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United States Department of Agriculture

Economic
Research
Service

Economic Brief
Number 27

February 2016

The Cost of Satisfying Fruit and Vegetable Recommendations in the Dietary Guidelines

Hayden Stewart, Jeffrey Hyman, Andrea Carlson, and Elizabeth Frazão





United States Department of Agriculture

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Recommended citation format for this publication:

Stewart, Hayden, Jeffrey Hyman, Andrea Carlson, and Elizabeth Frazão. *The Cost of Satisfying Fruit and Vegetable Recommendations in the Dietary Guidelines*, EB-27. U.S. Department of Agriculture, Economic Research Service, February 2016.

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Abstract

Most Americans do not consume enough fruits and vegetables to meet recommendations in the *2015-2020 Dietary Guidelines for Americans*. One reason may be that some consumers perceive these foods to be expensive. We estimate the average price at retail stores of a pound and an edible cup-equivalent (or for juices, a pint and an edible cup-equivalent) of 156 commonly consumed fresh and processed fruits and vegetables and find that in 2013, a consumer on a 2,000-calorie diet could satisfy Federal fruit and vegetable recommendations for \$2.10 to \$2.60 per day. We also find that a family of four could purchase a sufficient variety of fruits and vegetables to meet those same guidelines with a limited budget, based on the U.S. Department of Agriculture's Thrifty Food Plan (TFP). However, this would require the household to allocate a much larger share of its overall food budget to fruits and vegetables and a smaller share to foods high in solid fats, added sugars, and sodium.

Keywords: dietary recommendations, food prices, food budgeting, fruit and vegetable consumption, *2015-2020 Dietary Guidelines for Americans*, Thrifty Food Plan

Acknowledgments

The authors would like to thank the following reviewers of this report: Michelle Saksena, USDA, Economic Research Service; Professor Diana Cassady, University of California-Davis; Professor Christina Mushi-Brunt, Indiana University-Purdue University Indianapolis; Colette Rihane and Mark Lino, USDA, Center for Nutrition Policy and Promotion. Finally, we thank USDA, Economic Research Service employees Courtney Knauth for editing and Curtia Taylor for design and layout.

Overview

Most Americans do not consume enough fruits and vegetables to meet recommendations in the Dietary Guidelines (Dong and Lin, 2009; Guenther et al., 2006).¹ One possible reason is a perception among some consumers that fruits and vegetables are expensive. In a number of surveys, members of lower income households have reported that costs prevent them from eating more fruits and vegetables (e.g., Mushi-Brunt et al., 2007; Eikenberry and Smith, 2004).

This belief has been echoed in numerous media reports. To tackle the question of fruit and vegetable prices, *Food & Health*, a blog maintained by a registered dietitian, cited a medical and health expert at each of two universities (Gustafson, 2015). Both of these authorities believed that high prices for healthy foods like fruits and vegetables prevent many consumers from adhering to Federal dietary guidelines. One authority stated that “the government really needs to make dietary guidelines more relevant to Americans.” An initiative for helping consumers increase fruit and vegetable consumption, “Fruits and Vegetables – More Matters,” acknowledges that such opinions are widespread but counters with evidence that many types of fruit and vegetables are less expensive than common snack foods (Fruits and Vegetables–More Matters, 2015).

How much do fruits and vegetables cost? Stewart et al. (2011) used 2008 household scanner data to estimate average retail prices across the contiguous United States. They demonstrated that a consumer on a 2,000-calorie reference diet could satisfy Federal dietary recommendations for fruits and vegetables for \$2.00 to \$2.50 a day. Carlson and Stewart (2011) used the same data to illustrate the variety of fruits and vegetables that a family of four could purchase on a limited budget. The researchers assembled a basket of fruits and vegetables whose total cost did not exceed a budget based on the Thrifty Food Plan (TFP). The TFP was developed—and is updated—by the U.S. Department of Agriculture’s (USDA) Center for Nutrition Policy and Promotion (CNPP) to demonstrate how people with limited resources can acquire a nutritious diet at a minimal cost (USDA, CNPP, 2015). The TFP also serves as the basis for estimating a household’s benefits under the Supplemental Nutrition Assistance Program (SNAP).

