

# Trends in Fruit and Vegetable Consumption Among Adults in the United States: Behavioral Risk Factor Surveillance System, 1994–2000

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Consuming a diet high in fruits and vegetables is associated with lower risks for numerous chronic diseases, including cancer and cardiovascular disease.<sup>1,2</sup> In 1990, the Dietary Guidelines Committee recommended 3 or more servings of vegetables and 2 or more servings of fruit each day,<sup>3</sup> and in 1991 the National Cancer Institute and the Produce for Better Health Foundation jointly established the national 5 A Day for Better Health Program.<sup>4</sup> Since that time, all of the states and many national organizations have instituted programs to encourage people to increase their consumption of fruits and vegetables.

We used data from the Behavioral Risk Factor Surveillance System (BRFSS) to examine consumption trends from 1994 through 2000 in 49 states and the District of Columbia.

## METHODS

The BRFSS is a continuous telephone survey conducted by the state health departments in collaboration with the Centers for Disease Control and Prevention. The primary purpose of this system is to provide state-specific estimates of health behaviors that relate to the leading causes of death among US adults. All states use an identical core questionnaire administered by trained interviewers. Each state uses random-digit dialing to select an independent probability sample of residents aged 18 years or older. The data from each state are weighted to reflect both the respondent's probability of selection and the age- and gender-specific or race/ethnicity-, age-, and gender-specific population of the state. Representative state estimates are then aggregated.<sup>5</sup> The median state cooperation rate (the number of completed interviews divided by the number of completed, refused, or terminated interviews) was 74.0%. A detailed

**Objectives.** We examined trends in fruit and vegetable consumption in the United States.

**Methods.** A 6-item food frequency questionnaire was used to assess consumption among 434 121 adults in 49 states and the District of Columbia who were sampled in random-digit-dialed telephone surveys administered in 1994, 1996, 1998, and 2000.

**Results.** Although the geometric mean frequency of fruit and vegetable consumption declined slightly, the proportion of respondents consuming fruits and vegetables 5 or more times per day did not change. With the exception of the group aged 18 to 24 years, which experienced a 3-percentage-point increase, little change was seen among sociodemographic subgroups.

**Conclusions.** Frequency of fruit and vegetable consumption changed little from 1994 to 2000. If increases are to be achieved, additional efforts and new strategies will be needed. (*Am J Public Health.* 2004;94:1014–1018)

description of the BRFSS methods is available elsewhere.<sup>6</sup>

Respondents were asked the following 6 questions: “How often do you drink fruit juices such as orange, grapefruit, or tomato?” “Not counting juice, how often do you eat fruit?” “How often do you eat green salad?” “How often do you eat potatoes, not including french fries, fried potatoes, or potato chips?” “How often do you eat carrots?” “Not counting carrots, potatoes, or salad, how many servings of vegetables do you usually eat? For example, a serving of vegetables at both lunch and dinner would count as 2 servings.” Consistent with the national 5 A Day campaign, fried potatoes were specifically excluded. We created an index of fruit and vegetable consumption by summing the daily frequency of consumption of food items in the module.<sup>7</sup>

At the end of the interview, respondents were asked to report both their weight and their height without shoes. We calculated body mass index (BMI) as weight (in kilograms) divided by height (in meters squared) and grouped respondents into 3 categories: normal weight (BMI <25), overweight (BMI ≥25 to <30), and obese

(BMI ≥30).<sup>8</sup> Respondents were asked about the type, duration, and frequency of the 2 leisure-time activities in which they had participated most frequently in the previous month. We grouped respondents into 3 levels: sufficient (meeting recommendations for physical activity: moderate activity 5 or more times per week for 30 or more minutes each time or vigorous activity 3 or more times per week for 20 minutes or more each time), insufficient (active, but not meeting recommendations), or inactive (no leisure-time physical activity).<sup>9,10</sup> We grouped respondents into 4 regions: Northeast (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, Delaware, District of Columbia, Maryland), Midwest (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin), South (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia), and West (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming).

