

# Surveillance of Fruit and Vegetable Intake Using the Behavioral Risk Factor Surveillance System

## Summary

This document was developed to address frequently asked questions and common concerns with the Behavioral Risk Factor Surveillance System (BRFSS) fruit and vegetable dietary intake module. This document compiles information on the need for fruit and vegetable intake surveillance, the history of the BRFSS fruit and vegetable intake module, the validity and reliability of the module, and ways to analyze data from the module.

Eating fruits and vegetables contributes important under-consumed nutrients to the diet, reduce the risk of many chronic diseases, and may help individuals achieve and maintain a healthy weight when consumed instead of higher calorie foods. However, very few Americans consume recommended amounts of fruits and vegetables.

A state-level assessment of fruit and vegetable intake can be used to identify populations at risk, track trends in intake over time, and inform policy and program development. For most states, the only source of uniform, state-level nutritional data for adults is fruit and vegetable intake data from the Behavioral Risk Factor Surveillance System (BRFSS). BRFSS measures fruit and vegetable intake with a 6-item brief dietary assessment tool, or module, which assesses the frequency of consumption of 100% fruit juice, fruit, beans (legumes), dark green vegetables, orange vegetables, and other vegetables over the past month. Many tools can assess fruit and vegetable intake; however, all have some limitations. Brief dietary assessment tools like the BRFSS fruit and vegetable module are often used for surveillance purposes because of their low number of items and low response burden. Although the validity and reliability of the 2011 fruit and vegetable module has not been directly evaluated, this type of module (with slightly different questions) has been shown to be moderately valid and reliable and able to detect population-level change.

Surveillance indicators from the module include median times per day fruits and median times per day vegetables are consumed and the percentage of people who report consuming fruit less than once per day and the percentage of people who report consuming vegetables less than once per day. Fruit and vegetable consumption is reported separately to reflect national intake recommendations and median statistics are reported because of the skewed data distribution.

In resource constrained environments, the BRFSS fruit and vegetable module provides a short, relatively simple, and moderately valid way to track levels of state and, in some areas, local level fruit and vegetable consumption

over time. This surveillance tool also provides a way to identify disparities in intake and can be used to inform state nutrition programs and initiatives.

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Questions regarding this document should be forwarded to [fvteam@cdc.gov](mailto:fvteam@cdc.gov).

## Introduction

This document was developed to address frequently asked questions about the Behavioral Risk Factor Surveillance System (BRFSS) fruit and vegetable dietary intake module. This document contains information on the need for fruit and vegetable intake surveillance, the history of the BRFSS fruit and vegetable intake module, the validity and reliability of the module, and appropriate ways to analyze data from the module.

### Why the focus on fruits and vegetables?

Fruits and vegetables are major contributors of important under-consumed nutrients, may reduce the risk of many chronic diseases, and may help individuals achieve and maintain a healthy weight when consumed instead of higher calorie foods.<sup>1</sup> Fruit and vegetable intake is also an indicator of a healthy overall diet. Specifically, total fruit (whole fruit and 100% fruit juice) and whole fruit intake are the second and third most correlated factors with an overall healthy eating pattern, respectively, after amount of empty calories consumed.<sup>2</sup> In spite of the benefits, very few Americans consume recommended amounts of fruits and vegetables.<sup>3</sup>

### Why are state specific fruit and vegetable data needed?

Although 3 states\* currently have state-based monitoring of adult dietary intake, for most states, the only source of uniform, state-level nutritional data for adults is fruit and vegetable intake data from the Behavioral Risk Factor Surveillance System (BRFSS).<sup>4</sup> Ongoing surveillance of fruit and vegetable intake is required to identify populations at risk, effectively manage population-level fruit and vegetable intervention programs, and inform nutrition policy and program development.<sup>5</sup> Currently, numerous federal, state, and local public health-related initiatives focus on improving access to and consumption of healthy foods, including fruits and vegetables, in the context of reducing the burden of obesity and chronic diseases and building local food infrastructure and economies.

Regular surveillance of fruit and vegetable intake and other dietary indicators is conducted at the national level through the National Health and Nutrition Examination Survey. The US Department of Health and Human Services uses this data to set objectives related to important dietary indicators. Healthy People objectives are used to establish benchmarks and monitor progress over time to encourage collaborations across communities and sectors, empower individuals toward making informed health decisions, and measure the effect of prevention activities.<sup>6</sup> Although these data are important to monitor fruit and vegetable intake of the nation as a

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\* Arkansas, California, and Wisconsin

whole, they have limited value in the implementation and evaluation of nutrition programs in state and local public health agencies.<sup>7</sup> Fruit and vegetable consumption varies significantly across states<sup>8</sup> and state and local-level data are important for catalyzing local interest in nutrition programs and designing and assessing programs.<sup>7</sup>

