# A Data Users Guide to the BRFSS Fruit and Vegetable Questions: How to Analyze Consumption of Fruits and Vegetables

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# Section I.

## Introduction

Fruits and vegetables are major contributors of important under consumed nutrients.[1] Consuming them may reduce the risk of many chronic diseases and may help people achieve and maintain a healthy weight when consumed instead of higher-calorie foods.[1] Fruit and vegetable intake is one of the most consistent dietary factors that promotes health.[2] Despite the benefits, few Americans consume recommended amounts of fruits and vegetables.[3]

Surveillance of fruit and vegetable intake is important because it can identify populations at risk, track trends in intake over time, and inform policy and program development. The 2017 Behavioral Risk Factor Surveillance System (BRFSS) Fruit and Vegetable (FV) Module is included as part of the rotating core survey (odd years) (Appendix A). The Module is one of the only sources of data to biannually monitor consumption of FVs at the state level. These questions differ from the FV intake questions asked as part of the 1989–2009 and 2011–2015 FV Module. As with any change, questions may arise about how to use the FV Module.

The purpose of this guidance document is to provide answers to common questions about the FV Module and increase the capacity for states to use it. People commonly ask about the rationale for collecting FV intake data, what revisions were made to the new 2017 FV Module, and how to use the FV Module to estimate the state-level frequency of daily total FV intake and percentage of adults meeting United States Department of Agriculture (USDA) FV recommendations.[4,5]

# Section II

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

A few states, such as California* and Wisconsin†, have independent state-based monitoring of adult dietary intake. For most states, the BRFSS FV intake data is the only source of uniform, state-level dietary data for adults.[6] Another source of state-level FV data was the nationally representative National Health Interview Survey (NHIS). NHIS no longer provides state-level estimates because the questionnaire was redesigned in 2019 to better meet the needs of data users.‡ Previously, NHIS collected FV intake data every 5 years, however, 3 years of combined data were needed to provide necessary sample sizes for reliable estimates of state-level intake. As such, timely estimates were not possible and made surveillance of FV intake more challenging.

Ongoing surveillance of FV intake can be important for identifying populations at risk, managing population-level FV intervention programs, and informing nutrition policy and program development. State and local-level data are also important for catalyzing local interest in nutrition programs and designing and assessing programs.[7] Currently, numerous federal, state, and local public health initiatives focus on improving access to and consumption of healthy foods, including fruits and vegetables, as a strategy to reduce obesity and chronic diseases and build local food infrastructure and economies.

The BRFSS has measured the frequency of FV intake since 1989. Since then, FV intake has been described differently by various data users and for different purposes. For example, CDC's Division of Nutrition, Physical Activity, and Obesity tracks median intakes for fruits and vegetables[8] and the percentage of the population who

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* California has Health Interview Survey (http://healthpolicy.ucla.edu/chis/Pages/default.aspx).
† Survey of the Health of Wisconsin (https://www.med.wisc.edu/show/).
‡ National Health Interview Survey 2019 Redesign (https://www.cdc.gov/nchs/nhis/2019_quest_redesign.htm).

report consuming fruits and vegetables less than one time daily to highlight very low levels of intakes across states.[9] State health departments use data to assess time trends, geographic variation (e.g., county-level), and disparities (e.g., sex, age, race/ethnicity, income, and education) of low FV consumption.[§] In addition, researchers and public health practitioners can use data to investigate the direction and magnitude of FV consumption with a wide range of behavior and health outcomes collected in BRFSS.

## Changes made to FV Module in 2017

BRFSS measures FV intake using a 6-item brief dietary assessment tool, or Module, to assess the frequency of consumption of 100% fruit juices, fruits, salads, fried potatoes, other potatoes, and other vegetables over the past month. BRFSS uses this assessment method because other ways of assessing FV intake are impractical for a telephone survey. For example, an automated, self-administered 24-hour dietary recall, similar to those collected in person in the National Health and Nutrition Examination Survey, takes 17 to 34 minutes to complete[10] and would greatly increases participant burden. In 2017, the public reporting burden of responding to the BRFSS questions was estimated to be an average of 18 minutes per person for the entire 86 core questions.[**] Brief tools which have few items and can be answered quickly are easier to incorporate into surveillance to track trends and discern affected populations.[11]

In 2017, the FV Module was redesigned by CDC and BRFSS coordinators to reduce burden on the interviewers and respondents and better align with other national surveys. The revised Module was developed by selecting FV questions from the short, previously validated, National Cancer Institute Dietary Screener Questionnaire.[12] The revised questions asked respondents how often they drink or eat the following: 1) 100% pure fruit juices, 2) fruit, 3) salad, 4) fried potatoes, 5) other potatoes, and 6) other vegetables during the past month. The current BRFSS FV Module takes about 1–2 minutes to complete, about half the time compared to the previous 2011–2015 FV Module. In addition, the 2017 BRFSS FV Module has been cognitively tested and is based on previously validated 26-item dietary screener.