Forty-nine states and the District of Columbia participated in the BRFSS during the survey years 1994, 1996, 1998, and 2000. A total of 538 793 people completed the interview. We excluded Hispanics (n=32 257) and racial/ethnic groups other than Black or White (n=21 881). Because of cultural differences in diet, abbreviated questionnaires may not capture some common sources of fruits and vegetables among these groups.<sup>7</sup> In addition, we excluded persons not reporting sociodemographic or smoking information (n=6239), leisure-time physical activities (n=246), or weight or height (n=17 628); not answering all 6 fruit and vegetable questions (n=29 790); or reporting consumption of 25 or more fruits and vegetables per day (n=84). The final sample for the 1994 to 2000 analysis included 434 121 persons (87 582 in 1994, 96 511 in 1986, 114 129 in 1998, and 135 899 in 2000).

For each of the survey years, we calculated mean daily consumption of fruits and vegetables and the percentage of respondents who consumed 5 or more servings per day. Because the frequency of consumption was skewed, we calculated geometric means by using a logarithmic transformation to normalize the distribution. To avoid taking the logarithm of 0, we assigned persons who reported no consumption a frequency of 0.1 times per month. For comparisons across survey years, the differences in intake were directly standardized for gender, age, and race/ethnicity to the 2000 BRFSS population. We used *t* tests to assess the statistical significance of the absolute change in geometric mean intake and of the standardized proportions between the year 1994 and the year 2000. Because of the large sample size, we set statistical significance at *P*<.01. We used SUDAAN to account for the complex sampling design and to report weighted findings.<sup>11</sup>

**RESULTS**

For the 4 survey years (1994 to 2000) combined, 48.7% of the respondents were men; 89.3% were White, and 10.7% were Black (data not shown). Slightly more than half (56.4%) had at least some college education, and 18.1% were aged 65 years or older. Although most respondents engaged in some

**TABLE 1—Geometric Mean Frequency of Daily Fruit and Vegetable Consumption: Behavioral Risk Factor Surveillance System, 1994–2000**

	Geometric Mean Daily Frequency of Consumption				Standardized <sup>a</sup> change (SE), 1994–2000
	1994	1996	1998	2000	
<b>Total</b>					
Total fruits and vegetables	3.44	3.43	3.38	3.37	-0.05 (0.01) <sup>b</sup>
Total fruits	1.05	1.05	1.04	1.00	-0.03 (0.01) <sup>b</sup>
Fruit juice	0.32	0.31	0.30	0.28	-0.02 (0.01) <sup>b</sup>
Fruits	0.44	0.44	0.44	0.42	-0.01 (0.01)
Total vegetables	2.06	2.05	2.02	2.02	-0.02 (0.01)
Green salad	0.29	0.28	0.28	0.29	0.00 (0.00)
Carrots	0.10	0.10	0.09	0.09	0.00 (0.00)
Potatoes, nonfried	0.24	0.23	0.22	0.19	-0.04 (0.00) <sup>b</sup>
All other vegetables	0.93	0.93	0.91	0.92	0.03 (0.01) <sup>b</sup>
<b>Men</b>					
Total fruits and vegetables	3.22	3.20	3.13	3.13	-0.08 (0.02) <sup>b</sup>
Total fruits	0.96	0.96	0.94	0.92	-0.03 (0.01) <sup>b</sup>
Fruit juice	0.33	0.33	0.33	0.31	0.00 (0.01)
Fruits	0.37	0.37	0.37	0.35	-0.03 (0.01) <sup>b</sup>
Total vegetables	1.93	1.91	1.86	1.88	-0.05 (0.01) <sup>b</sup>
Green salad	0.26	0.25	0.25	0.26	-0.01 (0.01) <sup>b</sup>
Carrots	0.08	0.09	0.08	0.08	0.00 (0.00)
Potatoes, nonfried	0.24	0.24	0.22	0.20	-0.03 (0.00) <sup>b</sup>
All other vegetables	0.86	0.85	0.82	0.83	0.00 (0.01)
<b>Women</b>					
Total fruits and vegetables	3.68	3.66	3.64	3.61	-0.02 (0.02)
Total fruits	1.14	1.14	1.13	1.08	-0.03 (0.01)
Fruit juice	0.30	0.29	0.28	0.25	-0.03 (0.01) <sup>b</sup>
Fruits	0.51	0.52	0.52	0.50	0.00 (0.01)
Total vegetables	2.20	2.19	2.18	2.17	-0.01 (0.01)
Green salad	0.31	0.30	0.31	0.32	0.01 (0.00)
Carrots	0.11	0.11	0.10	0.10	0.00 (0.00)
Potatoes, nonfried	0.23	0.23	0.22	0.18	-0.04 (0.00) <sup>b</sup>
All other vegetables	1.01	1.02	1.00	1.02	0.05 (0.01) <sup>b</sup>