### **Why use the BRFSS module to measure fruit and vegetable intake?**

The BRFSS measures fruit and vegetable intake with a 6-item dietary assessment tool hereafter referred to as the fruit and vegetable module. The module assesses the frequency of consumption of 100% fruit juice, fruit, beans (legumes), dark green vegetables, orange vegetables, and other vegetables over the past month (see [Appendix A](#)). While many tools that assess fruit and vegetable intake exist, all have limitations. In addition to brief dietary assessments like the fruit and vegetable module, other methods for assessing intake include direct observation, food records or diaries, 24-hour dietary recalls, food frequency questionnaires, dietary histories, and biomarkers. Interviewer-administered 24-hour recall has long been regarded as optimal for assessing population-level dietary intake because it provides the highest-quality and least biased data for a single day.<sup>9</sup> However, for large telephone administered public health surveillance systems like BRFSS, it may be difficult to incorporate a 24-hour recall module or many of the other assessment methods. For example, an automated, self-administered version of 24-hour recall, which was modeled on the methods used to collect 24-hour recall data in the National Health and Nutrition Examination Survey, takes 20 to 30 minutes to complete.<sup>10</sup> This administration length is likely prohibitive for BRFSS, which in 2011, had an average completion time of 18 minutes for the entire 86 core questions not including state-added and optional questions.<sup>11</sup> Brief dietary assessment tools like the BRFSS fruit and vegetable module are easier to incorporate into surveillance systems with limited space because they are able to track trends in population-level intake over time and discern population subgroup differences<sup>12</sup> but have a low number of items that can be asked in a relatively short amount of time. According to personal observations of BRFSS state coordinators, the BRFSS fruit and vegetable module takes about 3–4 minutes to complete.

## **History**

### **When was the module first used in BRFSS and how was it developed?**

The fruit and vegetable module was originally included in the BRFSS in 1989 as an official module and was included in the rotating core questionnaire in even-numbered years from 1994 to 2002 and every odd-numbered year from 2003 and beyond.<sup>13</sup> The module administered from 1989–2009 asked respondents how often they drank or ate the following: 1) fruit juices such as orange, grapefruit, or tomato, 2) fruit, 3) green

salad, 4) potatoes not including French fries, fried potatoes, or potato chips, 5) carrots, and 6) other vegetables. Respondents were asked to think about fruits and vegetables they ate or drank during the past 30 days, including at home and away from home. Respondents could report the number of times per day, week, or month they ate or drank fruits and vegetables. This version of the module was based in part on a short 7-item assessment tool developed by the National Cancer Institute (NCI) to measure intake of fruits and vegetables among grantees participating in the 5-A-Day for Better Health Program.<sup>14</sup> The NCI 5-A-Day tool was derived from a 64-item food frequency questionnaire in the 1987 National Health Interview Survey Cancer Risk Factor Supplement Epidemiology study that included 17 fruit and vegetable items.<sup>14,15</sup> The individual items in the 1989–2009 BRFSS module were selected for inclusion based on reported high frequency of consumption and/or their contributions to nutrient intake.<sup>16,17</sup>

### **What revisions has the module undergone over time?**

The module has only had two versions since 1989. The module administered from 1989–2009 asked respondents how often they drank or ate the following: 1) fruit juices such as orange, grapefruit, or tomato, 2) fruit, 3) green salad, 4) potatoes not including French fries, fried potatoes, or potato chips, 5) carrots, and 6) other vegetables. In 2011, the module was substantially revised to align more closely with the updated Dietary Guidelines for Americans. The changes coincided with methodological changes in the administration of the 2011 BRFSS core questions (changes in weighting and inclusion of cell phones)<sup>18</sup> that prevented comparing estimates collected in 2011 and after with data collected in previous years. Questions on carrots, salads, and potatoes were replaced with questions intended to monitor intake of the vegetables that are most encouraged for prevention of chronic disease in the 2005 and 2010 Dietary Guidelines for Americans (beans (legumes), dark green vegetables, and orange vegetables). The juice question was modified to exclude beverages that were not 100% fruit juice. Text was also added to prompt participants to report all forms of fruits and vegetables (cooked or raw, fresh, frozen, and canned). Interviewer notes instructed interviewers to also include dried fruits if respondents reported them, but because of the small serving size they were not included in the fruit question as a prompt. The revised questions asked respondents how often they drink or eat the following: 1) 100% PURE fruit juices, 2) fruit, 3) cooked or canned beans, 4) dark green vegetables, 5) orange-colored vegetables, and 6) other vegetables.

The revised module was developed by reviewing the federal nutrition guidance for fruit and vegetable intake (e.g., Healthy People 2010, Dietary Guidelines for Americans, 2005 MyPyramid Recommendations); consulting with National Cancer Institute dietary assessment experts and BRFSS coordinators; and reviewing data on commonly consumed fruits and vegetables among adults from the 2003–2004 National Health and Nutrition

Examination Survey.<sup>19</sup> The revised module went through two rounds of cognitive interviews in the fall of 2007 (n = 9 for each round). Round table discussions with Centers for Disease Control and Prevention (CDC) staff and state coordinators and field testing via approximately 300 completed telephone interviews were conducted in the spring of 2008 to obtain feedback on and refine the proposed pilot module. Because of revisions to the module and the methodological changes to the BRFSS in 2011,<sup>18</sup> data from the revised module provides a new baseline for fruit and vegetable trend assessment.