A comparison of the FV Module from 2011–2015[††] and those in 2017 and beyond is shown in Table 2.

Given the methodological changes made to the Module, data from the 2017 FV Module provides a new baseline for FV trend assessment.

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[§] For example, Washington https://www.doh.wa.gov/Portals/1/Documents/1000/SHA-FruitandVegetableIntake.pdf and New York, https://www.health.ny.gov/statistics/brfss/reports/docs/1504_brfss_fruits_and_vegetables.pdf.

[**] Behavioral Risk Factor Surveillance System Overview document is available online: https://www.cdc.gov/brfss/annual_data/2017/pdf/overview-2017-508.pdf

[††] Behavioral Risk Factor Surveillance System Questionnaires from 2011–2019 is available online: https://www.cdc.gov/brfss/questionnaires/index.htm

Table 2. Comparison of the 2011– 2015 and 2017 BRFSS FV Module Questions.

| | 2011–2015 | 2017 and beyond |
|---|---|---|
| Introduction | 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. | Now think about the foods you ate or drank during the past month, that is, the past 30 days, including meals and snacks. |
| Response Options | 1 _ _ Days<br>2 _ _ Weeks<br>3 _ _ Months<br>888 Never<br>777 Don‘t know<br>999 Refused | 1 _ _ Days<br>2 _ _ Weeks<br>3 _ _ Months<br>888 Never<br>777 Don‘t know<br>999 Refused |
| Fruit | • 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.<br>• 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. | • During the past month, how often did you eat fruit?‡‡ Do not include juices. You can tell me times per day, per week or per month.<br>• How often did you drink 100% fruit juice such as apple or orange juices? Do not include fruit-flavored drinks or fruit juices you added sugar to. |
| Vegetable | • 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.<br>• 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?<br>• 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?<br>• 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 | • How often did you eat a green leafy or lettuce salad, with or without other vegetables?<br>• How often did you eat any kind of fried potatoes, including French fries, home fries, or hash browns?<br>• How often did you eat any other kind of potatoes, such as baked, boiled, mashed potatoes, or potato salad?<br>• Not including lettuce salads and potatoes, how often did you eat other vegetables? |

‡‡ In 2017, fruit question was asked before the 100% fruit juice question.

| | | |
|---|---|---|
| | 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 | |

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

There are three types of indicators CDC uses to measure FV intake: the percentage of people who report consuming FV less than once per day, median frequency of daily FV intake, and the percentage of people meeting federal recommendations. FV consumption for each indicator is reported separately to reflect separate intake recommendations for FV.[4,5]

The median frequency of daily FV intake and the percentage of people meeting federal recommendations can be calculated using SAS Callable SUDAAN code included in Appendix B. The percentage of people who report consuming FV less than once per day can be estimated using standard survey procedures from the calculated variable for "consume fruit less than one a day" (FRTLT1A) and "consume vegetable less than one a day" (VEGLT1A), provided by the BRFSS.[§§]

### 1. Estimating Median Fruit and Vegetable Consumption

BRFSS respondents report intake as times per day, per week, or per month. Total fruit intake includes how often 100% fruit juice (FRUITJU2) and fruit (FRUIT2) are reported. Total vegetable intake includes French fries (FRENCHF1), salad (FVGREEN1), other potatoes (POTATOE1), and other vegetables (VEGETAB2) (Appendix A). CDC reported median frequency of intake (times per day) rather than mean intake because of the historically skewed data distribution. The method to calculate daily total fruit and total vegetable consumption is described below and the SAS Callable-SUDAAN programming code is provided in Appendix B.

Median frequency of fruit and vegetable daily intake is first calculated by converting weekly and monthly intake into daily intake by dividing the frequency of weekly or monthly reported intake by 7 or 30, respectively. Subsequently, the frequencies of all fruit and all vegetable variables are summed to obtain the total frequency of FV intake. Exclusion criteria included those who reported implausible values (i.e., consuming fruits >16 times and vegetables >23 times per day). Median is calculated using total daily FV frequency as continuous variable using SUDAAN (Appendix B), and the results can be found in Appendix C.

### 2.Percentage Consuming Fruits and Vegetables Less than One Time per Day

The percentage of the population who report consuming fruits and vegetables less than one time daily was used as an indicator to highlight very low levels of intakes across states.[9] Total daily FV intake variables are dichotomized to differentiate adults who consumed fruit less than one time daily (FRTLT1A) and consumed vegetables less than one time daily (VEGLT1A) from those who consumed more. The percentage of the population who report consuming FV less than one time per day is calculated and reported in the 2017 BRFSS Codebook Report.[***]

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[§§] Calculated variables can be found at https://www.cdc.gov/brfss/annual_data/2017/pdf/2017-calculated-variables-version4-508.pdf.

