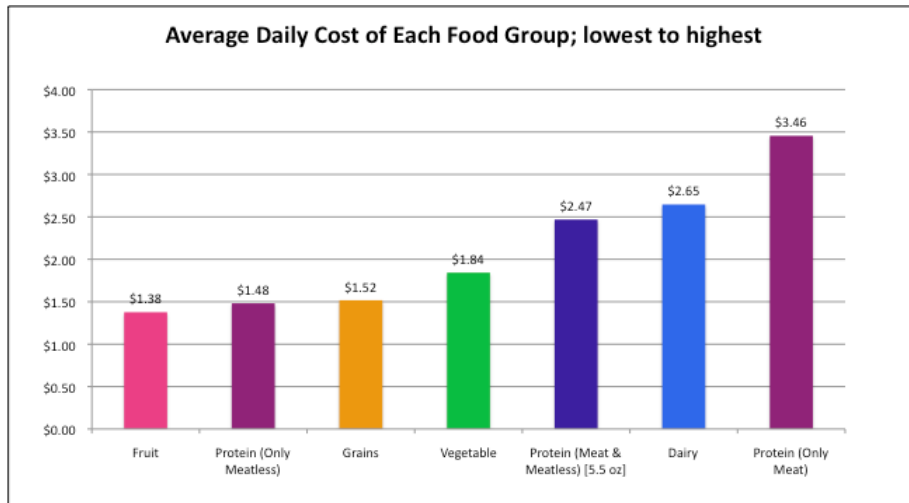


Figure 4

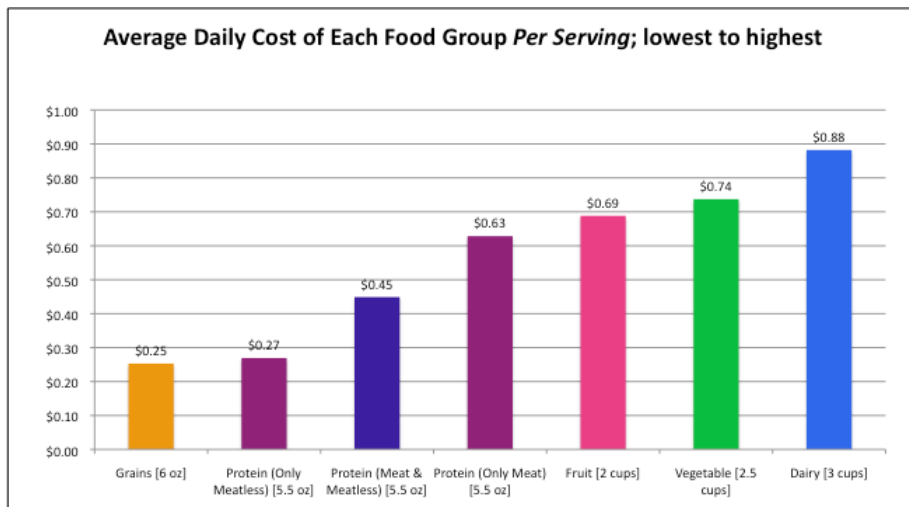


Figure 5

finding is surprising given that the common assumption is that fruits and vegetables will be the most expensive components of a healthy diet. Fruits, on a per serving basis, shifted from the least expensive for average daily cost to the third most expensive. Meat-based proteins, on the other hand, shifted from the most expensive food group for average daily cost to the middle-most expensive food group per serving.

The Supplemental Nutrition Assistant Program (SNAP) is the primary federal anti-hunger program for low-income Americans (“Maine food supplement program,” n.d.). In the state of Maine, 1 in 5 people received SNAP benefits as of January 2013 (“Maine food,” n.d.). The average SNAP benefits per person in Maine in 2013 was \$1,473, annually or approximately \$4.04 per day (U.S. Department of Agriculture, Food and Nutrition Service, 2014). Adhering to the meal plan that included meat, which cost approximately \$4,630 per person annually, equates

to a cost of over 200% more than the received SNAP benefits. To follow the meat meal plan, therefore, an individual would have to supplement their SNAP benefits with over \$3,100 of their own income or other benefits (e.g. Temporary Assistance for Needy Families [TANF]) each year just to pay for food.