## Module design

### Why does the module have six items?

Four of the six questions in the 2011 fruit and vegetable module classify fruits and vegetables according to 2010 Dietary Guidelines for Americans fruit and vegetable subgroups recommended for chronic disease prevention (whole fruit, legumes, dark green vegetables, and orange colored vegetables).<sup>1</sup> An item also asks about 100% fruit juice because the 2010 Dietary Guidelines recommended that when juices are consumed, 100% juice should be encouraged; although the majority of fruit intake should come from whole fruits, including fresh, canned, frozen, and dried forms.<sup>1</sup> The sixth item asks about any other vegetables that are consumed.

How foods are organized on questionnaires may affect how subjects respond to the questions. Multiple simple, clear questions are preferable to a single longer complex question.<sup>20</sup> However, some groupings of single foods are needed to prevent excessive questionnaire length.<sup>21</sup> Cognitive testing of the orange and dark green vegetable questions in 2009 indicated people were able to confidently answer the questions and thought of appropriate types of vegetables to include in response to the items.

Brief dietary assessment tools, also known as dietary screeners, vary substantially in their number of items. Survey instruments with relatively greater numbers of fruit and vegetable items, and with questions on portion sizes and mixed vegetable dishes, are more highly correlated with reference instruments and more closely approximate average fruit and vegetable intake.<sup>22</sup> Per the National Cancer Institute, 37 validated short dietary assessment screeners are available that assess fruit and vegetable intake, ranging in length from 2 to 74 questions.<sup>12</sup> Only two instruments have fewer items than the BRFSS module and have been tested in adults: a 2-item screener that asks about cups of fruits and vegetables consumed and a 2-item screener that asks about servings of fruits and vegetables consumed.<sup>23,24</sup> The 2-item serving screener was not recommended for use because of low validity estimates and difficulties with conveying serving size information to respondents.<sup>23,24</sup> The 2-item cup screener was recommended for uses in resource and space constrained environments; however,

it was administered via a mail survey with visual cues to illustrate what 1 cup of fruit and 1 cup of vegetables constitutes.<sup>23</sup> It is unclear whether this screener would perform as well on a telephone survey like BRFSS where visual cues could not be provided.

### **Why does the module ask about the past month?**

The fruit and vegetable module uses a recall timeframe of the past month or past 30 days. Brief dietary assessment tools and food frequency questionnaires are used to record usual dietary intake rather than intake on a few specific days as it is the former that is important for chronic disease prevention.<sup>20</sup> Thus by asking about consumption over a long time period, such as the past month or past year, food frequency questionnaires and related short instruments like the BRFSS module are used to collect information about foods people *usually* eat rather than what they *actually* ate on a given day. It may also be easier for respondents to recall what they usually eat versus what they actually ate because usual intake relies on generic memory rather than episodic memory.<sup>20</sup> The past month is common among food frequency questionnaires and brief dietary assessment tools, but to date no research among adults has rigorously evaluated what timeframe is ideal for accurately capturing usual intake while minimizing respondent burden and recall error.

### **Other frequently asked module design questions**

During plenary sessions and round table discussions at BRFSS conferences, many questions have been asked about why the module does not ask about portion sizes, how fruits and vegetables are classified, and how to account for fruits and vegetables in mixed foods. Brief dietary assessment tools like the BRFSS module are not usually able to address all of these types of design issues that arise when collecting dietary information because of space constraints. Serving sizes of foods consumed are difficult for respondents to evaluate and thus are problematic for all dietary history instruments.<sup>14</sup> For most foods, portion sizes vary more within individuals than between individuals<sup>21</sup> and post hoc statistical adjustments may be used to account for these differences in intake without additional participant burden.<sup>25</sup> Researchers have used scoring procedures with information from external surveys to estimate amounts consumed from times per day data in other surveys,<sup>26</sup> and are currently being developed for use on the BRFSS. How fruits and vegetables are defined is another issue that is not addressable within the module because of the amount of space it would take to explain the distinctions. For example, while tomatoes are botanically classified as fruit they are typically cooked and eaten as vegetables and thus are counted as vegetables in the module. Composite foods are frequently omitted when responding to brief dietary assessments unless specific prompts are included. Again, because the module is intended to be a brief assessment tool, adding such prompts is likely to lengthen the administration time.

## Validity, reliability, and sensitivity

There is no published data on the validity and reliability of module used in 2011 in its entirety, although 3 items (legumes, fruit, and 100% fruit juice) are similar to questions undergoing testing by National Cancer Institute as part of a 26-item screener in the 2009–2010 National Health and Nutrition Examination Survey.<sup>27</sup> Although the validity and reliability of the 2011 module have not been formally evaluated, the evaluation of the 1989–2009 module provides insight into how this type of module performs.

