

Effect of Changes in BRFSS Protocols on 2011 Behavioral Risk Factor Surveillance Data in Kentucky

Background:

The Behavioral Risk Factor Surveillance System (BRFSS) is a collaborative project of the Centers for Disease Control and Prevention (CDC) and the Commonwealth of Kentucky. The BRFSS is an ongoing data collection program designed to measure behavioral risk factors for the adult population (18 years of age or older) living in households. It was initiated in 1985 in Kentucky. The BRFSS objective is to collect uniform, state-specific data on preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases that affect the adult population. Some of the factors assessed by the BRFSS include tobacco use, health care coverage, HIV/AIDS knowledge and prevention, physical activity, and fruit and vegetable consumption. Data are collected from a random sample of adults (one per household) through a telephone survey.

BRFSS program management is within the Kentucky Department for Public Health. Data collection in Kentucky is contracted through the University of Kentucky's Survey Research Center. The data are transmitted to the CDC's Office of Surveillance, Epidemiology, and Laboratory Services Behavioral Risk Factor Surveillance Branch for editing, processing, weighting, and analysis. An edited and weighted data file is provided by CDC to each participating state for each year of data collection.

The process of weighting includes statistical procedures to make sure the data are representative of the population for each state and/or local area. There are several methods available for weighting surveillance data and for more than two decades, CDC has been using the method of post-stratification to weigh BRFSS data collected through landline telephone interviews. However, the increasing number of American households having cellular telephones required a change in the weighting methodology to allow the inclusion of cell phone interviews.

Changes in Protocol:

After sufficient research and pilot testing, two changes in the methods of the BRFSS were introduced by CDC and implemented with the release of the 2011 BRFSS data.¹ They are:

- Inclusion of cell phone interviews
- Introduction of a new "weighting" procedure called raking

Approximately 3 in 10 American homes have only cellular telephones. The trend towards cell-only households has been especially strong among younger adults and among persons in racial and ethnic minority groups.¹ Kentucky started sampling cell phone users in 2009 and 2010 but the sample size was not large enough to see effect of these changes. In 2011, Kentucky increased the cell phone sample to 15% of complete interviews. In this report, we compare the 2010 data that has been weighted using post-stratification with the 2011 data which has been weighted using the new methodology and includes cell phone as well as landline completed interviews. This enables us to explore the direction and magnitude of differences in prevalence estimates that may occur because of the new protocol.

Post-stratification weighting forces the proportion of a given demographic subgroup in the sample to match the proportion of that subgroup in the population.² For example, if males 55 to 64 years of age represent 10% of a survey sample, but U.S. Census Bureau population estimates indicate that 15% of the total population consists of males 55 to 64 years of age, then each male respondent from that age group would be given a higher weight in the sample data to account for the difference. The assigned weight for each respondent in the dataset indicates how much each respondent will count in statistical procedures. In un-weighted datasets, each respondent represents one person in the population. In weighted datasets, one respondent may represent 100 individuals, another may represent 25 individuals, and so on.³

The new method for weighting is known as *iterative proportional fitting* or raking. This methodology represents an enhancement over previous post-stratification weighting procedures.⁴ Raking adjusts the data in a manner that groups which are underrepresented in the sample can be accurately represented in the final dataset.

Raking allows for:

- incorporation of cell phone survey data
- introduction of additional demographic characteristics
- match sample distributions to known demographic characteristics of populations
- reduces non-response bias
- reduces error within estimates

BRFSS raking includes categories of age by gender, detailed race and ethnicity groups, education levels, marital status, regions within states, gender by race and ethnicity, telephone source, renter/owner status, and age groups by race and ethnicity.^{3,4}

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, whichever comes first.⁵

Effect of Changes:

In 2010, the Kentucky sample included 500 completed cell phone interviews and 8,061 completed landline interviews, for a total sample size of 8,561. The 2011 Kentucky sample included 1,197 completed cell phone interviews and 9,697 completed landline interviews, for a total sample size of 10,894. Before estimating prevalence we looked at the changes in the demographic distribution of the respondents in 2011 BRFSS data due to inclusion of cell phone users (Table1). There is a higher prevalence of adults aged 18-24 years, African American respondents, Hispanic respondents, those that did not graduate high school, and adults whose annual household income was less than \$15,000.

Tables 2-5 show selected BRFSS estimates that use post-stratification weights with 2010 landline data only and raking weights with both landline and cell phone data from 2011. In this report, Kentucky prevalence estimates calculated with the raking methodology using 2011 landline and cell phone data differed by a range of 0.1 to 7.3 percentage points compared to estimates using post-stratification weights with 2010 landline only data. The only exception was the leisure-time physical activity measure which showed no change in estimate.