[***] 2017 BRFSS Codebook Report can be found at https://www.cdc.gov/brfss/annual_data/2017/pdf/codebook17_llcp-508.pdf.

Because of the changes made to the 2017 FV module, the findings cannot be compared to the previous years.

### 3. Estimating the Percentage of Adults Meeting Fruit or Vegetable Recommendations

The third type of indicator CDC uses is the percentage of adults who met federal fruit or vegetable recommendations. Adults should consume 1.5–2.0 cup equivalents of fruits[4] and 2.0–3.0 cups of vegetables per day[5]. Because BRFSS collects frequency of FV intake, the data cannot be used to compare directly with the federal recommendations. Therefore, CDC developed scoring algorithms to predict whether a respondent met the federal recommendations based on the number of times per day they reported consuming fruits and vegetables separately and their demographic characteristics.[8,13]

The method to calculate the percentage of the population meeting federal recommendations is described below, the SAS Callable-SUDAAN programming code is provided in Appendix B, and the results can be found in Appendix C.

To estimate the percentage of each state's population meeting FV intake recommendations by demographic characteristics, previously developed scoring algorithms derived from the National Health and Nutrition Examination Survey (NHANES) were used. The algorithm predicts whether a respondent met FV recommendations for their age and sex based on the number of times per day they reported consuming fruits and vegetables separately, accounting for race/ethnicity and income-to-poverty ratio (poverty defined according to 2017 federal poverty guidelines for the 48 contiguous states and DC[†††]). More details on the methodology can be found elsewhere.[13]

## Section III.

### Conclusion

This document was developed to provide guidance for those who use the 2017 FV module for various research and surveillance needs. In resource-constrained environments, the BRFSS FV module provides a short, relatively simple, and useful way to track state FV consumption over time. This surveillance tool also provides a way to identify disparities in FV intake and can be used to inform state nutrition programs and initiatives.

[†††] Office of The Assistant Secretary for Planning and Evaluation, 2017 Poverty Guidelines available at: https://aspe.hhs.gov/2017-poverty-guidelines

# References


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# Appendices

## Appendix A: BRFSS 2017 Fruit and Vegetable Module

Now think about the foods you ate or drank during the past month, that is, the past 30 days, including meals and snacks.

INTERVIEWER INSTRUCTIONS: IF A RESPONDENT INDICATES THAT THEY CONSUME A FOOD ITEM EVERY DAY THEN ENTER THE NUMBER OF TIMES PER DAY. IF THE RESPONDENT INDICATES THAT THEY EAT A FOOD LESS THAN DAILY, THEN ENTER TIMES PER WEEK OR TIMES PER MONTH. DO NOT ENTER TIMES PER DAY UNLESS THE RESPONDENT REPORTS THAT HE/SHE CONSUMED THAT FOOD ITEM EACH DAY DURING THE PAST MONTH.

12.1 Not including juices, how often did you eat fruit? You can tell me times per day, times per week or times per month.

INTERVIEWER NOTE: ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS READ IF RESPONDENT ASKS WHAT TO INCLUDE OR SAYS 'I DON'T KNOW': INCLUDE FRESH, FROZEN OR CANNED FRUIT. DO NOT INCLUDE DRIED FRUITS.

1 _ _ Days
2 _ _ Weeks
3 _ _ Months
888 Never
777 Don't know
999 Refused

12.2 Not including fruit-flavored drinks or fruit juices with added sugar, how often did you drink 100% fruit juice such as apple or orange juice?

INTERVIEWER NOTE: ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS IF RESPONDENT GIVES A NUMBER WITHOUT A TIME FRAME, ASK "WAS THAT PER DAY, WEEK, OR MONTH?" READ IF RESPONDENT ASKS ABOUT EXAMPLES OF FRUIT-FLAVORED DRINKS: "DO NOT INCLUDE FRUIT-FLAVORED DRINKS WITH ADDED SUGAR LIKE CRANBERRY COCKTAIL, HI-C, LEMONADE, KOOL-AID, GATORADE, TAMPICO, AND SUNNY DELIGHT. INCLUDE ONLY 100% PURE JUICES OR 100% JUICE BLENDS."

1 _ _ Days
2 _ _ Weeks
3 _ _ Months
888 Never
777 Don't know
999 Refused

12.3 How often did you eat a green leafy or lettuce salad, with or without other vegetables?

INTERVIEWER NOTE: ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS IF RESPONDENT GIVES A NUMBER WITHOUT A TIME FRAME, ASK "WAS THAT PER DAY, WEEK, OR MONTH? READ IF RESPONDENT ASKS ABOUT SPINACH: "INCLUDE SPINACH SALADS."