In this brief, we update previous estimates of the costs to meet Federal fruit and vegetable recommendations. Using 2013 retail scanner data from Information Resources, Inc. (IRI), we calculate average prices for 156 fruit and vegetable products sold at retail stores across the country. We then show that in 2013, a consumer on a 2,000-calorie reference diet could satisfy fruit and vegetable recommendations in the *2015-2020 Dietary Guidelines for Americans* for \$2.10 to \$2.60 per day. This is only slightly higher than the estimate using 2008 data and is consistent with the modest inflation in fruit and vegetable prices in recent years. The Bureau of Labor Statistics’ Consumer Price Index (CPI) shows that fruit and vegetable prices increased by about 4 percent in nominal terms between 2008 and 2013, close to the approximate 4- to 5-percent increase we find in comparing 2008 and 2013 estimates and less than price increases for consumer goods and services in general. We also reconsider the basket of fruits and vegetables that a family of four could purchase with a limited budget based on the TFP while meeting current Federal dietary guidelines.

¹ While the Dietary Guidelines recommend that a 2,000-calorie diet include 2 cup-equivalents of fruit and 2.5 cup-equivalents of vegetables each day, ERS analysis of data from the National Health and Nutrition Examination Survey finds that American adults consume about 1 cup of fruit and 1.6 cups of vegetables per day, on average (USDA, ERS, 2015a).

Economic Research Service (ERS) Fruit and Vegetable Price Estimates

We estimated average prices for 156 fruits and vegetables. The list of foods selected for pricing includes 24 fresh fruits and 40 fresh vegetables, as well as 92 processed fruits and vegetables (canned, frozen, dried, and juiced products). For example, oranges include fresh oranges and 100-percent juice. Moreover, orange juice is priced in two forms: ready-to-drink and frozen concentrate that must be reconstituted at home.² For each product, we estimated the average retail price on a per pound basis (or a per pint basis for juices). For each food, we also estimated the cost to consume a cup-equivalent as defined in the *2015-2020 Dietary Guidelines for Americans*. For most fruits and vegetables, 1 cup-equivalent is the amount of edible food that will fit in a standard measuring cup; for lettuce and other raw leafy vegetables, a cup-equivalent is 2 cups, and for raisins and other dried fruits, ½ cup. The full set of fruit and vegetable prices is available on the ERS website at: <http://www.ers.usda.gov/data-products/fruit-and-vegetable-prices.aspx>.

The retail prices are based on 2013 retail scanner data from IRI. For its retail scanner data product (named InfoScan), IRI collects weekly sales data from a panel of stores that includes grocery stores, supermarkets, supercenters, and convenience stores, among others (see box: Retail Scanner Data Enhance Ability To Study Food Prices). Using these data, for each product we calculated a national average retail price paid by all American households over a 1-year period, including items sold in different package sizes, under different brand names, and at different types of retail outlets. Thus, our retail price estimates are very broad averages and do not reflect what individual households pay for specific products at particular stores. Some fruit and vegetable prices vary seasonally, and annual averages may disproportionately reflect in-season prices in these cases. Retail food prices also vary among supercenters, supermarkets, wholesale club stores, convenience stores, and other retail formats (e.g., Leibtag, 2006; Cassady et al., 2007). To estimate the average retail price of each food, we divided the aggregate sales revenue by the aggregate sales quantity. For example, we estimated that participating retailers sold 114.8 million pounds of frozen broccoli for \$214.6 million in 2013 (excluding mixed dishes like broccoli with cheese). The average retail price of frozen broccoli was then estimated at \$1.87 per pound (\$214.6 million divided by 114.8 million pounds).

Costs to consume foods per edible cup-equivalent were calculated by adjusting retail prices for the removal of inedible parts and cooking loss that occur prior to consumption. For example, a cup-equivalent of raw apple with skin weighs 0.243 pounds. However, the inedible stem and core of a raw apple account for 10 percent of the fruit's weight at retail stores, implying a preparation yield of 90 percent when apples are eaten raw, including the peel. Thus, to consume one cup-equivalent of fresh apple, consumers must buy 0.269 pounds at retail (calculated as 0.243 pounds divided by the preparation yield of 0.9 percent).