The difference between average SNAP benefits and the cost of the meal plan is slightly reduced when meat is eliminated from the diet. The meatless meal plan cost a total of \$3,730 per year. The difference between the average yearly SNAP benefits received by a Maine resident in 2013 and the meatless meal plan was \$2,250, or 150% more than their benefits. An individual, would, therefore need an additional \$2,300 of income or benefits to afford the meatless meal plan.

The meal plan costs can easily be tripled to approximate food costs for a three-person family (a single adult with two children). Accordingly, some economies of scale might be gained when purchasing food in larger quantities. The USDA suggests a 15% cost savings when purchasing food for a family of three versus for one individual (“Official USDA food plan,” 2014). Using this percentage, the “overall household foods costs [would be calculated by] (1) adjust[ing] food costs for each person in household [e.g. subtracting 15%] and then (2) sum[ming] these adjusted food costs” (p 1). The meal plans would therefore cost approximately \$11,800 and \$9,500 (plans with meat and without meat, respectively) for a family of three. The meat meal plan thus costs \$7,400 (170%) more than the average SNAP benefits received by a family of three in Maine while the meatless meal plan is \$5,000 (115%) more.

LIMITATIONS

Time Constraints

This study’s first limitation came from designing it so that it could be conducted in a four-month time period. This meant that it had to include several constraints. First, for each season, only two week-long meal plans were created instead of creating a more ideal month-long meal plan, which would have allowed for more precise measurements and realistic meal variations. Second, only one supermarket was used to source prices for food items. While this grocery chain was thought to be the most average-priced grocery store in the Portland area,

gathering price data from one or two more stores would increase the reliability of the findings. Furthermore, gathering price data from additional stores might reveal areas for further cost savings. The third constraint created by time was that price data for food items had to be based on a snap shot data collection method. In other words, prices and availability of food items were only measured at a specific location at a specific point in time rather than in many locations and over the course of many weeks or months. The reality is that food prices and availability – at the Farmers' Market or in the grocery store – fluctuates from week to week and from location to location. For a more precise cost analysis for a yearly meal plan, pricing data would need to be gathered every week for the entire year as well as averaged out between locations.

Caloric Constraints

Maintaining a 2,000-calorie-per-day average presented another limitation for creating less-expensive meal plans, although in an unexpected manner. In several cases, less-expensive food items were higher in calories (per serving) than another similar food group item: nuts and legumes were cheaper than meat but higher in calories; bananas were cheaper than apples but higher in calories. Since the goal was to create meal plans that balanced both food group servings and caloric intake while simultaneously keeping costs as low as possible, this calorie-cost relationship affected the cost of the meal plans. For instance, at \$3.19/lb, a one-cup serving of apple was \$0.84 (calculated in as-purchased weight) and was 57 calories. At \$0.89/lb, a one-cup serving of banana was \$0.31 (calculated in as-purchased weight) and was 134 calories. So while a meal plan that used bananas had a total fruit cost that was less than half the cost of a meal plan that used apples, the meal plan with bananas also had more than double the amount of calories. This was specifically problematic for the winter meatless meal plan, when high-calorie non-meat proteins, such as hummus and peanut butter, increased the daily calorie total and left little room for caloric flexibility. Due to their lower calorie content, apples had to be used for a greater portion of the fruit servings for that particular meal plan. Over the course of the 35-week winter, this meant that the cost of fruit was \$50 more with the meatless meal plan than with the meat meal plan.

Measurement & Estimate Constraints

As previously described in the methods section, this study's process for determining the

meal plan costs was based on multiple steps and calculations. The accuracy of most of these calculations relied on outside sources such as the USDA's Food tracker (for calories and serving sizes) (2014), the online weight conversion calculator (for food quantity to weight conversions) ("Grams," 2014), and the edible portion calculator (for edible portion to purchasable portion conversions) ("Table of conversion," n.d.). Because the result of one calculation was almost always based on the result of a previous calculation, there was potential for small misestimates to grow into significant errors thus skewing portions of the study's results. Great care was taken to minimize any errors. For example, only *raw* foods were chosen for the meal plans to reduce the number of necessary calculation steps by eliminating a cooked-to-raw food conversion. Furthermore, estimates, calculations, and measurements were crosschecked whenever possible. For instance, in addition to being entered into the online weight calculator, many of the food items were also weighed in the grocery store and at home on the author's personal food scale.