1 _ _ Days
2 _ _ Weeks
3 _ _ Months
888 Never

777 Don‘t know
999 Refused

12.4 How often did you eat any kind of fried potatoes, including French fries, home fries, or hash browns?

INTERVIEWER NOTE: ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS
IF RESPONDENT GIVES A NUMBER WITHOUT A TIME FRAME, ASK “WAS THAT PER DAY, WEEK, OR MONTH?
READ IF RESPONDENT ASKS ABOUT POTATO CHIPS: “DO NOT INCLUDE POTATO CHIPS.”

1 _ _ Days
2 _ _ Weeks
3 _ _ Months
888 Never
777 Don‘t know
999 Refused

12.5 How often did you eat any other kind of potatoes, or sweet potatoes, such as baked, boiled, mashed potatoes, or potato salad?

INTERVIEWER NOTE: ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS IF RESPONDENT GIVES A NUMBER WITHOUT A TIME FRAME, ASK “WAS THAT PER DAY, WEEK, OR MONTH?” READ IF RESPONDENT ASKS ABOUT WHAT TYPES OF POTATOES TO INCLUDE: “INCLUDE ALL TYPES OF POTATOES EXCEPT FRIED. INCLUDE POTATOES AU GRATIN, SCALLOPED POTATOES.”

1 _ _ Days
2 _ _ Weeks
3 _ _ Months
888 Never
777 Don‘t know
999 Refused

12.6 Not including lettuce salads and potatoes, how often did you eat other vegetables?

INTERVIEWER NOTE: ENTER QUANTITY IN DAYS, WEEKS, OR MONTHS
IF RESPONDENT GIVES A NUMBER WITHOUT A TIME FRAME, ASK “WAS THAT PER DAY, WEEK, OR MONTH?”
READ IF RESPONDENT ASKS ABOUT WHAT TO INCLUDE: “INCLUDE TOMATOES, GREEN BEANS, CARROTS, CORN, CABBAGE, BEAN SPROUTS, COLLARD GREENS, AND BROCCOLI. INCLUDE RAW, COOKED, CANNED, OR FROZEN VEGETABLES. DO NOT INCLUDE RICE.”