### How valid was the 1999–2009 module?

The 1989–2009 module was reasonably correlated with other dietary assessment tools and appears to rank individuals in appropriate fashion, but may have underestimated mean intake. In one study, researchers compared this module to several food frequency questionnaires, diet records, and 24-hour recalls.<sup>16</sup> Each food frequency questionnaire included 19 to 40 items to assess fruit and vegetable intake. Correlations ranged from 0.47–0.57. Correlations of this magnitude are common when comparing longer food questionnaires to diet records and 24-hour dietary recalls.<sup>28</sup> Correlations of the module with multiple days of diet records and 24-hour recall ranged from 0.29 to 0.54. Estimates of mean daily intake were similar to diet records and recalls in two of the three populations studied but were generally lower than estimates from the food frequency questionnaires.<sup>16</sup> Another study showed that correlations of diet records and food frequency questionnaires with this version of the module were 0.56 and 0.63, respectively.<sup>29</sup> Yet another study showed that the 1999–2009 BRFSS underestimated intake by about 40% compared with the diet records and the food frequency questionnaires, with larger discrepancies by demographic subgroups.<sup>29</sup> Overall, there was low agreement in classification of total fruit and vegetable intake between both the module and food frequency questionnaires and the diet records. However, the module was able to rank individuals similarly to the food frequency questionnaire as 44% and 29% of participants were classified into the same quintile or adjacent quintiles, respectively, when comparing the intake distribution of the food-frequency questionnaire with the module. Based on comparing reference methods and the similarity of trends produced by the module to other national surveys, the 1989–2009 BRFSS fruit and vegetable module was deemed as having moderate validity.<sup>30</sup>

### Is the 1989–2009 module reliable and can it detect change?

Based on a review of 3 studies using the 1989–2009 module that relied on repeat interviews up to 3 months later, the module has moderate reliability.<sup>30</sup> Reliability as measured by correlation coefficients and kappa values

ranged from 0.33 to 0.77 and 0.19 to 0.47 respectively with substantial variation by race/ethnicity and fruit and vegetable subgroup.

The module appears to be sensitive to change in population-level dietary intake when compared with other surveillance sources but does not always yield similar results to other instruments when used to assess changes in individual intake. In a 1997 study, researchers compared baseline estimates of fruit and vegetable intake from diet records, a 153-item food frequency questionnaire, and the 1989–2009 BRFSS module to estimates at 3 months and one year, post-intervention.<sup>29</sup> The module performed similarly to the diet records in tracking fruit and vegetable changes at 3 months; fruit intake declined 9%–13% and vegetable intake declined 8%–9% per both the diet records and the module.<sup>29</sup> The module also performed similarly to diet records for tracking fruit intake at 1 year; fruit intake declined 8%–9% per both the diet records and the module. However, the diet records indicated a 5% decline in vegetable intake at 1 year while the module did not register any change. The food frequency questionnaire found increases in both fruit and vegetable intake of 6% to 11% over the 3-month and 1 year time periods. There was considerable variation by fruit and vegetable subgroup.

Trends in total fruit and vegetable consumption measured by the 1989–2009 BRFSS screener during the last decade were relatively flat.<sup>8</sup> National trend data from the National Health and Nutrition Examination Survey, marketing studies (e.g., Nielsen), and USDA food disappearance data similarly suggest there has been no significant improvement in total fruit and vegetable consumption.<sup>31-33</sup> Trends by fruit and vegetable subgroup have yet to be compared across data systems. However, in at least one state, there appear to be increases in fruit and vegetable intake that are not mirrored by the BRFSS module. Data from a telephone survey using a modified 24-hour recall in California indicated the percentage of adults consuming 5 or more servings of fruits and vegetables increased from 33% in 1997 to 50% in 2007.<sup>34</sup> Data from BRFSS for California indicated the percentage of adults consuming fruits and vegetables 5 or more times per was estimated at 27.5% in 1998 and 28.9% in 2007.<sup>35</sup>

## **Analysis and interpretation**

Short instruments like the BRFSS module appear to underestimate intake especially in regards to vegetable intake<sup>36,37</sup> and fruits and vegetables in mixtures, such as soups, casseroles, and pasta dishes,<sup>37</sup> but in resource constrained environments provide a short, relatively simple, and moderately valid way to track population-level fruit and vegetable consumption over time and rank individuals.<sup>22</sup> They typically are not recommended for providing the quantitatively precise estimates of dietary intake that are required to capture changes in individual intake because of nutrition interventions. Without additional statistical manipulation, the BRFSS module is not

recommended for estimating the percentage of the population meeting dietary recommendations.<sup>7</sup> CDC's Division of Nutrition, Physical Activity, and Obesity (DNPAO) tracks fruit and vegetable intake at the state-level over time by estimating median times per day fruit and median times per day vegetables are consumed. In the future, fruit and vegetable intake from the module will also be able to be reported as median cup-equivalents consumed per day and percentage of the population meeting USDA recommendations in addition to median times per day using a post-hoc scoring procedure that are currently being developed.<sup>25,26</sup>

### **What indicators can be used to assess fruit and vegetable intake from the module?**

In surveillance reports like the *State Indicator Report for Fruits and Vegetables, 2013*, CDC reported median intakes for fruits and vegetables and the percentages of the population who report consuming fruits and vegetables less than one time daily.<sup>38</sup> CDC reported estimates separately for fruits and vegetables because there are separate recommendations for fruits and vegetables.<sup>39,40</sup> CDC also reported median intake rather than mean intake due to the non-normal distribution of the data. Percentages of the population who report consuming fruits and vegetables less than one time daily were used as indicators to highlight very low levels of intakes across states. SAS Callable SUDAAN code to estimate median intakes of fruits and vegetables and percentage who report consuming fruits and vegetables less than one time daily is included in [Appendix B](#).