Calculating average prices per edible cup-equivalent for a large number of fruits reveals much variation from the least to the most expensive products (fig. 1). Nine of 63 fruits (14 percent) cost less than \$0.40 per cup-equivalent. Watermelon (\$0.21), frozen concentrated apple juice (\$0.27), and bananas (\$0.29) were least expensive. Twenty-six fruits (41 percent) cost between 40 and 80 cents per cup-equivalent. These include apples (\$0.42), oranges (\$0.58), and grapes (\$0.72). Twenty-seven fruits cost more than 80 cents per cup-equivalent. Fresh raspberries (\$2.32) and canned cherries (\$2.39) are at the high end of the price range.

² Ready-to-drink includes not-from-concentrate juice and juice that has been reconstituted before purchase.

Box: Retail Scanner Data Enhance Ability To Study Food Prices

A panel of retail stores across the United States provides Information Resources, Inc. (IRI) with a record of weekly food purchase transactions. This panel includes supercenters, club warehouses, grocery stores, supermarkets, convenience stores, and drugstores, among others. For its retail scanner data product (named InfoScan), IRI combines these transaction data with detailed information about each product sold.

For each item sold by a participating store, InfoScan reports both the quantity purchased and the retailer's revenue in dollars. Information is also provided on various characteristics of each item such as the form, the package size, and a number of relevant health characteristics. IRI distinguishes, for example, between classic and tropical fruit cocktail. It also identifies whether the fruit is packaged in 100-percent juice, water, light syrup, heavy syrup, or another liquid medium. Also identified is whether the manufacturer claims that the product is organic.

IRI's retail panel includes tens of thousands of stores nationwide. Many of the Nation's largest food retailers are among its participants. Some report sales for individual retail outlets. Others provide data by retail market area (RMA), such as total sales by all stores in the Southeastern or Northeastern United States. Total sales by all panel members can be estimated by combining both types of data.

The comprehensive nature of InfoScan data enhances the ability of ERS to study food prices, especially for items like fresh produce. It is particularly advantageous that InfoScan data include detailed quantity and revenue information for items sold on a "random weight" basis, such as untrimmed heads of Romaine lettuce, cucumbers, and some apples. Consumers can often choose among loose apples on display and place their selection in a plastic bag. The weight of the food placed in the bag is not fixed. Thus, in retail terminology, the apples are sold by random weight. The data used by Stewart et al. (2011) to estimate fruit and vegetable prices in 2008 did not provide sufficient information to calculate average retail prices for random-weight foods. Because of this, the study could only price apples sold in fixed-weight bags with a Universal Product Code (UPC, a type of bar code), such as a 5-pound bag of apples.

A large panel of stores reporting sales information for all products sold ensures that ERS researchers have a sufficient sample size to estimate average retail prices, even for food products that households purchase less frequently.

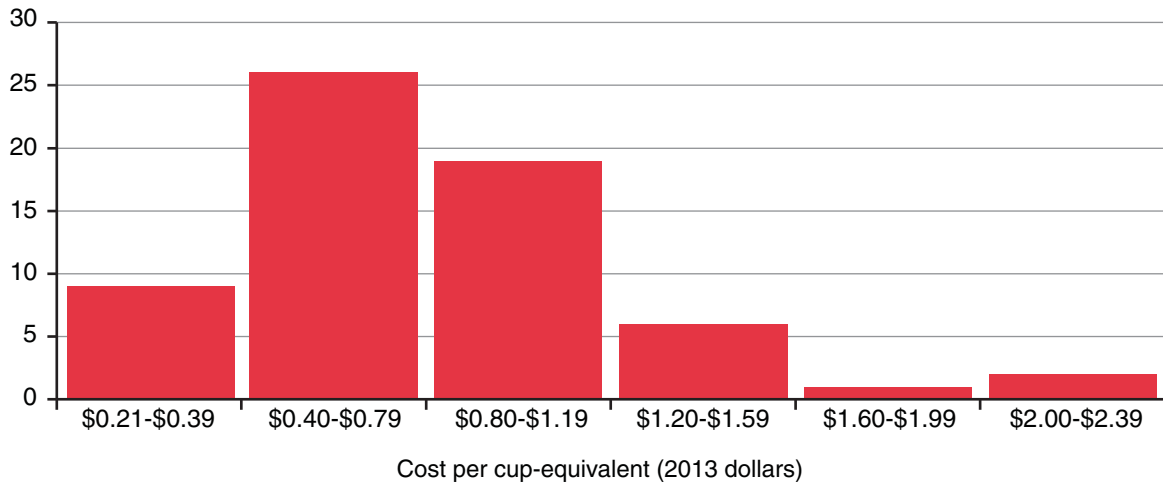
A similar range of prices exists for vegetables (fig. 2). Sixteen of 96 vegetables (17 percent) cost less than \$0.40 per cup-equivalent. Potatoes (\$0.18), dried pinto beans (\$0.19), and dried lentils (\$0.20) were least expensive. Fifty-eight vegetables (60 percent) cost between 40 and 80 cents per cup-equivalent. These include onions (\$0.41), canned tomatoes (\$0.50), and broccoli (\$0.72). Twenty-two vegetables cost more than 80 cents per cup-equivalent. Frozen artichokes (\$2.55) and fresh asparagus (\$2.58) are at the high end of the price range.