1 _ _ Days
2 _ _ Weeks
3 _ _ Months
888 Never
777 Don‘t know
999 Refused

## 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, 2017

```
*******************************************************************************
Program:
Appendix B SAS Callable SUDAAN code

Email:seungheelee@cdc.gov

Last Updated:
04/2020

Input Dataset: https://www.cdc.gov/brfss/annual_data/2017/files/LLCP2017XPT.zip

Output Dataset:
work.estimates

Description:
This program generates national and state specific estimates of fruit and
vegetable intake from 2017 BRFSS. Four indicators are created:
1) median times per day fruit are consumed
2) median times per day vegetables are consumed
3) percent of the population meeting fruit recommendations
4) percent of the population meeting vegetable recommendations
*******************************************************************************;
*******************************************************************************
NOTE: Set location of 2017 BRFSS XPORT file
*******************************************************************************;
      %let library=\\xxx\xxx\xxx;
      LIBNAME BRFSS17 XPORT "&library\LLCP2017.XPT";
*******************************************************************************
SAS code to estimate median intake of fruits and vegetables (times per day)
*******************************************************************************;
DATA one;
SET brfss17.LLCP2017 (KEEP= _PSU _STSTR _LLCPWT SEX _AGE80 _race _BMI5 _BMI5CAT
NUMADULT CHILDREN INCOME2 FRUITJU2  FRUIT2 FRENCHF1
FVGREEN1  POTATOE1  VEGETAB2 _state _FRUITE1 _VEGETE1);

*Algorithm to estimate times per day fv consumed;
ARRAY FVIN [6] FRUITJU2  FRUIT2 FRENCHF1 FVGREEN1  POTATOE1  VEGETAB2;
ARRAY FVOUT [6] FTJUDA2_ FRUTDA2_ FRNCHDA_ GRENDA1_ POTADA1_ VEGEDA2_ ;
      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;
_FRUTSU1=FTJUDA2_+FRUTDA2_;
_VEGESU1=FRNCHDA_ + GRENDA1_ + POTADA1_ + VEGEDA2_;

*Create demographic variables needed for algorithms to estimate cup equivalents and
percent meeting recommendations;
```

```
*Variable 1:sexagec - 8 groups in the ChooseMyPlate.gov Fruit and Vegetable Daily
Recommendations;
      select;
*Females;
      when (_AGE80 >= 18 and _AGE80 <= 30 and SEX=2) sexagec=1;
      when (_AGE80 >= 31 and _AGE80 <= 50 and SEX=2) sexagec=2;
      when (_AGE80 >= 51 and _AGE80 <= 70 and SEX=2) sexagec=3;
      when (_AGE80 >= 71 and SEX=2) sexagec=4;
*Males;
      when (_AGE80 >= 18 and _AGE80 <= 30 and SEX=1) sexagec=5;
      when (_AGE80 >= 31 and _AGE80 <= 50 and SEX=1) sexagec=6;
      when (_AGE80 >= 51 and _AGE80 <= 70 and SEX=1) sexagec=7;
      when (_AGE80 >= 71 and SEX=1) sexagec=8;
      otherwise sexagec=.;
end;
*Variable 2-3: Binary race/ethnicity variables;

if _race ne . then do;
      race1=(_race=8);*Hispanic;
      race2=(_race=2);*NH Black;
end;

*Variable 4-6: Binary poverty to income ratio variables using ASPE 2015 poverty
guidelines;
*Calculating TOTAL HOUSEHOLD SIZE FROM NUMBER OF ADULTS & NUMBER OF CHILDREN;
*Number of children capped at 18;
IF CHILDREN IN (., 88,99) THEN CHILDREN_CAPPED=0;
ELSE IF CHILDREN>18 THEN CHILDREN_CAPPED=18;
ELSE IF 1<=CHILDREN<=18 THEN CHILDREN_CAPPED=CHILDREN;

*IF RESPONDENT DID NOT REPORT NO. OF ADULTS ASSUME 1 ADULT;
IF NUMADULT=. THEN NUMADULTR=1;
ELSE NUMADULTR=NUMADULT;
THH_SIZE=NUMADULTR+CHILDREN_CAPPED;

*HOUSEHOLD SIZE capped at 7 (99TH PERCENTILE OF HOUSEHOLD IN NHANES);
IF 1<=THH_SIZE<=6 THEN THH_PIR=THH_SIZE;
ELSE IF THH_SIZE > 6 THEN THH_PIR=7;

*Income level by household size from ASPE 2017 Tables;
IF THH_PIR=1 THEN INCLEVEL2=12060;
ELSE IF THH_PIR=2 THEN INCLEVEL2=16240;
ELSE IF THH_PIR=3 THEN INCLEVEL2=20420;
ELSE IF THH_PIR=4 THEN INCLEVEL2=24600;
ELSE IF THH_PIR=5 THEN INCLEVEL2=28780;
ELSE IF THH_PIR=6 THEN INCLEVEL2=32960;
ELSE IF THH_PIR=7 THEN INCLEVEL2=37140;
ELSE INCLEVEL2=.;

*Use MIDPOINT OF INCOME2 RANGE TO CREATE PIR;
IF INCOME2=1 THEN INDFMPIR=5000/INCLEVEL2; /*LESS THAN 10000*/
ELSE IF INCOME2=2 THEN INDFMPIR=12500/INCLEVEL2; /*10000 - <15000*/
ELSE IF INCOME2=3 THEN INDFMPIR=17500/INCLEVEL2; /*15000 - <20000*/
ELSE IF INCOME2=4 THEN INDFMPIR=22500/INCLEVEL2; /*20000 - <25000*/
ELSE IF INCOME2=5 THEN INDFMPIR=30000/INCLEVEL2; /*25000 - <35000*/
