



The Behavioral Risk Factor Surveillance System

Comparability of Data BRFSS 2018

(Version #1—Revised: August 2019)



Introduction

The Behavioral Risk Factor Surveillance System (BRFSS) is an ongoing, state-based, random-digit-dialed telephone survey of noninstitutionalized adults 18 years of age or older, residing in the United States.^{1,2} For detailed descriptions of the BRFSS questionnaires, data, and reports, please see the [BRFSS website](#). In 2018, all 50 states, the District of Columbia (DC), Puerto Rico, and Guam conducted both household landline telephone and cell-phone interviews for the BRFSS data collection.

The BRFSS data collection, structure, and weighting methodology changed in 2011 to allow the addition of data collection by cell phones. The BRFSS survey uses disproportionate stratified sample (DSS) design for landline telephone samples and random sample design for the cell-phone survey. The BRFSS used iterative proportional fitting (IPF)—also known as raking—for weighting 2018 BRFSS data. Because of sample design and the multiple reporting areas, the BRFSS data showed some variation between states and territories for the 2018 data year. The following sections identify important similarities and variations for the 2018 data year from previous years.

A. 2018 Data Anomalies and Deviations from the Sampling Frame

The BRFSS state-based annual sample designs are fixed for the data collection year beginning in January in all the states and participating territories. The samples are drawn quarterly and screened monthly to provide a representative sample for monthly data collection. The intent of the monthly sample is to use it for 1 month, but in most states it took more than 1 month to complete data collection using the monthly sample. In several instances, states used their monthly sample during a period of several months. This deviation will disproportionately affect analyses based on monthly (rather than annual) data. Michigan and California continued to receive their sample quarterly rather than monthly, allowing them to keep their sample active across three or more months.

Several states conducted fewer than 12 monthly data collections during the year. The following states did not collect **landline** data for one or two months, as noted: Idaho (April), New York (January), North Dakota (April), and Texas (January). Some states did not collect landline data for three or more months: DC (January, February, March, July, August), New Jersey (April through September, December), North Carolina (April, May, June), Pennsylvania (April, May, June), and Puerto Rico (January through March, December).

The following states did not collect **cell-phone** data for one or two months, as noted: Colorado (March, December), Idaho (March, April), New Hampshire (December), New York (January), North Dakota (March, April), Texas (January), Puerto Rico (January, February). DC (January, February, March, July, August), New Jersey (April through September, December), North Carolina (April through August), and Pennsylvania (March, April, May, June) did not collect data for three or more months.

Eighteen states, DC, and Puerto Rico were unable to close out their 2018 sample by December 31, 2018, and continued data collection into early 2019.

The US Virgin Islands did not collect data in 2018.

DC began data collection in June and changed data collectors in September. New Jersey data collection began in January and ended in March. New Jersey resumed data collection in October with a new data collector. The months of data collection missed in both situations will likely affect seasonal estimates, i.e. influenza. Although both met minimum requirements to be included in the public-use data set, please consider the differences in collection when comparing estimates across years.

B. Protocol Changes from 2017 Data Collection

1. Cell-phone Data

Telephone coverage varies by state, also by subpopulation. According to the 2017 American Community Survey (ACS), 98.5% of all occupied housing units in the United States had telephone service available; telephone non-coverage ranged from 1.0% in New Jersey, Rhode Island, and Washington to 3.0% in the District of Columbia. It is estimated that 4.0% of occupied households in Puerto Rico did not have telephone service.³ The percentage of households using only cell phones has been steadily increasing—57.1% of all adults lived in households with only cell phones in 2018.⁴ The increased use of cell phones required the BRFSS to begin to include the population of cell-phone users in 2011. At that time, all adult cell-phone respondents who had a landline telephone were not eligible for the survey. In 2012, the BRFSS changed the screening process. Cell-phone respondents were eligible—even if they had landline phones—as long as they received at least 90% of all calls on their cell phones. Beginning in 2014, all adults contacted through their personal (nonbusiness) phone numbers were eligible regardless of their landline phone use (i.e., complete overlap).

