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Total fruit and vegetable consumption increases among consumers of frozen fruit and vegetables

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ABSTRACT

Objective: Consumption of fruits and vegetables (FV) remains lower than recommended by the 2015 to 2020 Dietary Guidelines for Americans. The aim of this study was to assess average FV and frozen FV consumption and the effect on nutrient intakes across sex and 10 age categories.
Methods: Nutrient intake from foods and consumption of FV were estimated using combined data from the National Health and Nutrition Examination Survey 2011 to 2014 and the Food Pattern Equivalents Database 2011 to 2012. Means were compared across sex and between frozen FV consumers and nonconsumers.
Results: On average, consumers of frozen FV consumed significantly more total FV than did nonconsumers, but neither group met the recommended servings of FV per day. Intake of nutrients of concern—dietary fiber, potassium, calcium, and vitamin D—were significantly higher among consumers of frozen FV, whereas sodium intake was lower. Mean energy intake among children ages 1 to 18 y was significantly lower among those who ate frozen FV, but energy intake was not affected by consumption of frozen FV for adults. Mean body mass index was significantly lower among adult consumers of frozen FV.
Conclusions: Results of this study suggested that when frozen FV are not consumed, other forms, such as fresh, canned, or dried, do not fill the FV gap. Government food programs and health professionals should encourage frozen FV as another way to increase FV consumption.

Introduction

Government, nonprofit organizations, and health professionals have exhorted the American public to eat more fruits and vegetables (FV) for better health and weight management. As early as 1916, guidance provided by the U.S. Department of Agriculture (USDA) consistently advised meal preparers to include FV every day [1].

The Dietary Guidelines for Americans (DGA) were first introduced in 1980 and the National Nutrition and Related Research Act of 1990 mandated that the Secretaries of USDA and the Department of Health and Human Services review current science and issue guidelines at least every 5 y. Nearly all of the messages to the public in the 1980s focused on avoiding certain components in the diet, such as “avoid too much sugar” and “avoid too much sodium.” The only positive message in the 1980 DGA was: “eat foods with adequate starch and fiber” [2]. The 1985 DGA maintained the same message; however, it was not clear if the American public understood which foods were good sources of starch and dietary fiber [3]. Hence, the 1990 DGA clarified the message to “choose a diet with plenty of vegetables, fruit and grain products” [4]. The 1995 recommendation changed the order of these foods, however, focusing greater attention on grain products [5]. In 2000, FV were separated from grain products and recommendations that urged more consumption of whole grains [6]. The main messages were to aim for fitness, build a healthy base, and choose sensibly. FV were part of building the healthy base that recommended consuming at least two servings of fruit and at least three servings of vegetables every day. The 2005 DGA shifted to “Foods to Encourage” with a message to consume “sufficient” amounts of FV. In addition to encouraging consumption of a variety of FV, the guidelines

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introduced greater specificity about the types of vegetables such as dark green, orange, starchy, legumes, and other vegetables [7].

Priority in the 2010 DGA shifted to "Foods and Food Components to Reduce" (Chapter 3) and "Foods and Nutrients to Increase" (Chapter 4) [8]. These guidelines maintained the recommended number of cups per day and week for FV; however, there was a significant shift in the type of vegetables recommended. For example, red and orange vegetable categories were combined, which more than doubled the recommended number of servings from 2 to 5½ cups per week for an individual on a 2000 kcal diet. The recommendation for starchy vegetables increased from 3 to 5 cups per week. Dark green vegetables and legumes recommended consumption was cut in half from 3 cups to 1½ cups per week; recommended consumption of other vegetables decreased from 6½ to 4 cups per week. The 2015 to 2020 DGA did not depart from previous guidelines on recommended consumption of the amount and types of FV [9].

Despite the guidelines and decades of public education campaigns urging Americans to eat more FV, consumption has actually declined [10]. Yet >80% of consumers report that they are making an effort to consume more FV [11]. Data from the USDA's Economic Research Service (ERS) show that total FV consumption decreased from 299 to 272 pounds per person per year between 2003 and 2013. Primarily potatoes, orange juice, and head lettuce have driven the decreased consumption, whereas tomato consumption has remained relatively stable. Only peppers, leafy greens, broccoli, and cauliflower saw increased consumption. Reasons for declining FV consumption remain elusive. The 2008 downturn in the U.S. economy may be one of many reasons as FV are thought to be expensive. Another reason may be that consumers believe they eat enough already or that unless the produce is fresh, it is somehow less desirable or nutritious [12]. Consumer messages that overemphasize the importance of consuming fresh rather than packaged FV negatively influence perceptions of the healthfulness of packaged FV.

Additionally, government programs targeting low-income individuals may have contributed to this belief. For example, the Farm Security and Rural Investment Act first authorized the creation of the Fresh Fruit and Vegetable Program in 2002. The initial pilot program was intended to introduce low-income children to a greater variety of produce and increase consumption of fresh and dried fruit and fresh vegetables. The program is currently implemented in all states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands. Although well-intended, government messages are clear that fresh produce is nutritionally superior and more desirable than other forms, such as frozen FV, although research shows that other forms, such as frozen, maintain nutrient content of fresh [13,14].