Additional Constraints and Caveats

The three previously discussed limitations – time, calories, and measurement errors – were the major constraints of this study. Nonetheless, there were several additional constraints and caveats that influenced this study, which, while not critical, are worth noting:

1. Flexibility regarding purchase quantities for food items depended on the food item. Many foods could only be purchased in predetermined quantities (e.g. 1 lb. of ground beef) and could not be purchased in smaller amounts. Fresh fruits and vegetables, on the other hand, often vary in size and therefore offer a larger degree of purchasing flexibility (e.g. small or large onions, etc.). For this reason, the calculated purchase price of fruits and vegetables was not based on number of food items (e.g. 2 onions, 1 cantaloupe, etc.) but rather on weight.
2. No beverages were factored into the meal plans including fruit juices, which were avoided to keep food items as close to their whole form as possible.
3. Although they are inexpensive, no potatoes were used in the meal plans due to the controversy about their nutritional value.
4. The USDA guidelines recommend that at least half of a person's grain servings be *whole* grains ("ChooseMyPlate.gov," 2011). For simplicity, this study only used whole grains.
5. Finally, this study was constrained by the researcher's current knowledge of food.

DISCUSSION

The USDA's Guidelines Compared to the Harvard School of Public Health's Guidelines

This study's meal plans were based on the dietary guidelines established by the USDA. These guidelines parallel other nations' governmental dietary guidelines (Kettings et. al, 2009) and are widely accepted and followed within the United States. In fact, the meals for the U.S.'s National School Lunch and School Breakfast Programs are based on these USDA nutrition standards and dietary guidelines (U.S. Department of Agriculture, Food and Nutrition Service, 2012). Regardless of their prominence, however, they are not the only accredited healthy eating guidelines in America. Another notable set of dietary guidelines was published by the Department of Nutrition at Harvard School of Public Health in 2011 (Harvard School of Public Health, Department of Nutrition, 2014).

Although many of the differences between the USDA and Harvard guidelines are not pertinent to this study, one difference is worth discussion. The Harvard guidelines recommend limiting dairy to one to two servings per day, in contrast to the USDA's recommended three servings (Harvard, 2014; "ChooseMyPlate.gov," 2011). A change in the number of recommended food group servings – such as the decreased dairy suggested by the Harvard guidelines – could significantly alter the cost of a meal plan. If the servings of dairy were decreased from three to one serving per day, the resulting meal plan cost could be substantially higher or lower, depending on which food items were substituted for the dairy to maintain the 2,000 calories-per-day total. For reference, it cost approximately \$640 per year to purchase two servings of dairy per day (the difference between the USDA and Harvard guidelines). If those two dairy servings were replaced with a half serving (cup) of fruit, one serving (cup) of vegetables, one and a half servings (ounces) of grains, and one serving (ounce) of non-meat protein it would maintain the equivalent calorie count and save about \$13 annually. If, on the other hand, the dairy were replaced with either all grains or all vegetables, the meal plan costs would vary significantly. The grain-only substitute would cost about \$310 in total, thus reducing the current cost of the meal plan by \$330 per year. The vegetable-only substitute, on the other

hand, would cost about \$1,860 per year; *increasing* the annual cost of the current meal plan by \$1,220.

The seemingly simple changes in food group servings and the resulting fluctuations in the cost of the meal plan indicate an unfortunate reality. In an effort to reduce the consumption of one type of food (e.g. dairy) in order to consume more vegetables, an individual would encounter a not-so-simple one-to-one replacement. Eating a greater amount of produce, while more nutritious, could actually widen the financial gap between the cost of the meal plan and a SNAP recipient's average benefits, making a healthy diet even less affordable.

Opportunities for Cost Savings

The purpose of this study was to attach a price to a realistic, organic diet that followed the USDA's guidelines and then compare that cost to the average SNAP benefits received by an individual in Maine. While the basic objective was met, the reality is that the cost of the meal plans could fluctuate significantly with only minor changes. Some of these changes might reduce the cost of the meal plan enough so that the plan would become affordable for an individual receiving government food assistance. More often than not, however, a decrease in the cost of a meal plan would coincide with an increase in the time commitment necessary to execute that meal plan, whether that meant shopping for food at several locations to find the lowest prices, buying in bulk quantities and doing one's own prep work, or making more food from scratch instead of purchasing pre-made food. Furthermore, in addition to the increased time commitment, several other factors would affect an individual's ability to save money on a meal plan including his/her: access to transportation, knowledge of how to bargain shop, willingness to try unfamiliar foods, and ability to cook. Below are examples of additional opportunities where an individual could further reduce the costs of the meal plans (including any caveats associated with those savings).¹¹

1. Utilize the Portland Farmers' Market 2013 Bonus Bucks Program ("The Portland Farmers' Market; token program," 2010). For every \$20 spent at the Farmers' Market, this program offered SNAP/EBT recipients an additional \$10 worth of tokens (to be spent at the market).