ELSE IF INCOME2=6 THEN INDFMPIR=42500/INCLEVEL2; /*35000 - <50000*/
ELSE IF INCOME2=7 THEN INDFMPIR=62500/INCLEVEL2; /*50000 - <75000*/
ELSE IF INCOME2=8 THEN INDFMPIR=87500/INCLEVEL2; /*>=75000*/
ELSE INDFMPIR=.;
```

```
if INDFMPIR=. THEN PIR=.;
ELSE IF 0 LE INDFMPIR lt 1.25 then PIR=1;*<125% poverty;
ELSE if 1.25 le INDFMPIR le 3.49 then PIR=2;*125%-349%;
else IF INDFMPIR GT 3.49 THEN PIR=3;*PIR>349%

*PIR binary variables for analysis;
if PIR ne . then do;
      PIR1=(PIR=1 AND PIR NE .);
      PIR2=(PIR=2 AND PIR NE .);
end;

*Assign recommended intake based on age and sex from the ChooseMyPlate.gov
Fruit and Vegetable Daily Recommendations;
*Fruit;
select;
       when (_AGE80 = 18 and sex=2) f_rec=1.5;
       when (19 le _AGE80 le 30 and sex=2) f_rec=2 ;
       when (_AGE80 ge 31 and sex=2) f_rec=1.5 ;
       when (sex=1) f_rec=2;
       otherwise;
end;
*Vegetables;
select;
       when (18 le _AGE80 le 50 and sex=2) v_rec=2.5;
       when (_AGE80 ge 51 and sex=2) v_rec=2;
       when (18 le _AGE80 le 50 and sex=1) v_rec=3;
       when (_AGE80 ge 51 and sex=1) v_rec=2.5;
otherwise;
end;

*Flag records with missing fruit, vegetable, or demographic information and
implausible fv values (f>16 times per day or v > 23 times per day);
complete=(sexagec ne . and _FRUITE1=0 and _VEGETE1=0 and pir1 ne . and pir2 ne .
and race1 ne . and race2 ne . and _state le 56);

label       FTJUDA2_='Fruit juice intake in times per day'
            FRUTDA2_='Fruit intake in times per day'
            FRNCHDA_='French fries intake in times per day'
            GRENDA1_='Salad greens intake in times per day'
            POTADA1_='Other potatoes intake in times per day'
            VEGEDA2_='Other vegetable intake in times per day'
            _FRUTSU1='Total fruits consumed per day'
            _VEGESU1='Total vegetables consumed per day'
            sexagec='Participant sex age group in the ChooseMyPlate.gov
Recommendations'
            race1='Binary race/ethnicity variable: 1=Hisp'
            race2='Binary race/ethnicity variables: 1=NH Blk'
            pir1='Binary poverty to income ratio variable: 1=PIR < 1.25'
            pir2='Binary poverty to income ratio variable: 1=1.25 <= PIR <=3.49'
            f_rec='Sex and age specific recommended fruit intake'
            v_rec='Sex and age specific recommended vegetable intake'
            complete='Participants w/ complete & plausible fv & demographic
data:1=No missing';

run;

*****************************************************************************
SAS Callable SUDAAN code to generate national and state FV median times per day -
*****************************************************************************;
```

```
proc sort data=one; by _STSTR _PSU; run;
proc descript data=one filetype=sas design=wr;
NEST _STSTR _PSU/missunit;
weight _LLCPWT;
subpopn complete=1/name="Respondents with no missing fv or demographic
information";
var _FRUTSU1 _VEGESU1 ;
tables _state ;
class _state;
Percentile / median ;
output nsum qtile=median /filetype=sas filename=work.temp replace;
run;

data times_per_day;
set temp;
length fv $20.;
if variable=2 then fv='TimesVegetable'; else fv='TimesFruit';
if _state ne 0 then statename=fipname(_state); else statename='National';
keep _state statename fv nsum median;
run;
*******************************************************************************
*******************************************************************************;


*******************************************************************************
Estimate percent meeting recommendations
*******************************************************************************;
*Use conversion equation regression coefficients to estimate predicted probability
of meeting the recommendation for each respondent;

*Regression parameters for predicted probability of meeting fruit models;

data parmsrecf;
input sexagec model $26. Intercept nfg1 nfg2 race1 race2 pir1 pir2;
cards;
1 Logit(Pr(yvar_f GE f_rec)) -6.2498 1.9607 2.0205 0.4291 0.3155 -1.4096 -0.5986
2 Logit(Pr(yvar_f GE f_rec)) -4.9336 1.6405 1.8725 0.6208 0.1108 -0.8326 -0.7293
3 Logit(Pr(yvar_f GE f_rec)) -5.3427 1.7345 1.9766 0.4088 -0.1161 -0.1761 -0.8339
4 Logit(Pr(yvar_f GE f_rec)) -5.3752 1.6493 1.8896 -0.2565 -0.1606 0.4332 0.1358