In the past, we reported the percentage of adults consuming fruits and vegetables 5 or more times daily and the percentage of adults consuming fruits 2 or more times daily and vegetables 3 or more times daily. We no longer use these indicators for two reasons. First, indicators reporting consuming fruits  $\geq 2$  times per day and vegetables  $\geq 3$  times per day were chosen as a proxy for the Healthy People 2010 objectives ( $\geq 2$  fruit servings and  $\geq 3$  vegetable servings). The newer Healthy People 2020 objectives are to increase the contribution of fruits and vegetables to the diets of Americans from 0.5 to 0.9 cup equivalent of fruits per 1,000 calories and 0.8 to 1.1 cup equivalent of total vegetables per 1,000 calories.<sup>6</sup> Second, national recommendations for fruit and vegetable intake changed from a general 5-a-day recommendation for everyone, to recommendations based on an individual's age, sex, and physical activity level.<sup>39,40</sup> USDA Food Patterns fruit and vegetable recommendations ranged from 1 cup of fruit and 1 cup of vegetables for children aged 2–5 years up to 2.5 cups of fruit and 3 cups of vegetables for males aged 19–50 years.<sup>39,40</sup> While CDC no longer uses BRFSS data to report consuming fruits and vegetables 5 or more times daily, fruits 2 or more times daily, or vegetables 3 or more times daily, times per day estimates from BRFSS may still be useful for comparing fruit and vegetable intake across states and for tracking the direction and magnitude of change within states.



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## Appendices

### Appendix A: BRFSS 2011 Fruit and Vegetable Module

These next questions are about the fruits and vegetables you ate or drank during the past 30 days. Please think about all forms of fruits and vegetables including cooked or raw, fresh, frozen or canned. Please think about all meals, snacks, and food consumed at home and away from home.

I will be asking how often you ate or drank each one: for example, once a day, twice a week, three times a month, and so forth.

INTERVIEWER NOTE: If respondent responds less than once per month, put "0" times per month. If respondent gives a number without a time frame, ask: "Was that per day, week, or month?"

9.1 During the past month, how many times per day, week or month did you drink 100% PURE fruit juices? Do not include fruit-flavored drinks with added sugar or fruit juice you made at home and added sugar to. Only include 100% juice.

1 \_\_ Per day

2 \_\_ Per week

3 \_\_ Per month

5 5 5 Never

7 7 7 Don't know / Not sure

9 9 9 Refused

INTERVIEWER NOTE: Do not include fruit drinks with added sugar or other added sweeteners like Kool-aid, Hi-C, lemonade, cranberry cocktail, Tampico, Sunny Delight, Snapple, Fruitopia, Gatorade, Power-Ade, or yogurt drinks. Do not include fruit juice drinks that provide 100% daily vitamin C but include added sugar. Do not include vegetable juices such as tomato and V8 if respondent provides but include in "other vegetables" question 9.6. DO include 100% pure juices including orange, mango, papaya, pineapple, apple, grape (white or red), or grapefruit. Only count cranberry juice if the perception is that it is 100% juice with no sugar or artificial sweetener added. 100% juice blends such as orange-pineapple, orange-tangerine, cranberry-grape are also acceptable as are fruit-vegetable 100% blends. 100% pure juice from concentrate (i.e., reconstituted) is counted.

9.2 During the past month, not counting juice, how many times per day, week, or month did you eat fruit? Count fresh, frozen, or canned fruit .

1 \_\_ Per day

2 \_\_ Per week

3 \_\_ Per month

5 5 5 Never

7 7 7 Don't know / Not sure

9 9 9 Refused

Read only if necessary: "Your best guess is fine. Include apples, bananas, applesauce, oranges, grape fruit, fruit salad, watermelon, cantaloupe or musk melon, papaya, lychees, star fruit, pomegranates, mangos, grapes, and berries such as blueberries and strawberries."

INTERVIEWER NOTE: Do not count fruit jam, jelly, or fruit preserves. Do not include dried fruit in ready-to-eat cereals. Do include dried raisins, cran-raisins if respondent tells you - but due to their small serving size they are not included in the prompt. Do include cut up fresh, frozen, or canned fruit added to yogurt, cereal, jello, and other meal items. Include culturally and geographically appropriate fruits that are not mentioned (e.g. genip, soursop, sugar apple, figs, tamarind, bread fruit, sea grapes, carambola, longans, lychees, akee, rambutan, etc.).

9.3 During the past month, how many times per day, week, or month did you eat cooked or canned beans, such as refried, baked, black, garbanzo beans, beans in soup, soybeans, edamame, tofu or lentils. Do NOT include long green beans.