2. Weighting Methodologies

Since 2011, the BRFSS has used the weighting methodology called iterative proportional fitting (IPF) or raking to weight data. Raking allows incorporation of cell-phone survey data, and it permits the introduction of additional demographic characteristics that more accurately match sample distributions to known demographic characteristics of populations at the state level. (Refer to the BRFSS website for more information on [methodologic changes](#)). Raking adjusts the estimates within each state using the margins (raking control variables). The raking method applies a proportional adjustment to the weights of the cases that belong to the same category of the margin. The iteration (up to 100 times) continues until a convergence to within a target percentage difference is achieved. Since 2013, up to 16 raking margins have been used in the following order—county by gender, county by age, county by race or ethnicity, county, region by race or ethnicity, region by gender, region by age, region, telephone service (landline, cell phone or dual user), age by race or ethnicity, gender by race or ethnicity, own/rent home, marital status, education, race or ethnicity, and gender by age.

Since 2014, the inclusion of all adult cell-phone respondents in the survey required an adjustment to the design weights to account for the overlapping sample frames. A compositing factor was calculated from each of the two samples (landline and cellular sample) for dual users—individuals who had both cell phone and landline phone. The BRFSS multiplied the design weight by the compositing factor to generate a composite weight for the records in the overlapping sample frame. The design weight was truncated later, based on quartiles within geographic region (or state). In 2018, the truncated weight was adjusted to regional (or state) population and the state phone source proportions prior to raking. This adjusted weight was used as the input weight for the first raking margin. At the last step of the raking

process, weight trimming was used to increase the value of extremely low weights and decrease the value of extremely high weights. Weight trimming is based on two alternative methods, IGCV (Individual and Global Cap Value) and MCV (Margin Cap Value).

3. Other Issues

As in previous years, the data from an optional module were included if interviewers asked module questions to all eligible respondents within a state for the entire data collection year. A state may have indicated the use of an optional module. If the module was not used for the entire data collection year, the data were moved into the state-added questions section. Several states collected data with optional modules by landline telephone and cell-phone surveys.

During the 2018 data collection process, California, Kentucky, and Michigan included an incorrect skip pattern, which excluded some respondents from the pregnancy question. During the first two quarters of data collection, female respondents 45–49 years of age were not asked if they were pregnant.

CDC has also provided limited technical support for the survey data collection of multiple (up to three in 2018) questionnaire versions. A state may ask a subset of its survey sample a different set of questions following the core, as long as the survey meets the minimum effective sample size (2,500 participants) for a given questionnaire version. States must use the core instrument without making any changes to it in any of their versions of the overall questionnaire. States can include an optional module on all versions or exclusively on a single version, but once a state chooses to use an optional module, the state must ask the module questions throughout the data-collection year. The objective of the multiple-version questionnaire is to ask more questions, on additional topics, within a statewide sample. In 2018, 16 states conducted multiple-questionnaire-version surveys on both their landline telephone and cell phone surveys. Data users can find version-specific data sets and additional documentation regarding module data analysis in the 2018 BRFSS Survey Data and Documentation section on the BRFSS [webpage](#).

A 2012 change to the final disposition code assignment rules modified the requirements for a partially complete interview. If a participant terminated an interview during or after the demographics section, the BRFSS coded it as a partial-complete. The coding of questions was discontinued at the point of interview termination. When determining which records to include in any analysis, data users should account for participants' missing and refused values. Beginning in 2015, questions in the demographic section were reordered and the definition of partial-complete changed. A partially complete disposition code was assigned if the interview terminated before completion of the survey and the selected respondent completed the demographics section through question 16.

More information about survey item nonresponse can be found in the 2018 BRFSS Summary Data Quality Report and in the respective states' Data Quality Reports.

C. Statistical and Analytic Issues

1. Analysis Procedures

To use the BRFSS data, the researcher needs to formulate a research question, review the existing data tabulations, develop an analytic plan, conduct the analyses, and use data for decision-making.⁵ Unweighted BRFSS data represent the actual responses of each respondent before any adjustment is made for variation in the respondents' probability of selection, disproportionate selection of population subgroups relative to the state's population distribution, or nonresponse. Weighted BRFSS data represent results that have been adjusted to compensate for these issues. Regardless of state sample design, use of the weight in analysis is necessary if generalizations are to be made from the sample to the population. Please note the statistical and analytic issues described in this section are the same as those of previous years.