Among the four measures evaluated for health risk behaviors, one showed no difference, one differed by 2 percentage points, and two differed by more than 4 percentage points (Fig 1). Prevalence estimates for seven out of eight chronic conditions (Fig 2) differed by less than one percentage point when comparing 2011 survey with weighted 2010 data using the old methodology. When comparing measures in health status and health care access, the range of differences was from 0.9 to 4.3 percentage points (Fig 3).

All the measures of immunization and screening tests differed by more than 3 percentage points. The biggest change in magnitude was observed in the HIV testing measure which was 7.3 percentage points lower than the 2010 estimate (Fig 4). Big changes in magnitude of estimates were also observed in binge drinking, cigarette smoking, activity limitation, and ever had a pneumonia vaccine.

As expected there are some differences in prevalence estimates when data from cell phone users and raking procedures are used. If comparisons are made between prevalence estimates calculated with post-stratification weights and estimates calculated with raking weights and cell phone users' data, then the true differences in analyzing trend data are not discernible.⁶ Therefore, it is recommended that time-trend graphs using BRFSS data will need to show a break in the trend line between years that use cell phone samples with raking weights and prior years that do not incorporate these strategies. Additionally, 2011 BRFSS data can be viewed as a baseline year for time-trend analysis.

Table 1: Demographic characteristics, Kentucky BRFSS, 2010 and 2011

Demographic Characteristics	2010			2011		
	Post-stratification Weights <i>Landline Only</i>			New Raking Weights <i>Landline and Cell Phone</i>		
	Wt. %	95% CI	UnWt. N	Wt. %	95% CI	UnWt. N
Age Groups						
18 - 24 years	9.9	8.1 - 11.6	229	12.5	11.2 - 13.9	381
25 - 34 years	17.4	15.7 - 19.1	599	17.3	16.0 - 18.6	988
35 - 44 years	20.0	18.3 - 21.7	1,014	17.4	16.2 - 18.6	1,310
45 - 54 years	19.0	17.7 - 20.3	1,579	18.8	17.7 - 20.0	2,010
55 - 64 years	15.9	14.8 - 16.9	1,981	16.0	15.1 - 16.9	2,710
65+ years	17.9	16.8 - 18.9	2,659	18.0	17.1 - 18.8	3,495
Race/Ethnicity						
White/Non-Hispanic	88.4	86.9 - 89.9	7,317	88.2	87.0 - 89.4	9,007
Black/Non-Hispanic	5.6	4.5 - 6.7	255	7.2	6.2 - 8.2	1,138
Hispanic	1.6	1.1 - 2.0	114	2.7	2.0 - 3.4	192
Other Race/Non-Hispanic	1.9	1.2 - 2.5	93	1.2	0.8 - 1.6	156
Multiracial/Non-Hispanic	2.5	1.6 - 3.3	154	0.7	0.5 - 1.0	226
Highest Level of Education Completed						
Did not graduate High School	11.8	10.6 - 13.0	1,228	18.8	17.4 - 20.2	1,637
Graduated High School	33.4	31.6 - 35.2	2,942	34.2	32.8 - 35.7	3,839
Attended College or Technical School	26.1	24.3 - 27.8	1,990	28.2	26.9 - 29.6	2,779
Graduated from College or Technical School	28.8	27.0 - 30.6	1,863	18.7	17.7 - 19.7	2,557
Annual Household Income						
Less than \$15,000	12.7	11.4 - 13.9	1,312	17.6	16.2 - 19.0	1,620
\$15,000 to less than \$25,000	17.4	15.9 - 19.0	1,448	14.8	13.5 - 16.1	1,239
\$25,000 to less than \$35,000	11.8	10.4 - 13.2	879	11.5	10.4 - 12.7	889
\$35,000 to less than \$50,000	15.7	14.2 - 17.2	1,021	15.6	14.3 - 16.8	1,102
\$50,000 or more	42.5	40.5 - 44.5	2,344	40.5	38.8 - 42.3	2,660
Gender						
Male	48.2	46.3 - 50.2	2,554	48.4	46.9 - 50.0	3,744
Female	51.8	49.8 - 53.7	5,507	51.6	50.0 - 53.1	7,150

All percentages are weighted to population characteristics.