1 \_\_ Per day

2 \_\_ Per week

3 \_\_ Per month

5 5 5 Never

7 7 7 Don't know / Not sure

9 9 9 Refused

Read only if necessary: "Include round or oval beans or peas such as navy, pinto, split peas, cow peas, hummus, lentils, soy beans and tofu. Do NOT include long green beans such as string beans, broad or winged beans, or pole beans."

INTERVIEWER NOTE: Include soybeans also called edamame, TOFU (BEAN CURD MADE FROM SOYBEANS), kidney, pinto, hummus, lentils, black, black-eyed peas, cow peas, lima beans and white beans. Include bean burgers including garden burgers and veggie burgers. Include falafel and tempeh.

9.4 During the past month, how many times per day, week, or month did you eat dark green vegetables for example broccoli or dark leafy greens including romaine, chard, collard greens or spinach?

1 \_\_ Per day

2 \_\_ Per week

3 \_\_ Per month

5 5 5 Never

7 7 7 Don't know / Not sure

9 9 9 Refused

INTERVIEWER NOTE: Each time a vegetable is eaten it counts as one time.

INTERVIEWER NOTE: Include all raw leafy green salads including spinach, mesclun, romaine lettuce, bok choy, dark green leafy lettuce, dandelions, komatsuna, watercress, and arugula. Do not include iceberg (head) lettuce if specifically told type of lettuce. Include all cooked greens including kale, collard greens, choys, turnip greens, mustard greens.

9.5 During the past month, how many times per day, week, or month did you eat orange- colored vegetables such as sweet potatoes, pumpkin, winter squash, or carrots?

1 \_\_ Per day

2 \_\_ Per week

3 \_\_ Per month

5 5 5 Never

7 7 7 Don't know / Not sure

9 9 9 Refused

Read only if needed: "Winter squash have hard, thick skins and deep yellow to orange flesh. They include acorn, buttercup, and spaghetti squash."

FOR INTERVIEWER: Include all forms of carrots including long or baby-cut. Include carrot-slaw (e.g. shredded carrots with or without other vegetables or fruit). Include all forms of sweet potatoes

including baked, mashed, casserole, pie, or sweet potatoes fries. Include all hard-winter squash varieties including acorn, autumn cup, banana, butternut, buttercup, delicate, hubbard, kabocha (Also known as an Ebisu, Delica, Hoka, Hokkaido, or Japanese Pumpkin; blue kuri), and spaghetti squash. Include all forms including soup. Include pumpkin, including pumpkin soup and pie. Do not include pumpkin bars, cake, bread or other grain-based desert-type food containing pumpkin (i.e. similar to banana bars, zucchini bars we do not include).

9.6 Not counting what you just told me about, during the past month, about how many times per day, week, or month did you eat OTHER vegetables? Examples of other vegetables include tomatoes, tomato juice or V-8 juice, corn, eggplant, peas, lettuce, cabbage, and white potatoes that are not fried such as baked or mashed potatoes.

1 \_\_ Per day

2 \_\_ Per week

3 \_\_ Per month

5 5 5 Never

7 7 7 Don't know / Not sure

9 9 9 Refused

Read only if needed: "Do not count vegetables you have already counted and do not include fried potatoes."

INTERVIEWER NOTE: Include corn, peas, tomatoes, okra, beets, cauliflower, bean sprouts, avocado, cucumber, onions, peppers (red, green, yellow, orange); all cabbage including American-style cole-slaw; mushrooms, snow peas, snap peas, broad beans, string, wax-, or pole-beans. Include any form of the vegetable (raw, cooked, canned, or frozen). Do not include products consumed usually as condiments including ketchup, catsup, salsa, chutney, relish. Do include tomato juice if respondent did not count in fruit juice. Include culturally and geographically appropriate vegetables that are not mentioned (e.g. daikon, jicama, oriental cucumber, etc.). Do not include rice or other grains.