2. Statistical Issues

The procedures for estimating variances described in most statistical texts and used in most statistical software packages are based on the assumption of simple random sampling (SRS). The data collected in the BRFSS, however, are obtained through a complex sample design. The direct application of standard statistical analysis methods for variance estimation and hypothesis testing may, therefore, yield misleading results. There are computer programs available that take such complex sample designs into account: SAS Version 9.4 SURVEYMEANS and SURVEYREG procedures, SUDAAN, and Epi Info's C-Sample are among those suitable for analyzing BRFSS data.^{6,7,8} SAS and SUDAAN can be used for tabular and regression analyses.^{6,7} Epi Info's C-sample can be used to calculate simple frequencies and two-way cross-tabulations.⁸ When using these software products, users must know the stratum, the primary sampling units, and the record weight—all of which are in the public use data file. For more information on calculating variance estimations using SAS, see the SAS/STAT® 13.1 User's Guide.⁶ For information about SUDAAN, see the SUDAAN Language Manual, Release 11⁶, and to find more about Epi Info, see *Epi Info, Version 7.0*.⁸

Although the overall number of respondents in the BRFSS is more than sufficiently large for statistical inference purposes, subgroup analyses can lead to estimates that are unreliable. Consequently, users need to pay particular attention to the subgroup sample when analyzing subgroup data, especially within a single data year or geographic area. Small sample sizes may produce unstable estimates. Reliability of an estimate depends on the actual unweighted number of respondents in a category, not on the weighted number. Interpreting and reporting weighted numbers that are based on a small, unweighted number of respondents can mislead the reader into believing that a given finding is much more precise than it actually is. The BRFSS previously followed a rule of not reporting or interpreting percentages based upon a denominator of fewer than 50 respondents (unweighted sample) or the half-width of a 95% confidence interval greater than 10.

From 2011, the BRFSS replaced the confidence interval limitation with the relative standard error (RSE)—the standard error divided by the mean. The survey with the lower RSE has a more-precise measurement. Because there is less variance around the mean, BRFSS did not report percentage estimates where the RSE was greater than 30% or the denominator represented fewer than 50 respondents from an unweighted sample. Details of changes beginning with the 2011 BRFSS are available in the *Morbidity and Mortality Weekly Report (MMWR)*, which highlights weighting and coverage effects on trend lines.⁹ Because of the changes in the methodology, researchers are advised to avoid comparing data collected before the changes (up to 2010) with data collected from 2011 and onward.

3. Analytic Issues

a. Advantages and Disadvantages of Telephone Surveys

Compared with face-to-face interviewing techniques, telephone interviews are easy to conduct and monitor and are cost efficient; however, telephone interviews have limitations. Telephone surveys may have higher levels of no coverage than face-to-face interviews because interviewers may not be able to reach some US households by telephone. As mentioned earlier, approximately 98.5% of households in the United States have telephones. A number of studies have shown that the telephone and non-telephone populations are different with respect to demographic, economic, and health characteristics.^{10,11,12} Although the estimates of characteristics for the total population are unlikely to be substantially affected by the omission of the households without telephones, some of the subpopulation estimates could be biased. Telephone coverage is lower for population subgroups such as people with low incomes, people in rural areas, people with less than 12 years of education, people in poor health, and heads of households younger than 25 years of age.¹³ Raking adjustments for age, race, and sex, and more demographic variables, however, minimize the impact of differences to a greater extent in no coverage, under-coverage, and nonresponse at the state level.

Surveys based on self-reported information may be less-accurate than those based on physical measurements. For example, respondents are known to underreport body weight and risky health behaviors, such as alcohol intake and smoking. This type of potential bias arises when conducting both telephone and face-to-face interviews; when interpreting self-reported data, data users should take into consideration the potential for underreporting.

Despite the above limitations, the BRFSS data are reliable and valid.¹⁴ The prevalence estimates from the BRFSS correspond well with findings from surveys based on face-to-face interviews, including the National Health Interview Survey (NHIS) and the National Health and Nutrition Examination Survey (NHANES).¹⁵ Please visit the BRFSS website for more information about [methodological studies](#).

b. New Calculated Variables and Risk Factors

Not all of the variables that appear on the public use data set are taken directly from the state files. CDC prepares a set of SAS programs that are used for end-of-year processing. These programs prepare the data for analysis and add weighting, sample design, calculated variables, and risk factors to the data set. The following calculated variables and risk factors, which the BRFSS has created for the user's convenience, are examples of results from this procedure for 2018 data:

`_ALTETH3, _MAM5022, _PNEUMO3, _RFMAM21, _RFPAP34, _RFPSA22, _DENVST3, _EXTETH3, _RFDRHV6`

The procedures for the variables vary in complexity. Some only combine codes, while others require sorting and combining selected codes from multiple variables. This may result in the calculation of an intermediate variable. For more information regarding the calculated variables and risk factors, refer to the document entitled *Calculated Variables in the 2018 Data File of the Behavioral Risk Factor Surveillance System*, found in the 2018 BRFSS Survey Data and Documentation section of the BRFSS [website](#).