5 Logit(Pr(yvar_f GE f_rec)) -6.4183 2.0349 2.04   0.2657 0.2914 -0.6043 -0.1755
6 Logit(Pr(yvar_f GE f_rec)) -6.5098 2.0364 2.1556 1.0874 0.2707 -0.9158 -0.8839
7 Logit(Pr(yvar_f GE f_rec)) -5.4408 1.4606 1.7719 1.0951 0.2248 -0.7641 -0.9727
8 Logit(Pr(yvar_f GE f_rec)) -6.4409 1.7985 1.9891 -0.2786 -0.1552 -0.2307 -0.3376
;

*Regression parameters for predicted probability of meeting vegetable models;
data parmsrecv;
input sexagec model $26. Intercept nfg3 nfg4 nfg5 nfg6 race1 race2 pir1 pir2;
cards;
1 Logit(Pr(yvar_v GE v_rec)) -8.3581 5.1296 -0.7118 3.4612 2.8023 0.7745 -0.6003
-1.4835 -0.7838
2 Logit(Pr(yvar_v GE v_rec)) -6.7874 3.4244 -0.4083 2.2651 2.1522 0.7375 -0.621
-0.0501 0.4002
3 Logit(Pr(yvar_v GE v_rec)) -5.5051 4.3116 -0.5587 2.4303 2.4136 1.2027 -0.4069
-1.218 -1.634
4 Logit(Pr(yvar_v GE v_rec)) -6.4208 3.8024 -1.1678 2.7638 2.0856 1.1976 0.2102
-0.6394 -0.5156
5 Logit(Pr(yvar_v GE v_rec)) -7.8759 3.857 -0.4039 3.144 2.7532 1.0946 -0.8543
-0.6755 -0.4942
6 Logit(Pr(yvar_v GE v_rec))  -8.058 4.4607 -0.8384 3.3121 2.6918 1.229 -1.0089
```

```
-0.8455 -0.5866
7 Logit(Pr(yvar_v GE v_rec))  -5.3579 3.1035 -0.4667 2.385 2.0745 1.1748 -0.6317
-0.8327 -1.0242
8 Logit(Pr(yvar_v GE v_rec))  -6.556 3.2938 -0.6409 2.7149 2.514  0.0623 -1.8285
-0.858 -0.6787
;
run;

proc sql;
create table two as
select a._state, a.sexagec, a.FTJUDA2_, a.FRUTDA2_, a.FRNCHDA_,  a.POTADA1_,
a.GRENDA1_, a.VEGEDA2_, _PSU, _STSTR, _LLCPWT, a.complete,

b.intercept + (b.nfg1*FTJUDA2_)
            + (b.nfg2*FRUTDA2_) + (b.race1*a.race1)
            + (b.race2*a.race2)+ (b.pir1*a.pir1) + (b.pir2*a.pir2)
            as logitf label='log odds of predicted probability of meeting fruit
      recommendation',

c.intercept + (c.nfg3*0.65*GRENDA1_)
            + (c.nfg4*0.65*FRNCHDA_) +(c.nfg5*0.65*POTADA1_)
            + (c.nfg6*0.65*VEGEDA2_)+ (c.race1*a.race1)
            + (c.race2*a.race2)+ (c.pir1*a.pir1) + (c.pir2*a.pir2)
            as logitv2 label='corrected log odds of predicted probability of
meeting veg recommendation',

      exp(calculated logitf)/(1+exp(calculated logitf))
            as pctf label='Predicted probability of meeting fruit recommendation',

      exp(calculated logitv2)/(1+exp(calculated logitv2))
            as pctv2 label='Corrected predicted probability of meeting veg
recommendation'

from one as a,  parmsrecf as b, parmsrecv as c
where a.sexagec=b.sexagec=c.sexagec
order by a.sexagec;
quit;


*STATE - SAS Callable SUDAAN code to estimate national and state percent meeting
recommendations;
proc sort data=two; by _STSTR _PSU;
proc descript data=two filetype=sas design=wr;
      NEST  _STSTR _PSU/missunit;
      weight _LLCPWT;
      subpopn complete=1/name="Respondents with no missing fv or demographic
information";
      var pctf pctv2 ;
      tables _state ;
      class _state  ;
      output nsum mean /filetype=sas filename=work.temp  replace meanFMT=F8.4;
data percents;
      set temp;
      if variable=2 then fv='PercentVegetable'; else fv='PercentFruit';
      if _state ne 0 then statename=fipname(_state); else statename='National';
      keep _state statename fv nsum mean;
      run;

/*************************************************************************/
/* Merge output datasets with fruit and vegetable intake estimates to create */
```

```
/* one table with all 6 fv indicators overall and by state with sample sizes */
/*****************************************************************************/
proc sort data=percents; by fv _state;
data table;
merge times_per_day (obs=52 keep=_state statename nsum median
rename=(median=TimesFruit nsum=tfn))
      times_per_day (firstobs=53 obs=104 keep=_state nsum median
rename=(median=TimesVege nsum=tvn))
      percents (obs=52 keep= nsum _state mean rename=(mean=Pctfruit nsum=pfn))
      percents (firstobs=53 obs=104 keep= nsum _state mean rename=(mean=Pctveg
nsum=pvn));
by _state;
      /*if tfn=TimesFruit=pfn=pvn then n=tfn; else n=.;
      drop tfn tvn pfn pvn _state;*/
format timesfruit timesvege 8.1 Pctfruit Pctveg percent8.1;
run;
proc print;var statename tfn TimesFruit tvn TimesVege pfn Pctfruit pvn Pctveg;
title 'Fruit And Vegetable Intake, Behavioral Risk Factor Surveillance System,
United States, 2017a';
run;
```