The aims of this study were to compare total FV consumption among consumers and nonconsumers of frozen FV across age and sex groups within the context of energy intake and body mass index (BMI). Protein, total fat, and carbohydrate intake was examined as well as intakes of nutrients of concern, including potassium (K), dietary fiber (DF), vitamin D, calcium, magnesium, iron, vitamins A and C, and sodium. Lutein and lycopene intake was assessed as FV are rich sources of these phytonutrients.

Data and methods

The present study examined nutrient intakes from foods and consumption of FV using dietary data from the National Health and Nutrition Examination Survey (NHANES) 2011 to 2012 and 2013 to 2014 and cup-equivalent conversions from the Food Patterns Equivalents Database (FPED) 2011 to 2012. NHANES is conducted by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC) and survey data are released in 2-y cycles. All NHANES data collections receive approval from the NCHS Research Ethics Review Board. These data are publicly available and represent all noninstitutionalized persons living in the United States.

The present analysis used data from the first day of the 24-h dietary recall and the total nutrient intake files from both data cycles. Dietary intake was measured using a multipass 24-h recall instrument that has been thoroughly tested for accuracy [15]. Only day 1 dietary recall data were used because, according to the NHANES documentation, "the mean of the population's distribution of usual intake can be estimated from a sample of individuals' 24-h recalls, without sophisticated statistical adjustment" [16]. Additionally, day 1 dietary recall data were collected in person whereas day 2 data were collected on a much smaller subsample by phone interview. Dietary data from NHANES 2013 to 2014 and the FPED 2011 to 2012 were the most recent data available to the public.

The FPED converts foods and beverages in the Food and Nutrient Database for Dietary Studies to cup equivalents of fruit, vegetables, and dairy; ounce equivalents of grains and protein foods; teaspoon equivalents of added sugars; gram equivalents of solid fats and oils; and number of alcoholic drinks [17,18]. For purposes of this study, all vegetables and vegetable combinations in the Food and Nutrient Databases for Dietary Studies 2011 to 2012 and 2013 to 2014 were included [19]. The fruit category included fruits, fruit combinations, smoothies, and juices but excluded jams, jellies, preserves, candies, and desserts. This analysis did not include dietary supplements.

The analysis used appropriate survey weights to calculate average daily consumption of total FV, and consumption of frozen FV [20]. The FPED was used to convert grams of FV and frozen FV to cup equivalents. Mean intakes of total energy and select nutrients, including total fat, protein, carbohydrates, potassium, DF, sodium, calcium, magnesium, iron, vitamins C, A, and vitamin D, lutein and zeaxanthin, and lycopene were calculated from foods and beverages.

Means of vegetable consumption and nutrient intake were calculated for males and females ages 1 to 4, 5 to 8, 9 to 12, 13 to 18, 1 to 18, 19 to 30, 31 to 50, 51

Table 1
Description of sample population of NHANES 2011 to 2014

Age groups, y	% Male	% Non-Hispanic white	% Non-Hispanic black	% Mexican American	% Other races	% of frozen FV consumers	% with annual household incomes <$25 000
Children and adolescents							
1–4 (n = 1626)	50.6 (±1.8)	50.4 (±4.1)	14.3 (±2.2)	15.9 (±2.7)	19.4 (±1.5)	13.6 (±1.1)	28.3 (±2.4)
5–8 (n = 1457)	54.3 (±2.1)	53.7 (±4.4)	14 (±1.9)	15.2 (±2.4)	17.1 (±1.6)	8.9 (±1.9)	27.1 (±2.2)
9–12 (n = 1370)	50.2 (±2.6)	52.9 (±3.4)	13.5 (±1.8)	16.6 (±2.5)	17 (±1.4)	9.4 (±1.8)	24.1 (±2.1)
13–18 (n = 1854)	50.3 (±2)	55 (±3.7)	14 (±2.1)	14.8 (±2)	16.1 (±1.4)	5.8 (±0.9)	23.1 (±2.4)
1–18 (n = 6307)	51.2 (±1)	53.2 (±3.6)	14 (±1.8)	15.5 (±2.1)	17.3 (±1.2)	9 (±0.8)	25.4 (±1.9)
Adults							
19–30 (n = 2203)	51.5 (±1.3)	57 (±3.1)	13.5 (±2.1)	11.6 (±1.5)	17.9 (±1.4)	5.6 (±0.9)	38.2 (±4)
31–50 (n = 3399)	48.9 (±1.3)	61.9 (±2.8)	11.7 (±1.4)	11.3 (±1.6)	15.1 (±1.1)	7.8 (±0.7)	19.9 (±1.7)
51–70 (n = 3204)	47.7 (±1)	73.4 (±2.4)	11.1 (±1.6)	5.0 (±0.9)	10.5 (±1)	9.1 (±0.8)	22.4 (±1.9)
71+ (n = 1318)	43.9 (±1.2)	81.2 (±1.8)	7.8 (±1.2)	2.4 (±0.7)	8.7 (±1)	13.1 (±1.4)	31.3 (±2.4)
19+ (n = 10 124)	48.6 (±0.6)	66.5 (±2.5)	11.5 (±1.5)	8.4 (±1.2)	13.6 (±0.9)	8.3 (±0.4)	26 (±1.7)
All							
≥1 (N = 16 431)	49.3 (±0.5)	63.3 (±2.7)	12.1 (±1.5)	10.1 (±1.4)	14.5 (±0.9)	8.4 (±0.4)	25.9 (±1.7)

FV, fruits and vegetables; NHANES, National Health and Nutrition Examination Survey.
Values presented are weighted % of sample ± SE.