Two geography-based variables (`_METSTAT`, `_URBSTAT`) have been included based on the 2013 NCHS urban-rural classification scheme for counties. The two variables identify metropolitan status versus nonmetropolitan or urban versus rural within a given state. Three states had a single county in nonmetropolitan or rural category, thus requiring a recode of the value to an adjacent category as a disclosure-avoidance measure. The definitions below show the categorization of the two variables based on the sub-setting of the original six categories.

`_METSTAT` :

1 = `_URBNRRL` IN (1,2,3,4) = Metropolitan counties

2 = `_URBNRRL` IN (5,6) = Nonmetropolitan counties

`_URBSTAT` :

1 = `_URBNRRL` IN (1,2,3,4,5) = Urban counties

2 = `_URBNRRL` IN (6) = Rural counties

References

1. Mokdad AH, Stroup DF, Giles WH. Public health surveillance for behavioral risk factors in a changing environment: recommendations from the Behavioral Risk Factor Surveillance team. *MMWR Recomm Rep*. 2003;52(RR-9):1-12.
2. Holtzman D. The Behavioral Risk Factor Surveillance System. In: Blumenthal DS, DiClemente RJ, eds. *Community-Based Health Research: Issues and Methods*. New York, NY: Springer Publishing Company Inc; 2004:115-131.
3. Federal Communications Commission USA. Universal Service Monitoring Report. 2018; <https://docs.fcc.gov/public/attachments/DOC-357769A1.pdf>.
4. Blumberg SJ, Luke JV. Wireless substitution: Early release of estimates from the National Health Interview Survey, July–December 2018. National Center for Health Statistics. June 2019. Available from: <https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201906.pdf>.
5. Frazier EL, Franks AL, Sanderson LM, Centers for Disease Control and Prevention. Behavioral risk factor data. In: *Using Chronic Disease Data: a Handbook for Public Health Practitioners*. Atlanta, GA: Centers for Disease Control and Prevention, US Dept. of Health and Human Resources; 1992.
6. SAS Institute Inc. 2013, *SAS/STAT*® 13.1 User's Guide. Cary, NC: SAS Institute, Inc.
7. Research Triangle Institute (2012). SUDAAN Language Manual, Volumes 1 and 2, Release 11.
8. Dean AG, Arner TG, Sunki GG, et al. Epi Info™, a database and statistics program for public health professionals. Atlanta, GA: Centers for Disease Control, US Dept. of Health and Human Resources; 2011.
9. Pierannunzi C, Town M, Garvin W, et al. Methodologic changes in the Behavioral Risk Factor Surveillance System in 2011 and potential effects on prevalence estimates. *MMWR Morb Mortal Wkly Rep*. 2012;61(22):410-413. www.cdc.gov/mmwr/preview/mmwrhtml/mm6122a3.htm Accessed 8 September 2015.
10. Groves RM, Kahn RL. *Surveys by Telephone: A National Comparison with Personal Interviews*, New York, NY: Academic Press; 1979.
11. Banks MJ. Comparing health and medical care estimates of the phone and nonphone populations. In: *Proceedings of the Section on Survey Research Methods*. American Statistical Association. 1983:569-574.
12. Thornberry OT, Massey JT. Trends in United States telephone coverage across time and subgroups. In: Groves RM, et al, eds. *Telephone Survey Methodology*. New York, NY: John Wiley & Sons; 1988:25-49.
13. Massey JT, Botman SL. Weighting adjustments for random digit dialed surveys. In: Groves RM, et al, eds. *Telephone Survey Methodology*. New York, NY: John Wiley &

Sons; 1988:143-160.

14. Pierannunzi C, Hu SS, Balluz L. A systematic review of publications assessing reliability and validity of the Behavioral Risk Factor Surveillance System (BRFSS), 2004–2011. *BMC Med Res Methodol.* 2013;13:49.
15. Li C, Balluz L, Ford ES, et al. A comparison of prevalence estimates for selected health indicators and chronic diseases or conditions from the Behavioral Risk Factor Surveillance System, the National Health Interview Survey, and the National Health and Nutrition Examination Survey, 2007-2008. *Prev Med.* 2012;54(6):381-387.
16. Ingram DD, Franco SJ. 2013 NCHS urban–rural classification scheme for counties. National Center for Health Statistics. *Vital Health Stat* 2(166). 2014.