Fresh fruits and vegetables are not always less expensive than processed. For example, fresh whole carrots eaten raw (\$0.23 per cup-equivalent) are less expensive to consume than either canned carrots (\$0.52) or frozen carrots (\$0.48). By contrast, canned corn (\$0.51) is more economical than fresh (\$1.81).

Figure 1

The cost of fruit ranges from \$0.21 to \$2.39 per edible cup-equivalent

Number of fruits (out of 63)

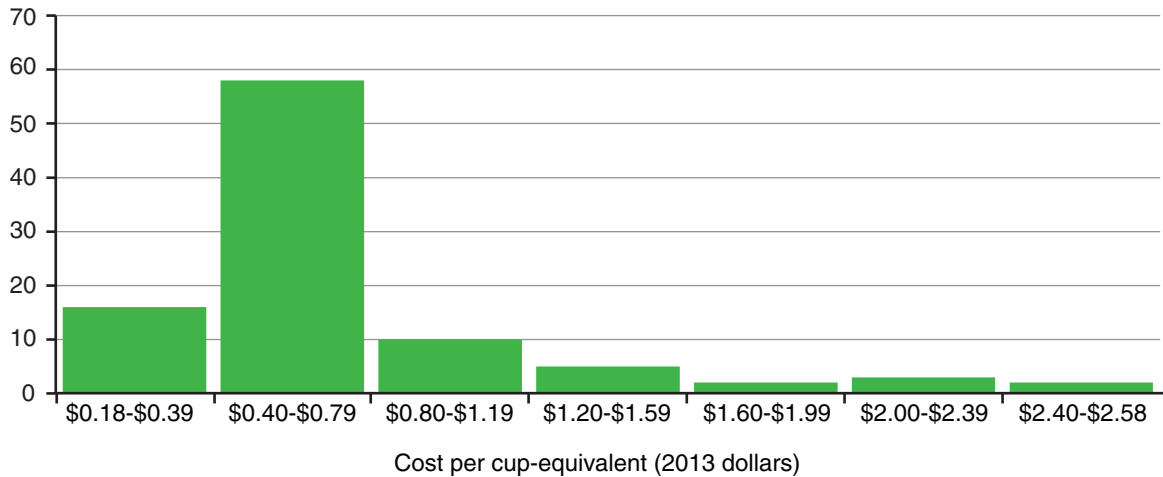


Source: Calculated by USDA, Economic Research Service from 2013 retail scanner data.

Figure 2

The cost of vegetables ranges from \$0.18 to \$2.58 per edible cup-equivalent

Number of vegetables (out of 96*)



*Three of the fresh vegetables were priced in both their raw and cooked forms.

Source: Calculated by USDA, Economic Research Service from 2013 retail scanner data.

Retail prices can be a misleading indicator of the costs to consume fruits and vegetables per edible cup-equivalent. Canned fruits are a case in point. We priced five canned fruits packed in syrup and the same five fruits packed in 100-percent juice. All five were cheaper at retail stores on a per pound basis when packed in syrup than when packed in 100-percent juice. However, consuming the syrup counts against the added sugar limit rather than toward the fruit requirement; in contrast, consuming the juice counts toward the fruit requirement. As a result, four of the five canned fruits were cheaper on a per edible cup-equivalent basis when packed in 100-percent juice.