¹¹ These cost saving techniques should not be considered as recommendations by the author.

Assuming the program's funds lasted for the entire year, the potential savings from utilizing this program would be approximately \$650 for the meatless meal plan and \$970 for the meal plan with meat. Caveat: The less food that is purchased at the market, the lower the potential savings.

2. Buy whole (or half) chickens instead of boneless, skinless chicken breasts. Regardless of where it was purchased, a whole chicken would be cheaper than chicken breasts per pound of edible meat. At the Farmers' Market summer price, a whole organic chicken was \$7.78 per edible pound versus boneless, skinless chicken breasts at \$12.48 per edible pound. Caveats: A whole chicken provides more meat than the weekly meal plan requires so an individual has to be able to cut up and freeze the extra meat. Secondly, a whole chicken includes dark meat, which is higher in calories than the white breast meat so serving portions would need to be adjusted accordingly. Lastly, the initial costs of buying a whole chicken instead of chicken breasts might be higher.
3. Make any legume-based food from dried beans rather than buying them canned or premade (e.g. hummus). For the meatless meal plan, using dried black beans instead of canned black beans would save over \$60 per year and making hummus from scratch instead buying it pre-made would save an additional \$30 per year. Caveats: Higher up-front costs of making a one-time purchase of all the ingredients needed to make hummus.
4. Purchase the more expensive food items at the grocery store instead of the Farmers' Market. Chicken purchased at the grocery store instead of the Farmers' Market would have resulted in a \$230 annual cost savings for the meal plan that included meat. Yogurt purchased at the grocery store would have saved \$100 yearly for either meal plan. Interestingly, milk presented no significant cost savings. Caveats: The grocery store did not carry *organic* chicken, only *all natural* chicken. This would not be different from the type of chicken available at the Farmers' Market in the winter but in the summer, the Farmers' Market *did* have organic chicken available.

5. Eat more beef and fish, and less chicken, for meat-based proteins. When prices were compared per location (i.e. Farmers' Market to Farmers' Market), beef and fish were always cheaper, per pound, than chicken breasts. Caveats: The USDA recommends limiting red meat consumption. Also, since beef had more calories per serving than chicken, serving portions would need to be adjusted.
6. Eat less variety. One watermelon – which was cheaper per edible pound than strawberries or cantaloupe – could easily fulfill the fruit requirements for one person for one week. Brown rice was cheaper per pound than quinoa. Cheese was more expensive per serving than milk. In other words, if the variety of foods eaten was reduced, the cost of the meal plan could also be reduced. Caveats: Eating the exact same foods for an entire year would be unpleasant for most people and might lead to an individual giving up on following the meal plan.
7. Bargain shop. Finding store coupons and sales could potentially lead to significant savings. Caveats: Bargain shopping requires time and access to transportation.

For all of the above areas of potential cost savings, it is important to note that the savings could *not* be combined en masse to result in even greater savings. The savings in one area (e.g. the Bonus Bucks Program at the Farmers' Market) could be nullified by implementing another savings method (e.g. purchasing more food at the grocery store).

Public Policy Recommendations

It is unlikely that in the near future, the *cost* of healthy meal plans will be reduced so that they become affordable for those living in poverty.¹² Efforts must instead be made to increase the *value* of those meal plans. This could be achieved through implementing a healthy-food incentive program for SNAP recipients, much like the Portland Farmers' Market Bonus Bucks Program (2010).¹³ Rather than taking the approach of prohibiting the purchase of less-healthy

¹² It is unlikely that any of the following policy changes (which would help offset the cost of this study's meal plans) will be made in the near future. Conventionally-grown food will not be taxed to compensate for the negative externalities associated with the farming practices (thus making its price more equivalent to organic prices); subsidies for corn, wheat, soy and rice will not be reduced nor will fresh or organic produce likely gain subsidies; and SNAP benefits (or other government aid) will not increase to the point of covering the costs of an organic, local diet.