<sup>a</sup>Changes are standardized to the gender, age, and racial/ethnic distribution of the 2000 Behavioral Risk Factor Surveillance System population in our study.  
<sup>b</sup>Standardized change was significant at *P*<.01.

leisure-time physical activity, only 21.3% met the national guidelines. Most reported that they were current nonsmokers (76.7%), and nearly half (46.5%) reported that they were of normal weight.

From 1994 to 2000, the geometric mean frequency of consumption of fruits and vegetables declined slightly, from 3.44 times per day in 1994 to 3.37 times per day in 2000 (Table 1). Although the mean frequency of consumption of fruits and vegetables declined slightly in men (-0.08 times/day), no change

was seen in women. Of the 6 fruit and vegetable categories, fruit juice and nonfried potato consumption showed small declines and “all other vegetable” consumption showed a small increase (Table 1). Men evidenced small declines in consumption of fruits, green salad, and nonfried potatoes. Women showed small declines in consumption of fruit juice and nonfried potatoes and a small increase in consumption of “all other vegetables.”

The prevalence of consuming fruits and vegetables 5 or more times per day was about

**TABLE 2—Percentage of Adults Consuming Fruits and Vegetables 5 or More Times per Day: Behavioral Risk Factor Surveillance System, 1994–2000**

	Percentage				Standardized <sup>a</sup> change (SE), 1994–2000
	1994	1996	1998	2000	
Total	24.56	24.77	24.72	24.57	-0.40 (0.29)
Men	20.50	20.50	20.10	19.95	-0.86 (0.42)
Women	28.40	28.80	29.09	28.98	0.03 (0.40)
Age group, y					
18–24	18.54	19.53	21.05	21.80	3.31 (0.92) <sup>b</sup>
25–34	20.02	21.15	20.20	19.43	-0.58 (0.61)
35–44	21.89	22.25	21.50	21.44	-0.38 (0.58)
45–54	24.68	23.90	24.55	23.10	-1.48 (0.70)
55–64	28.70	26.42	26.33	27.43	-1.14 (0.87)
≥ 65	35.45	34.59	34.46	34.42	-0.96 (0.75)
Race/ethnicity					
Non-Hispanic White	24.95	25.29	25.19	24.83	-0.64 (0.31)
Non-Hispanic Black	20.87	20.55	20.91	22.52	1.38 (0.87)
Education					
< High school	21.18	20.52	19.95	19.84	-1.17 (0.85)
High school graduate	21.54	21.38	21.70	21.30	-1.05 (0.48)
Some college	24.75	25.51	25.01	25.20	-0.52 (0.59)
College graduate	29.80	29.74	29.77	28.76	-2.16 (0.64) <sup>b</sup>
Smoking status					
Nonsmoker	26.49	26.89	26.83	26.75	-0.47 (0.44)
Former smoker	27.25	27.37	26.52	26.25	-0.89 (0.65)
Current smoker	17.36	17.46	18.15	17.80	0.35 (0.59)
Leisure-time activity level <sup>c</sup>					
Inactive	18.43	17.44	18.38	18.09	-0.35 (0.49)
Insufficient	23.96	24.60	23.77	23.58	-0.99 (0.41)
Sufficient	34.37	35.12	34.68	33.85	-1.50 (0.71)
Body mass index (kg/m <sup>2</sup> )					
< 25	26.13	26.46	26.48	27.15	0.19 (0.46)
25–< 30	23.31	23.77	23.74	23.21	-0.13 (0.50)
≥ 30	22.28	21.92	22.32	21.59	-1.05 (0.75)
Region					
Northeast	26.03	26.21	27.67	26.92	0.53 (0.69)
Midwest	22.91	21.79	23.06	22.01	-1.20 (0.56) <sup>b</sup>
South	24.24	23.95	24.23	24.33	-0.44 (0.47)
West	25.79	28.45	24.73	25.81	-0.17 (0.80)