How Much Does It Cost To Meet Dietary Guidelines Overall?

The amount of fruits and vegetables individual Americans need to eat to meet the guidelines depends on age, gender, and level of physical activity. According to the *2015-2020 Dietary Guidelines for Americans*, a person on a 2,000-calorie diet needs to consume 2 cup-equivalents of fruit and 2.5 cup-equivalents of vegetables each day. Fresh, canned, frozen, dried, and 100-percent juice count equally toward recommended intakes for both food groups. However, Americans are encouraged to consume more whole fruit (raw, canned, or frozen) than juice to help ensure intake of dietary fiber. They are also encouraged to eat a variety of vegetables daily from several of the five subgroups: legumes, dark green vegetables, red and orange vegetables, starchy vegetables, and other vegetables.

To illustrate a consumer's costs to meet Federal fruit and vegetable recommendations, we provide three examples of how a person on a 2,000-calorie reference diet could satisfy these guidelines over 1 day at 3 cost levels (table 1). As recommended in the *2015-2020 Dietary Guidelines for Americans*, each daily example includes 2 cup-equivalents of fruit and 2.5 cup-equivalents of vegetables. We also

Table 1

Examples of how to satisfy fruit and vegetable recommendations over 1 day¹

| | Example 1 | | Example 2 | | Example 3 | |
|-------------------------------------|------------|---------------|------------|---------------|------------|---------------|
| | Cup-eq. | Cost | Cup-eq. | Cost | Cup-eq. | Cost |
| Fruit and fruit juice | | | | | | |
| Orange juice, ready-to-drink | | | 1 | \$0.60 | 1 | \$0.60 |
| Strawberries, fresh | | | | | 1 | \$0.80 |
| Cantaloupe, fresh | | | 1 | \$0.39 | | |
| Apples, fresh | 1 | \$0.42 | | | | |
| Orange, fresh | 1 | \$0.58 | | | | |
| Dark green vegetables | | | | | | |
| Romaine lettuce, head, fresh | 0.5 | \$0.20 | | | | |
| Broccoli florets, boiled from fresh | | | 0.5 | \$0.44 | 0.5 | \$0.44 |
| Red and orange vegetables | | | | | | |
| Carrots, whole, fresh | 0.5 | \$0.11 | | | | |
| Tomato, Roma, fresh | 0.5 | \$0.26 | | | | |
| Sweet potato, boiled from fresh | | | 0.5 | \$0.25 | | |
| Carrots, boiled from frozen | | | | | 0.5 | \$0.24 |
| Starchy vegetables | | | | | | |
| Corn, whole kernel, canned | 0.5 | \$0.25 | | | | |
| Potato, boiled from fresh | | | 0.5 | \$0.09 | 0.5 | \$0.09 |
| Other vegetables | | | | | | |
| Green beans, frozen | 0.5 | \$0.28 | 0.5 | \$0.28 | | |
| Cucumber, fresh | | | | | 0.5 | \$0.18 |
| Beans and peas | | | | | | |
| Pinto beans, canned | | | | | 0.5 | \$0.26 |
| Black beans, canned | | | 0.5 | \$0.29 | | |
| Total | 4.5 | \$2.10 | 4.5 | \$2.34 | 4.5 | \$2.61 |

Note: A cup-equivalent is the edible portion that will generally fit in a 1-cup measuring cup. For lettuce and other raw leafy greens, it is the amount that will fit in 2 cups; for raisins and other dried fruit, it is the amount that will fit in ½ cup.

¹ For a person on a 2,000-calorie reference diet.

Source: Calculated by USDA, Economic Research Service using 2013 retail scanner data and the *2015-2020 Dietary Guidelines for Americans*.

include popular foods from different vegetable subgroups to allow for variety in vegetable consumption. Our results show that, in 2013, it was possible to satisfy fruit and vegetable recommendations for about \$2.10 to \$2.60 per day, which translates into an average cost of approximately 47 to 57 cents per cup-equivalent.

How Much Variety Can a Family on a Limited Budget Purchase?