## Appendix C: Median frequencies and percentages of adults meeting federal fruit and vegetable intake recommendations per day, by state – Behavioral Risk Factor Surveillance System, United States and District of Columbia, 2017[a]

| | Fruit | | | Vegetable | | |
|---|---|---|---|---|---|---|
| | No.[b] | Median times/day | % of respondents meeting recommendations | No.[c] | Median times/day | % of respondents meeting recommendations |
| National | 336790 | 1.0 | 13.3% | 334123 | 1.7 | 10.4% |
| Alabama | 4777 | 1.0 | 10.4% | 4748 | 1.6 | 6.8% |
| Alaska | 2630 | 1.0 | 12.9% | 2608 | 1.7 | 11.7% |
| Arizona | 11178 | 1.0 | 13.9% | 11073 | 1.7 | 11.2% |
| Arkansas | 3732 | 1.0 | 11.5% | 3694 | 1.7 | 10.5% |
| California | 7155 | 1.1 | 15.0% | 7109 | 1.6 | 12.3% |
| Colorado | 7116 | 1.1 | 14.2% | 7060 | 1.8 | 12.7% |
| Connecticut | 7628 | 1.1 | 15.9% | 7560 | 1.7 | 13.0% |
| Delaware | 2930 | 1.0 | 13.7% | 2888 | 1.7 | 9.3% |
| District of Columbia | 2681 | 1.1 | 21.5% | 2648 | 2.1 | 22.0% |
| Florida | 16069 | 1.1 | 14.1% | 15905 | 1.7 | 11.3% |
| Georgia | 4289 | 1.0 | 12.6% | 4229 | 1.7 | 9.4% |
| Hawaii | 6624 | 1.0 | 13.7% | 6591 | 1.7 | 13.5% |
| Idaho | 4123 | 1.1 | 13.1% | 4102 | 1.7 | 10.4% |
| Illinois | 4788 | 1.1 | 14.0% | 4777 | 1.6 | 9.8% |
| Indiana | 11115 | 1.0 | 11.7% | 11024 | 1.7 | 8.9% |
| Iowa | 6068 | 1.0 | 11.7% | 6024 | 1.7 | 8.2% |
| Kansas | 16148 | 1.0 | 12.2% | 16010 | 1.7 | 10.4% |
| Kentucky | 5336 | 1.0 | 10.7% | 5284 | 1.7 | 7.8% |
| Louisiana | 3551 | 1.0 | 12.4% | 3513 | 1.5 | 8.6% |
| Maine | 8355 | 1.1 | 14.9% | 8319 | 1.9 | 13.0% |
| Maryland | 9815 | 1.1 | 14.8% | 9746 | 1.7 | 11.0% |
| Massachusetts | 4631 | 1.1 | 14.3% | 4607 | 1.8 | 12.2% |
| Michigan | 8501 | 1.0 | 12.3% | 8448 | 1.7 | 8.1% |
| Minnesota | 13083 | 1.1 | 14.0% | 12972 | 1.7 | 10.0% |
| Mississippi | 3974 | 1.0 | 11.1% | 3936 | 1.6 | 6.8% |
| Missouri | 5766 | 1.0 | 9.5% | 5725 | 1.7 | 7.3% |
| Montana | 4615 | 1.0 | 8.8% | 4582 | 1.8 | 8.4% |
| Nebraska | 12516 | 1.0 | 12.1% | 12440 | 1.7 | 8.8% |
| Nevada | 2914 | 1.0 | 11.0% | 2893 | 1.6 | 8.6% |
| New Hampshire | 4175 | 1.1 | 15.9% | 4142 | 1.9 | 13.3% |
| New Jersey | 8822 | 1.0 | 12.5% | 8732 | 1.7 | 10.7% |
| New Mexico | 5114 | 1.0 | 13.1% | 5064 | 1.6 | 10.3% |
| New York | 9449 | 1.1 | 14.4% | 9352 | 1.7 | 11.4% |
| North Carolina | 3646 | 1.0 | 12.7% | 3620 | 1.8 | 10.6% |
| North Dakota | 5849 | 1.0 | 12.0% | 5822 | 1.7 | 9.6% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ohio | 9418 | 1.0 | 11.8% | 9346 | 1.7 | 8.1% |
| Oklahoma | 4553 | 1.0 | 8.0% | 4496 | 1.7 | 6.8% |
| Oregon | 3975 | 1.1 | 14.9% | 3945 | 1.8 | 12.7% |
| Pennsylvania | 5260 | 1.1 | 12.7% | 5233 | 1.7 | 9.9% |
| Rhode Island | 4046 | 1.1 | 14.4% | 4019 | 1.7 | 13.1% |
| South Carolina | 8348 | 1.0 | 11.1% | 8268 | 1.7 | 8.1% |
| South Dakota | 5444 | 1.0 | 10.6% | 5412 | 1.8 | 8.5% |
| Tennessee | 4236 | 1.0 | 12.1% | 4191 | 1.7 | 10.0% |
| Texas | 9394 | 1.0 | 14.2% | 9299 | 1.7 | 11.0% |
| Utah | 7948 | 1.1 | 13.6% | 7898 | 1.7 | 9.5% |
| Vermont | 4905 | 1.1 | 15.8% | 4869 | 1.9 | 13.8% |
| Virginia | 7374 | 1.0 | 13.2% | 7319 | 1.8 | 10.6% |
| Washington | 10091 | 1.1 | 14.6% | 10016 | 1.8 | 12.3% |
| West Virginia | 4264 | 1.0 | 7.2% | 4234 | 1.7 | 6.0% |
| Wisconsin | 4721 | 1.1 | 13.7% | 4701 | 1.7 | 9.1% |
| Wyoming | 3650 | 1.0 | 12.0% | 3630 | 1.8 | 9.4% |

[a] 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.

[b] No.= Unweighted number of participants with no missing fruit data and with plausible fruit values.

[c] No.= Unweighted number of participants with no missing vegetable data and with plausible vegetable values.