<sup>a</sup>Changes are standardized to the gender, age, and racial/ethnic distribution of the 2000 Behavioral Risk Factor Surveillance System population in our study.

<sup>b</sup>Standardized change was significant at  $P < .01$ .

<sup>c</sup>Levels are defined as follows: inactive = no leisure-time physical activity in the previous month; insufficient = some activity, but not enough to meet recommendations; sufficient = moderate activity 5 times a week for 30 minutes each time or vigorous activity 3 times a week for 20 minutes per time.

women, those 55 years or older, and non-smokers than among men, those younger than 55 years, and current smokers, respectively. In addition, the prevalence of consuming fruits and vegetables 5 or more times per day increased with education and level of leisure-time physical activity (Table 2).

## DISCUSSION

Although the geometric mean frequency of consumption declined slightly, the proportion of US adults who consumed fruits and vegetables 5 or more times per day did not change from 1994 to 2000 in the 49 states and the District of Columbia. Furthermore, with the exception of the 18- to 24-year age group, who showed an increase of 3 percentage points in consumption, only small negative changes or no changes were seen in all other population subgroups.

National and state surveys of fruit and vegetable consumption conducted in the 1990s have found mixed trends—some have shown increases in consumption, whereas others have shown no change. Between 1990 and 1994 and in 1998, national food supply data revealed an increase of fruit intake, from 1.30 to 1.36 servings per day.<sup>12</sup> During this period, vegetable intake increased from 3.66 to 3.93 servings (0.08 of which was from frozen potatoes, which were mostly used for fried potatoes). The Continuing Survey of Food Intake by Individuals, which collected national data from 24-hour recalls from children aged 2–17.9 years and adults ≥ 18 years of age, showed an increase, from 4.5 fruit and vegetable servings in 1989–1991 to 4.9 servings in 1994–1996.<sup>12</sup> In contrast to previous studies, the California Dietary Practices Survey, which used a simplified dietary recall method, found that adult consumption of 5 or more daily servings of fruits and vegetables was 34% in 1989, 37% in 1995, and 33% in 1997.<sup>13</sup> Between 1991 and 1997, data from 2 food frequency surveys conducted by the National Cancer Institute showed an increase in the percentage of adults eating 5 or more daily servings of fruits and vegetables (23.4% vs 25.8%) but did not show a statistically significant increase in mean intake after adjustment for demographic differences between the surveys.<sup>14</sup> However, direct comparison of trends

25% in all 4 survey years (Table 2). Of the population subgroups examined, most showed either no change or small decreases over time. Only the 18- to 24-year group showed an in-

crease (3.3 percentage points) in fruit and vegetable consumption. For all survey years, the prevalence of consuming fruits and vegetables 5 or more times per day was higher among

in BRFSS data with trends in other surveys is difficult because of differences in methods of dietary assessment and possible year-to-year variability in results. The BRFSS data extend to the year 2000, whereas published studies have measured consumption only through 1997 or earlier.