Next, we considered the variety of fruits and vegetables that a family could purchase over 1 week with a budget based on USDA’s Thrifty Food Plan. As noted, this food plan serves as the basis for calculating a household’s maximum SNAP benefits. However, we asked, what *variety* of fruits and vegetables a family can purchase at the TFP cost level while meeting guidelines.

Federal dietary guidelines are specific about how Americans need to divide their consumption of vegetables between subgroups over the course of a full week. According to the *2015-2020 Dietary Guidelines for Americans*, a moderately active family including one adult male (40 years old), one adult female (40 years old), and two children (one 8 years old and another aged 10) needs to consume a combined 122.5 cup-equivalents of fruits and vegetables per week (table 2). Vegetable consumption must be divided among dark green vegetables (7 cup-equivalents), red and orange vegetables (22 cup-equivalents), legumes (6.5 cup-equivalents), starchy vegetables (21 cup-equivalents), and other vegetables (17 cup-equivalents). Whole fruit (including raw, canned, dried, and frozen but not juice) must also account for at least half of all fruit consumed (49 cup-equivalents).

Households who follow the TFP must be frugal to satisfy the Dietary Guidelines. In 2013, the TFP for our family of four was \$145.86 per week, of which \$61.80, or 42 percent, was earmarked for fruits and vegetables. Given that the family must buy a combined 122.5 cup-equivalents of fruits and vegetables to meet guidelines, it can only spend, on average, 50 cents or less per cup-equivalent. This is at the lower end of the price range of 47 to 57 cents per cup-equivalent identified above.

Using our estimated prices for 156 products, we assembled a selection of these items that satisfies the recommendations while not exceeding the family’s TFP budget for fruits and vegetables (table 3). The resulting sample list contains about 5 to 10 percent more food than the 122.5 cup-equivalent minimum. This allows for food loss due to spoilage and other factors that can lower consumption. The TFP similarly assumes that 5 percent of edible food is not consumed.

Despite the limited budget, our basket of foods still contains a wide variety of fruits and vegetables to satisfy the Dietary Guidelines. Many items in the basket cost less than \$0.40 per cup-equivalent. By choosing these lower cost items, such as potatoes (\$0.18 per cup-equivalent) and frozen concentrated orange juice (\$0.34), it is possible to buy some higher cost items like frozen broccoli (\$0.72) and canned fruit cocktail packed in 100-percent juice (\$0.80) and stay within budget. Overall, the average cost of the items in our basket is \$0.47 per cup-equivalent.

Table 2

Weekly fruit and vegetable recommendations for a moderately active family of four

| Description of person | Daily total calories | Weekly fruit cup-equivalents | Weekly vegetable cup-equivalents |
|-----------------------|----------------------|------------------------------|----------------------------------|
| Child, 8 years old | 1,600 | 10.5 | 14 |
| Child, 10 years old | 1,800 | 10.5 | 17.5 |
| Female, 40 years old | 2,000 | 14 | 17.5 |
| Male, 40 years old | 2,600 | 14 | 24.5 |
| Total | | 49 | 73.5 |

Note: All people are assumed to be moderately active.

Source: *2015-2020 Dietary Guidelines for Americans* (appendix tables A2-1 and A3-1).

Table 3

Example of how a four-person family following the Thrifty Food Plan can satisfy fruit and vegetable recommendations over 1 week