## Appendix B: Statistical Analysis Software (SAS) Callable SUDAAN Code to estimate median number of times fruits and vegetables reported per day and percentage of people consuming fruits and vegetables less than once per day, Behavioral Risk Factor Surveillance System, 2011

```

options formdlm=' ';
*****
Program:
Appendix B SAS Callable SUDAAN code

Written By:
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Last Updated:
02/2014

Input Dataset:
LLCP2011.XPT Available at ftp://ftp.cdc.gov/pub/data/brfss/LLCP2011XPT.ZIP

Output Dataset:
work.Appendixctable

Description:
This program generates national and state specific estimates of fruit and
vegetable intake from 2011 BRFSS. 4 indicators are created:

1) median times per day fruit are consumed (FruitMedian)
2) median times per day vegetables are consumed (VegeMedian)
3) percent consuming fruit less than one time per day (PctLT1Fruit)
4) percent consuming vegetables less than one time per day (PctLT1Vegetable)

*****;
*****
NOTE: Set location of 2011 BRFSS XPORT file
*****;
%let library=\\cdc.gov\private\L119\ggi9\My SAS Files\Datasets;

*****
SAS code to estimate median intake of fruits and vegetables (times per day)
*****;
LIBNAME BRFSS11 XPORT "&library\LLCP2011.XPT";
DATA one;
    SET brfss11.LLCP2011 (KEEP=_PSU _STSTR _LLCPWT SEX _IMPAGE _imprace
                        NUMADULT CHILDREN INCOME2 FRUITJU1 FRUIT1 FVBEANS
                        FVGREEN FVORANG VEGETAB1 _state _FRUITEX _VEGETEX);

    *Algorithm to estimate times per day fv consumed;
    ARRAY FVIN [6] FRUITJU1 FRUIT1 FVBEANS FVGREEN FVORANG VEGETAB1;
    ARRAY FVOUT [6] FTJUDA1_ FRUTDA1_ BEANDAY_ GRENDAY_ ORNGDAY_ VEGEDA1_ ;
    DO I=1 TO 6;
        IF 101<=FVIN(I)<=199 THEN FVOUT(I)=FVIN(I)-100;
        ELSE IF 201<=FVIN(I)<=299 THEN FVOUT(I)=(FVIN(I)-200)/7;
        ELSE IF 301<=FVIN(I)<=399 THEN FVOUT(I)=(FVIN(I)-300)/30;
        ELSE IF FVIN(I)=300 THEN FVOUT(I)=.02;
        ELSE IF 401<=FVIN(I)<=499 THEN FVOUT(I)=(FVIN(I)-400)/365;
        ELSE IF FVIN(I)=555 THEN FVOUT(I)=0;
        ELSE IF FVIN(I)in (777,999,.) THEN FVOUT(I)=.;
    END;

    *Calculate total fruit and total vegetable intake;
    _FRUTSUM=FTJUDA1_+FRUTDA1_;
    _VEGESUM=BEANDAY_ + GRENDAY_ + ORNGDAY_ + VEGEDA1_;

```

```

*Create variables to indicate whether individual consumed f or v less than once daily;
if _Frutsum ne . and _Frutsum lt 1 then FRUTOnce=1;
    else if _Frutsum ne . then FRUTOnce=2;
if _Vegesum ne . and _Vegesum lt 1 then VegeOnce=1;
    else if _Vegesum ne . then VegeOnce=2;

label FTJUDA1='Fruit juice intake in times per day'
FRUTDA1='Fruit intake in times per day'
BEANDAY_='Bean intake in times per day'
GRENDAY_='Dark green vegetable intake in times per day'
ORNGDAY_='Orange-colored vegetable intake in times per day'
VEGEDA1_='Other vegetable intake in times per day'
_FRUTSUM='Total fruits consumed per day'
_VEGESUM='Total vegetables consumed per day'
FRUTOnce='Fruits consumed less than once daily:1=Yes'
VEGEOnce='Vegetables consumed less than once daily:1=Yes';

*SAS Callable SUDAAN code to generate national and state median times per day;
proc sort data=one; by _STSTR _PSU;
proc descript data=one filetype=sas design=wr noprint;
    NEST _STSTR _PSU/missunit;
    weight _LLCPWT;
    subpopn _FRUITEX=0/
        name="Respondents with no missing fruit data or implausible values";
    var _FRUTSUM ;
    tables _state ;
    class _state ;
    Percentile / median ;
    output nsum qtile=median /filetype=sas filename=work.fmedians replace;
proc descript data=one filetype=sas design=wr noprint;
    NEST _STSTR _PSU/missunit;
    weight _LLCPWT;
    subpopn _VEGETEX=0/
        name="Respondents with no missing vegetable data or implausible values";
    var _VEGESUM ;
    tables _state ;
    class _state ;
    Percentile / median ;
    output nsum qtile=median /filetype=sas filename=work.vmedians replace;

*SAS Callable SUDAAN code to generate national and state median times per day;
proc crosstab data=one filetype=sas design=wr noprint;
    NEST _STSTR _PSU/missunit;
    weight _LLCPWT;
    subpopn _FRUITEX=0/
        name="Respondents with no missing fruit data or implausible values";
    class FRUTOnce _state;
    TABLES _state *FRUTOnce;
    output / filename= work.fpercents filetype= SAS replace tablecell= default;
proc crosstab data=one filetype=sas design=wr noprint;
    NEST _STSTR _PSU/missunit;
    weight _LLCPWT;
    subpopn _VEGETEX=0/
        name="Respondents with no missing vegetable data or implausible values";
    class VegeOnce _state;
    TABLES _state *VegeOnce;
    output / filename= work.vpercents filetype= SAS replace tablecell= default;
run;

*****
Print national & state specific fruit & vegetable median times per day and
percent consuming fruits and vegetables less than one time daily estimates
*****;
data appendixtable;
    merge fmedians (keep=_state nsum median rename=(nsum=fnsun median=FruitMedian))
        fpercents (keep=_state FrutOnce rowper where=(FrutOnce=1)
            rename=(rowper=PctLT1Fruit))
        vmedians (keep=_state nsum median rename=(nsum=vnsun median=VegeMedian))
        vpercents (keep=_state VegeOnce rowper where=(VegeOnce=1)
            rename=(rowper=PctLT1Vegetable));
    by _state;
    if _state ne 0 then statename=fipname(_state); else statename='U.S. National';