Using data from the BRFSS, Li et al.<sup>15</sup> reported trends from 1990 to 1996 in fruit and vegetable consumption among adults in 16 states. The progress from 1990 to 1994 was encouraging, but little change was seen thereafter. We analyzed data from the same 16 states as Li et al and found results from this smaller sample to be consistent with those from the larger sample of 49 states. No statistically significant changes in intake were seen after 1994. Mean geometric daily consumption levels were 3.26, 3.44, 3.48, 3.37, and 3.41 in 1990, 1994, 1996, 1998, and 2000, respectively. The proportions who consumed fruits and vegetables at least 5 times a day were 19.9, 23.9, 25.0, 24.3, and 25.2, respectively.

Methodological differences between the BRFSS survey and other surveys should be considered when interpreting differences in findings between surveys. Although the BRFSS includes representative data from 49 states and the District of Columbia, it was primarily designed to provide state-level estimates. In addition, the difference between the BRFSS module and other methods of dietary assessment should be considered in interpretation of differences. With the exception of "other vegetables," the BRFSS module assesses frequency of intake (times per day) rather than servings and is thus insensitive to changes in serving size.<sup>16</sup> However, previous research has shown that the magnitude of the correspondence between the BRFSS estimates and reference methods of dietary intake does not vary consistently by age, gender, or education.<sup>7</sup> In general, estimates of fruit and vegetable intake from abbreviated food frequency questionnaires, such as the BRFSS module, are lower than those from other methods of dietary assessment.<sup>16</sup> Compared with multiple 24-hour recalls or records that include fruit and vegetable intakes from mixed foods and condiments, the BRFSS module underestimates the proportion of adults consuming 5 or more servings of fruits and vegetables each

day.<sup>17</sup> In addition, fried potatoes are specifically excluded from the BRFSS module. Still, underestimation notwithstanding, the module should be able to measure trends in frequency of intake over time, assuming that reporting remains similar.

The lack of an increase in consumption of fruits and vegetables from 1994 to 2000 is not unexpected. A national campaign to change dietary habits is likely to have only a small prolonged effect. Focused interventions can increase fruit and vegetable intake in the short term at the local level, but the long-term effectiveness of broader-based interventions at the state and national levels has not been determined. A review of studies of interventions to increase fruit and vegetable intake found that, compared to baseline, average intake after the intervention increased by an average of 0.6 servings per day, but few of these studies followed participants for more than 1 year, and those that did usually found a diminution in effect.<sup>18</sup> From 1992 to 1999, the National Cancer Institute spent approximately \$40 million on all aspects (media, research, and evaluation) of the 5 A Day program, compared with approximately \$10 billion spent on industry marketing of food, fast food, and beverages in 1999 alone.<sup>19</sup> Thus far, most interventions have focused on heightening public awareness and increasing the population's knowledge<sup>20</sup>; knowledge of the 5 A Day recommendation increased from 8% in 1991 to 19% in 1997.<sup>14</sup> Although knowledge is an important factor in predicting fruit and vegetable consumption,<sup>21</sup> knowledge alone has not been sufficient to change diet or other health behaviors. Our findings underscore the need to broaden the traditional approach beyond increasing awareness and education. Innovative research is necessary to assess the influence of the environment and policy on behavior change and to develop cost-effective dietary approaches that promote long-term change. ■

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#### Contributors

M. K. Serdula, L. Kettel-Khan, R. Farris, J. Seymour, and C. Denny conceived and designed this study, interpreted the data, and wrote the article. C. Gillespie conducted the data analysis and interpreted the data.

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#### Human Participant Protection

No protocol approval was needed for this study because data were collected anonymously (no individual identifiers) from a public health surveillance system in which adults voluntarily consented to telephone interviews.

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Marsha Lillie-Blanton, DrPH, and Yvette Roubideaux, MD, MPH, Guest Editors

## Call for Papers

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