| Products (quantity bought) | Cup equivalents ¹ | Retail cost |
|---|------------------------------|----------------|
| Fruit | | |
| Apples (4 pounds) | 14.8 | \$6.27 |
| Bananas (4 pounds) | 7.7 | \$2.27 |
| Raisins (1 bag weighing 1 pound) | 6.0 | \$3.50 |
| Fruit cocktail, packed in juice (3 cans, 15.2 ounces each) | 5.3 | \$4.25 |
| Frozen concentrated orange juice (4 cans, 12 ounces each when frozen) | 18.0 | \$6.21 |
| Dark green vegetables | | |
| Spinach, frozen (2 bags, weighing 10 ounces each) | 2.6 | \$2.38 |
| Broccoli, frozen (2 bags, weighing 1 pound each) | 5.2 | \$3.74 |
| Red and orange vegetables | | |
| Baby carrots (2 bags, weighing 1 pound each) | 7.3 | \$2.89 |
| Whole carrots (1 bag, weighing 1 pound) | 2.6 | \$0.74 |
| Red bell pepper (2 vegetables, weighing about 8 ounces each) | 3.1 | \$2.28 |
| Sweet potato (2 pounds) | 3.7 | \$1.84 |
| Tomatoes, canned (2 cans, weighing 14.5 ounces each) | 3.4 | \$1.68 |
| Roma tomatoes (6 vegetables, weighing about 4 ounces each) | 3.6 | \$1.87 |
| Starchy vegetables | | |
| Corn, frozen (1 bag, weighing 1 pound) | 2.6 | \$1.62 |
| Green peas, frozen (2 bags, weighing 1 pound each) | 5.1 | \$3.29 |
| Potatoes (4 pounds) | 12.3 | \$2.26 |
| Green lima beans, canned (1 can, weighing 15 ounces) | 1.6 | \$1.30 |
| Other vegetables | | |
| Iceberg lettuce (1 small head, weighing about 12 ounces) | 2.9 | \$0.91 |
| Cauliflower florets (1 bag, weighing 12 ounces) | 2.6 | \$2.45 |
| Cucumber (1 vegetable, weighing about 11 ounces) | 2.5 | \$0.88 |
| Green beans, frozen (1 bag, weighing 1 pound) | 3.0 | \$1.67 |
| Onions (3 vegetables, weighing about 6 ounces each) | 2.8 | \$1.15 |
| Celery (1 bagged stalk, weighing about 1.5 pounds) | 4.1 | \$1.67 |
| Green bell pepper (1 vegetable, weighing about 8 ounces) | 1.5 | \$0.71 |
| Beans and peas | | |
| Pinto beans, canned (4 cans, weighing 16 ounces each) | 6.7 | \$3.46 |
| Total fruits and vegetables | 131.2 | \$61.28 |

Note: Family of four includes a male and a female age 40, one child age 10, and one child age 8. In June 2013, the household's weekly food budget is assumed to have been \$145.86, of which \$61.80, or 42 percent, was earmarked for fruits and vegetables.

¹ A cup-equivalent is the edible portion that will generally fit in a 1-cup measuring cup. For raw leafy vegetables, it is the amount that will fit in 2 cups; for raisins and other dried fruit, it is the amount that will fit in ½ cup.

Source: Calculated by USDA, Economic Research Service using 2013 retail scanner data and the 2015-2020 *Dietary Guidelines for Americans*.

Low-Income Households Need To Budget Carefully

Although most Americans need to greatly increase their fruit and vegetable consumption, the problem is more pronounced among low-income households. Research shows that intake is lower among households with income below 130 percent of Federal poverty thresholds (FPL) than among households with income greater than 400 percent of FPL (Grimm et al., 2012; Middaugh et al., 2012).

The results of our analysis suggest that a family of four facing national average prices with a food budget equal to the total cost of the TFP must budget carefully in order to meet fruit and vegetable recommendations. Because of the limited budget, household members would need to consume less expensive foods overall. They cannot regularly buy the more expensive products that higher income households may routinely consume, but they can still buy a wide variety of fruits and vegetables that satisfies the Dietary Guidelines.

Fruits and vegetables may appear particularly expensive to households that spend less money on food than the TFP suggests. A household's SNAP benefits are reduced as its income increases because the household is expected to spend some of its own money on food. In 2013, the median U.S. household spent 16 percent more money on food than the total cost of the TFP, while the median low-income household (income <130 percent of FPL) spent about 8 percent less on food, including food at home and food away from home, than the TFP cost (Coleman-Jensen et al., 2014).

Fruits and vegetables may also appear particularly expensive to households who allocate a much smaller share of their food budgets to fruits and vegetables than the TFP suggests. As noted above, in 2013, fruits and vegetables represented 42 percent of the cost of the TFP for our family of four people. By contrast, U.S. households in the lowest two income quintiles allocated only about 12-13 percent to fruits and vegetables bought for at-home consumption. About 32 percent of their total food budgets went to restaurant and other away-from-home foods, on average, according to the 2013 Consumer Expenditure Survey. They allocated about 15-16 percent to the purchase of meats, poultry, fish, and eggs for at-home consumption. This was followed closely by miscellaneous at-home foods—a broad category including ready-to-eat and ready-to-heat foods like frozen meals and snacks (12 percent). The remainder of the food budget went to at-home cereal and bakery products (9-10 percent), dairy products (7-8 percent), nonalcoholic beverages, excluding 100-percent juices and fluid milk but including carbonated beverages and coffee (7 percent), sugar and other sweets (2 percent), and fats and oils (2 percent).

