Understanding the Impact of Changes in BRFSS Weighting Protocols

Background:

Weighting processes are used by all large surveys. These processes adjust the data so that those groups which are underrepresented in the sample can be accurately represented in the data. The weighting process for BRFSS data will be changing from Post-Stratification to Raking (or iterative proportional fitting). Post-Stratification has been used by BRFSS for many years. During 2007 Raking was introduced and in 2011 Raking will be the only method used for weighting.

Post-Stratification and Raking methods used by the BRFSS differ. In Post-Stratification, categories of gender, age, race/ethnicity and regions within states were used to adjust data. In Raking, telephone source (landline or cell phone), education level, marital status and renter/owner status will be added to race and ethnicity, regions within states, age group by gender, gender by race and ethnicity, and age group by race and ethnicity. The post-stratification process also required that categories of variables had to be collapsed when too few respondents fit the criteria. For example, if there were only a few persons who met race, gender and age criteria, then groups of ages might be combined prior to weighting. Raking does not require the collapsing of categories, even though more demographic characteristics are being included. The inclusion of new demographic characteristics as weights allows for a greater understanding of how BRFSS samples represent populations.

Raking is completed by adjusting for one demographic variable (or dimension) at a time. For example, when weighting by age and gender, weights would first be adjusted for gender groups, then those estimates would be adjusted by age groups. This procedure would continue in an iterative process until all group proportions in the sample approach those of the population, or after 75 iterations.

Raking is a step forward in the weighting process. In the past, computer systems were strained by the complexity of Raking with very large survey samples. In 2011, computer systems are better able to accomplish this task. The changes in personal communication require that surveys include cell phone samples. Raking allows for the integration of cell phone samples in BRFSS estimates.

Differences in Estimates using Post-Stratification and Raking

It should be remembered that Raking will include new demographic characteristics on which weights are calculated. Raking adds new variables (telephone source, education level, marital status and renter/owner status) to variables which have been used for weighting in the past (age, race/ethnicity, gender, region/state). The statistical processes are also different. In some cases this will result in changes in prevalence estimates when comparing Post-Stratification and Raking. In the example below (see Table 1), small differences are noted between prevalence estimates for landline samples when Post-Stratification and Raking are compared for responses in a single state. This table provides weighted

frequency distributions for the variable DIABETE2: "Has a healthcare provider ever told you that you have diabetes?"

Table 1
State-level Responses to Question:
"Has a doctor, nurse or other healthcare provider ever told you that you have diabetes?"
By Type Of Weighting Procedure for Landline Data

Response	Landline Weighted frequency with Post-Stratification	Landline Percent With Post-Stratification	Landline Weighted frequency with Raking	Landline Percent With Raking	Differences in Landline Percentages (Post-Stratification - Raking)
Yes	434,858	12.26	440,694	12.43	-0.17
Yes, but only during pregnancy	26,306	0.74	26,262	0.74	0.00
No	3,031,681	85.44	3,029,545	85.42	0.02
No, Pre-diabetes/ borderline diabetes	55,454	1.56	50,196	1.42	0.15

As this table indicates, differences between the prevalence estimates are very small and not likely to be noted in trends of responses to this question over time. However, in other instances differences may be noted in some responses to questions when Post-Stratification and Raking are compared. In Table 2, below, responses to the variable GENHLTH are presented. These questions are in response to the question, "Would you say that in general your health is…Excellent, Very Good, Good, Fair or Poor." As the table indicates, some of the weighted percentages are similar when Post-Stratification and Raking are compared. Other categories of response differ. For example, the percentage of the responses in the response category "Good" is 31.26 percent when weighted using Post-Stratification, and it is 31.42 percent using Raking (a difference of only -0.16 percent). Differences are more pronounced between the prevalence estimates of those who respond "Fair," with percentages of 14.65 and 16.73 for Post-Stratification and Raking, respectively (a difference of -2.07 percent).

Table 2
State-level Responses to Question:
"Would you say that in general your health is excellent, very good, good, fair or poor?"
By Type Of Weighting Procedure for Landline Data

Response	Landline Weighted Frequency With Post-Stratification	Landline Percent With Post-Stratification	Landline Weighted Frequency With Raking	Landline Percent With Raking	Differences In Landline Percentages (Post-Stratification - Raking)
Excellent	631,742	17.83	575,541	16.27	1.56
Very Good	1,037,345	29.27	963,330	27.23	2.04
Good	1,107,272	31.26	1,111,484	31.42	-0.16
Fair	519,248	14.65	591,716	16.73	-2.07
Poor	247,424	6.98	295,425	8.35	-1.37

In the example below there are more consistent differences between weighted percentages in all of the responses to a question. The table below provides comparisons to the variable EXERANY2: "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?" As is depicted in the table, both categories of response are different when compared by weighting procedures.