¹³ The key to the program's success would be not to simply discount healthy foods because this would allow any savings to be spent on less-healthy food items. The program should encourage the consumption of more healthy foods, not create a system so that consumers could purchase healthy food plus extra non-healthy food.

food items, an incentive program would encourage SNAP recipients to purchase healthy foods by providing them with a rebate for purchasing those foods. Qualifying healthy food would include: fresh or frozen produce; whole grains; unprocessed meats; non-meat proteins free of additives or flavorings; and dairy without additives or flavorings. In other words, most qualifying foods would exist in their simplest, least-processed forms. While a box of plain whole-wheat pasta would qualify, a boxed pasta meal (e.g. cheesy noodle casserole) would not. Similarly, raw chicken breasts would qualify; chicken nuggets would not.

The incentive program would be designed so that SNAP participants would receive a rebate based on total SNAP benefits spent in one month on qualifying food items. The rebate amount would be added to their Electronic Benefit Transfer (EBT) card to be used the following month. Food items would have rebate “rankings” based on how much motivation people typically need to purchase those food items. For example, people generally need more incentive to purchase fresh produce than meat or dairy. Fresh produce, therefore, would have a higher rebate ranking and, therefore, larger rebate than meat or dairy. The rebate amounts would need to be substantial enough to incentivize SNAP participants to purchase qualifying foods while simultaneously being low enough to be politically feasible. Below are the suggested food items and rebate percentage amounts:

- Fresh Produce: 30% rebate
 - Frozen produce, non-meat proteins (e.g. eggs, legumes, and nuts), and whole grains: 20% rebate
 - Meat and dairy: 10% rebate
- *(An additional 3-5% rebate could be included for any organic food items)

The total rebate for each individual would depend upon the type and quantity of food items (s)he purchased in one month. If a Maine resident (who received the average \$123 per month in SNAP benefits) purchased foods from this study’s summer meatless meal plan (based on food group percentages rather than quantities), (s)he would receive a \$25 rebate: \$15 from fresh produce, \$4 from non-meat proteins, \$3 from whole grains, and \$3 from dairy. In addition to encouraging SNAP recipients to eat healthier foods, this program could also improve their health by reducing their intake of the sodium, sugar, and fats more commonly found in processed foods. Increasing the value of healthy foods to make them more comparably priced to less-healthy foods would, ideally, encourage the consumption of whole, healthy foods and improve the overall health of the consumers.

CONCLUSION

Research has established that a diet filled with healthy foods (fresh fruits and vegetables, whole grains, and lean proteins) is more expensive than a diet filled with sugars, simple carbohydrates, sodium, and unhealthy fats. It has also been established that many of these ingredients are components of highly processed foods, and these foods are contributing significantly to the U.S.'s rapidly rising rates of obesity and obesity-related diseases.

What has not been established, however, is the actual cost of eating a healthy diet. This is problematic for the millions of Americans who struggle to afford the food of an *unhealthy* diet let alone a healthy diet. Furthermore, these segments of the population tend to suffer disproportionately from diet-related health maladies. Herein lies the discrepancy. Unless policy makers acknowledge the existence of a significant gap between the cost of eating a healthy diet and the amount of money those in poverty have available to spend on food, few, if any steps are likely to be taken to narrow that gap to improve the health of the nation's poor. In addition, without a reasonable grasp of the factors that contribute to this situation, motivation for change through government policy will be low.

This study aimed to take the first step toward attaching tangible costs to a healthy diet (at least in a very specific set of circumstances). Not surprising, it was determined that even when kept to a basic level, the annual cost of eating a locally-sourced, organic diet within the Portland, Maine area was still thousands of dollars per person and far beyond the affordability of a person relying on SNAP benefits to pay for food. This study highlights the undeniable reality that a realistic, practical, and healthy food plan based on government-established guidelines is impractical for a significant number of people – many of whom may be at higher risk for health problems. Because of the complexity of this issue, it can only be improved through the shared commitment and efforts of officials and policy makers at all levels of government, educators, and the nation's citizens. Food security is vital to maintaining a strong and healthy population, economy, and country.

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