Even if a household's total food expenditures equaled the cost of the TFP, the household would have to allocate more of its food budget to fruits and vegetables than low-income households typically do in order to satisfy dietary recommendations. Our hypothetical four-person family needed \$145.86 per week to follow the TFP in June 2013. If it spent this much money on food and budgeted the food dollars as low-income households do, on average, the household would have had \$18.23 (12.5 percent of \$145.86) for buying fruits and vegetables at retail food stores. Moreover, if the family spent \$0.40 per cup-equivalent—a price at which few fruit and vegetable products are available (figs. 1 and 2),—it could have afforded just 46 cup-equivalents ($\$18.23/\0.40) with these funds, about one-third of the recommended 122.5 cup-equivalents. Aside from free foods, the family could only have satisfied Dietary Guidelines if it spent the half of its food budget allocated to restaurant and other away-from-home foods, miscellaneous at-home foods, and nonalcoholic beverages on versions of those products that were rich in fruits and vegetables. In reality, however, such foods are

not typically richer in fruits and vegetables than are at-home meals prepared from basic ingredients. Americans tend to eat less healthfully at restaurants than at home, and consuming more meals at restaurants is associated with eating fewer fruits and vegetables (Todd et al., 2010).

Overall, including both at-home and away-from-home foods, it is estimated that fruits and vegetables account for only about 26 percent of what Americans spend for food, on average (Carlson and Frazão, 2014). This estimate may overstate the importance of fruits and vegetables in a typical low-income family's food budget, since it is calculated over households of all income levels, including higher income households who, as noted, eat relatively more fruits and vegetables than other consumers.

Previous studies have identified potential strategies for increasing fruit and vegetable consumption, including price subsidies for low-income Americans (e.g., Dong and Lin, 2009), opening new retail outlets that offer fruits and vegetables in underserved communities (e.g., Weatherspoon et al., 2012; Weatherspoon et al., 2015), and encouraging restaurants to modify or reformulate menu items (*2015-2020 Dietary Guidelines for Americans, 2015*). However, based on the findings of this study, encouraging consumers to make room in their food budgets for fruits and vegetables by spending less money on products high in solid fats, added sugars, and sodium might also be helpful.

Conclusions

The health benefits of eating a sufficient quantity and variety of fruits and vegetables have been well documented, including a reduced risk of hypertension, stroke, and coronary heart disease (e.g., Boeing et al., 2012). However, most Americans do not consume enough of these foods to satisfy Federal dietary guidelines, and cost perceptions are one possible reason. In this brief, we update previous estimates of the costs to meet Federal fruit and vegetable recommendations. Our analysis shows that individuals on a 2,000-calorie reference diet can purchase a variety of fruits and vegetables satisfying the *2015-2020 Dietary Guidelines for Americans* for \$2.10 to \$2.60 per day. We also demonstrate that a family of four can purchase a wide variety of fruits and vegetables meeting the same guidelines with a limited budget based on USDA's Thrifty Food Plan. This may require the household to allocate more of each member's plate and more of their food dollars to fruits and vegetables, however, and less to foods high in solid fats, added sugars, and sodium.

The costs to consume a sufficient quantity and variety of fruits and vegetables change over time with price inflation and dietary guidance. Between 2008 and 2013, we estimate that the costs to satisfy Federal dietary guidelines for fruit and vegetable consumption increased modestly, with relatively small changes in retail prices for these food groups. In fact, the CPI shows that fruit and vegetable prices increased by about 4 percent in nominal terms between 2008 and 2013. By contrast, prices for all consumer goods and services increased by 8.2 percent over those years, suggesting that the relative cost of fruits and vegetables decreased.

As noted, cost estimates in this brief are broad averages for 2013 and may not reflect prices paid by individual households for particular products at the stores they patronize. However, our estimates serve as a nationally representative average for fruit and vegetable prices in the United States.

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