Table 3
State-level Responses to Question:
"During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"
By Type Of Weighting Procedure for Landline Data

Response	Landline Weighted Frequency With Post-Stratification	Landline Percent With Post-Stratification	Landline Weighted Frequency With Raking	Landline Percent With Raking	Differences In Landline Percentages (Post-Stratification - Raking)
Yes	2,448,288	68.97	2,342,381	65.98	2.99
No	1,101,378	31.03	1,207,643	34.02	-2.99

Differences between percentages noted in these examples are consequences of the inclusion of additional variables in the weighting process as well as differences in the procedure itself.

However, some of the differences which are noted in Tables 1-3 are ameliorated by the inclusion of cell phone data, which is also being included in the 2011 BRFSS data. In the section below, illustrations of the impact of cell phone data and concurrent weighting changes are presented.

Differences in Estimates using Post-Stratification and Raking With Integrated Cell Phone Data

One of the reasons for moving to Raking is to allow for the inclusion of cell phone data. In 2011, these two changes will be adopted for all BRFSS data. Some of the changes noted in the tables above, are minimized by the inclusion of cell phone data. For example, in Table 4 below, data from Table 3 are reproduced with additional columns to illustrate percentages using landline and cell phone data. As this table shows, the differences noted between estimates produced using Post-Stratification and Raking, are no longer a factor when cell phone samples are included in the weighting.

Table 4
State-level Responses to Question:
"During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"
By Type Of Weighting Procedure for Landline and Cell Phone Data

Response	Landline Weighted Frequency With Post-Stratification	Landline Percent With Post-Stratification	Landline Weighted Frequency With Raking	Landline Percent With Raking	Differences In Landline Percentages (Post-Stratification - Raking)	Landline And Cell Phone Weighted Frequency With Raking	Landline And Cell Phone Percent	Landline And Cell Phone Differences In Percentages (Post-Stratification - Raking)
Yes	2,448,288	68.97	2,342,381	65.98	2.99	2,447,823	68.96	0.02
No	1,101,378	31.03	1,207,643	34.02	-2.99	1,102,053	31.04	-0.02

In some cases, the inclusion of cell phone samples may reduce, but not minimize the impact of weighting changes. For example, in the table below, while differences in weighting are less substantial, there are still noticeable differences between estimates derived from Post-Stratification and Raking weighting. In this instance respondents were asked how often they smoked. As the data illustrate, in some categories the Raking landline/cell phone responses are closer to the Post-Stratification estimates. In one category (persons who smoke some days), the estimate is further off and in a different direction than with Raking alone.

Table 5
State-level Responses to Question:
"Do you smoke cigarettes every day, some days or not at all?"
By Type Of Weighting Procedure for Landline and Cell Phone Data

Response	Landline Weighted Frequency With Post-Stratification	Landline Percent With Post-Stratification	Landline Weighted Frequency With Raking	Landline Percent With Raking	Differences In Landline Percentages (Post-Stratification - Raking)	Landline And Cell Phone Weighted Frequency With Raking	Landline And Cell Phone Percent	Landline And Cell Phone Differences In Percentages (Post-Stratification - Raking)
Every day	581,967	36.32	704,831	40.95	-4.63	676,129	40.40	-4.08
Some Days	213,724	13.34	248,782	14.45	-1.12	199,278	11.91	1.43
Not At All	806,827	50.35	767,708	44.60	5.75	798,181	47.69	2.65

Conclusions

New weighting procedures are needed to keep pace with the changing landscape of personal communications. The inclusion of new variables and more complex weighting procedures for large scale survey data are now feasible, because of improvements in the capacity of computer systems. It is to be expected that there will be some differences in estimates when weighting procedures change and when new variables for weighting are introduced. The change from Post-Stratification to Raking will allow researchers to understand better the associations between variables, by controlling more factors through the weighting process. In addition Raking allows for the inclusion of cell phone samples in the data.

It should be remembered that these are only depictions of potential outcomes of changes at the BRFSS. The examples presented here may not be illustrative of impacts of weighting procedures in different states or for different variables.