```

```
drop frutonce vegeonce;
proc print data= appendixctable;
var statename PctLT1Fruit PctLT1Vegetable FruitMedian VegeMedian;
title2 'Percent consuming fruits and vegetables less than one time daily';
title 'and median number of times fruits and vegetables reported per day,';
title3 'Behavioral Risk Factor Surveillance System, 2011';
format PctLT1Fruit PctLT1Vegetable FruitMedian VegeMedian 8.1;
run;
```

**Appendix C: Median number of times fruits and vegetables reported per day and percentage of people consuming fruits and vegetables less than once per day, Behavioral Risk Factor Surveillance System, 2011<sup>a</sup>**

State	Fruit			Vegetable		
	No. <sup>b</sup>	Median Times Per Day	Percent < one time daily	No. <sup>c</sup>	Median Times Per Day	Percent < one time daily
National	473304	1.1	37.9	466693	1.6	22.5
Alabama	7231	1.0	43.8	7135	1.6	24.3
Alaska	3231	1.1	38.7	3233	1.7	19.6
Arizona	6105	1.1	38.0	6003	1.7	20.4
Arkansas	4391	1.0	47.5	4284	1.5	28.6
California	16387	1.3	30.4	16191	1.9	16.4
Colorado	12494	1.1	35.7	12314	1.7	19.2
Connecticut	6519	1.3	32.0	6420	1.7	20.5
Delaware	4625	1.0	39.2	4592	1.6	23.9
District of Columbia	4285	1.3	31.7	4236	1.8	20.0
Florida	11418	1.1	37.8	11219	1.6	22.7
Georgia	9175	1.0	41.9	9073	1.6	23.2
Hawaii	7301	1.0	39.5	7201	1.7	22.6
Idaho	5705	1.1	38.1	5611	1.6	19.9
Illinois	5303	1.1	36.0	5272	1.6	25.0
Indiana	7913	1.0	41.6	7778	1.5	27.2
Iowa	6937	1.0	39.8	6798	1.4	26.7
Kansas	19747	1.0	41.4	19476	1.6	22.3
Kentucky	9829	1.0	46.0	9660	1.5	25.0
Louisiana	10192	1.0	46.7	9940	1.4	32.4
Maine	12630	1.2	33.2	12514	1.7	18.9
Maryland	9461	1.1	36.4	9291	1.6	22.8
Massachusetts	20220	1.2	31.6	19903	1.7	20.6
Michigan	10589	1.1	37.3	10480	1.6	23.1
Minnesota	14391	1.1	36.2	14219	1.5	23.5
Mississippi	8303	0.9	50.8	8192	1.4	32.3
Missouri	5997	1.0	43.9	5919	1.5	25.0
Montana	9652	1.0	39.2	9569	1.6	21.6
Nebraska	24090	1.0	40.1	23785	1.5	26.2
Nevada	5056	1.1	36.9	4955	1.6	24.3
New Hampshire	6061	1.3	30.3	6006	1.8	17.5
New Jersey	13825	1.1	33.9	13598	1.6	22.1
New Mexico	8744	1.1	38.0	8618	1.7	21.9
New York	7165	1.2	33.9	7059	1.6	22.9
North Carolina	10774	1.0	40.8	10545	1.6	21.8
North Dakota	4958	1.1	39.1	4892	1.4	27.1
Ohio	9245	1.0	40.5	9089	1.5	25.8
Oklahoma	8068	0.9	50.2	8015	1.5	26.6
Oregon	5843	1.1	32.0	5707	1.9	15.3
Pennsylvania	10722	1.1	36.1	10542	1.5	24.0
Rhode Island	6210	1.2	32.9	6125	1.6	20.8
South Carolina	11940	1.0	44.4	11794	1.5	27.2

South Dakota	7893	1.0	39.6	7737	1.4	26.3
Tennessee	5367	1.0	46.3	5221	1.6	25.3
Texas	14026	1.0	40.3	13796	1.6	21.6
Utah	11873	1.1	34.9	11692	1.7	19.7
Vermont	6822	1.3	31.4	6697	1.8	18.1
Virginia	6057	1.1	38.4	5977	1.7	22.0
Washington	14155	1.1	35.0	13994	1.7	18.7
West Virginia	5024	1.0	47.2	5037	1.5	26.0
Wisconsin	4862	1.1	35.6	4803	1.5	26.1
Wyoming	6463	1.1	38.2	6403	1.6	22.3
Guam	1715	1.0	44.7	1683	1.5	30.3
Puerto Rico	6315	0.8	55.5	6400	1.4	24.8

<sup>a</sup> Estimates are weighted to account for complex sampling using SUDAAN except where noted. Fruit consists of 100% fruit juice and whole fruit. Vegetables include legumes, dark green vegetables, orange vegetables, and other vegetables.

<sup>b</sup> No.= Unweighted number of participants with no missing fruit data and with plausible fruit values.

<sup>c</sup> No.= Unweighted number of participants with no missing vegetable data and with plausible vegetable values.