Wt. % = Weighted %

UnWt. N = Unweighted N (number of respondents)

95% CI = 95% Confidence Interval

Table 2: Prevalence estimates of health risk behaviors, Kentucky BRFSS, 2010 and 2011

Health Risk Behaviors	2010			2011		
	Post-stratification Weights <i>Landline Only</i>			New Raking Weights <i>Landline and Cell Phone</i>		
	Wt. %	95% CI	UnWt. N	Wt. %	95% CI	UnWt. N
Binge Drinking (past 30 days)	11.9	10.5 - 13.3	552	16.1	14.8 - 17.4	880
Heavy Drinking (past 30 days)	3.9	3.1 - 4.7	221	5.7	4.9 - 6.5	387
Current Cigarette Smoking	24.8	23.0 - 26.6	1,843	29.0	27.5 - 30.5	2,528
No Leisure Time Physical Activity	29.3	27.7 - 30.9	2,893	29.3	27.9 - 30.7	3,282

Table 3: Prevalence estimates of chronic conditions, Kentucky BRFSS, 2010 and 2011

Chronic Conditions	2010			2011		
	Post-stratification Weights <i>Landline Only</i>			New Raking Weights <i>Landline and Cell Phone</i>		
	Wt. %	95% CI	UnWt. N	Wt. %	95% CI	UnWt. N
Lifetime Asthma (Adults)	14.9	13.5 - 16.3	1,329	15.0	13.9 - 16.2	1,706
Current Asthma (Adults)	10.4	9.2 - 11.6	991	10.5	9.5 - 11.4	1,275
Diabetes	10.0	9.2 - 10.9	1,254	10.8	10.0 - 11.6	1,742
Ever had Heart Attack	6.0	5.3 - 6.8	690	6.1	5.4 - 6.7	914
Coronary Heart Disease	5.8	5.1 - 6.4	705	5.9	5.2 - 6.5	888
Ever had a Stroke	3.5	3.0 - 4.0	468	3.9	3.3 - 4.5	610
Overweight (BMI 25.0 - 29.9)	35.7	33.7 - 37.7	2,706	36.1	34.6 - 37.6	3,595
Obese (BMI ≥30)	31.8	30.0 - 33.6	2,534	30.4	28.9 - 31.8	3,280

All percentages are weighted to population characteristics.

Wt. % = Weighted %

UnWt. N= Unweighted N (number of respondents)

95% CI = 95% Confidence Interval

Table 4: Prevalence estimates of health status, and health care access, Kentucky BRFSS, 2010 and 2011

Health Status, and Health Care Access	2010			2011		
	Post-stratification Weights <i>Landline Only</i>			New Raking Weights <i>Landline and Cell Phone</i>		
	Wt. %	95% CI	UnWt. N	Wt. %	95% CI	UnWt. N
Fair or Poor General Health	21.5	20.1 - 22.9	2,458	22.4	21.2 - 23.6	3,209
Disability: Activity Limitation	25.0	23.5 - 26.4	2,666	29.3	27.9 - 30.7	3,485
Health Care Coverage (all adults)	83.1	81.5 - 84.7	7,019	81.4	80.1 - 82.8	9,467
Health Care Coverage (age 18-64)	79.7	77.7 - 81.7	4,347	77.7	76.1 - 79.4	5,925
Could Not Afford to See Doctor	17.2	15.7 - 18.7	1,229	19.4	18.1 - 20.7	1,742
Routine Check-up in Past Year	63.5	61.6 - 65.5	5,702	66.2	64.7 - 67.7	7,844

Table 5: Prevalence estimates of immunization, and HIV screening test, Kentucky BRFSS, 2010 and 2011

Immunization, and HIV Screening Test	2010			2011		
	Post-stratification Weights <i>Landline Only</i>			New Raking Weights <i>Landline and Cell Phone</i>		
	Wt. %	95% CI	UnWt. N	Wt. %	95% CI	UnWt. N
Had Flu Shot in Past year	42.7	40.8 - 44.6	3,905	39.2	37.7 - 40.7	4,643
Had Flu Shot in Past year (age 65+)	67.7	65.2 - 70.2	1,717	64.2	61.6 - 66.8	1,992
Ever had Pneumonia Vaccine	28.0	26.3 - 29.7	2,862	31.8	30.3 - 33.3	3,817
Ever had Pneumonia Vaccine (age 65+)	64.6	61.9 - 67.3	1,656	70.0	67.6 - 72.4	2,130
Ever Been Tested for HIV (age 18-64)	37.7	35.3 - 40.1	1,663	30.4	28.8 - 31.9	2,426

All percentages are weighted to population characteristics.

Wt. % = Weighted %

UnWt. N= Unweighted N (number of respondents)

95% CI = 95% Confidence Interval

Figure 1: Health risk behaviors — Percent changes in 2011 prevalence estimates (raking weights, landline & cell phone) compared to 2010 prevalence estimates (post-stratification weights, landline only), KY BRFSS

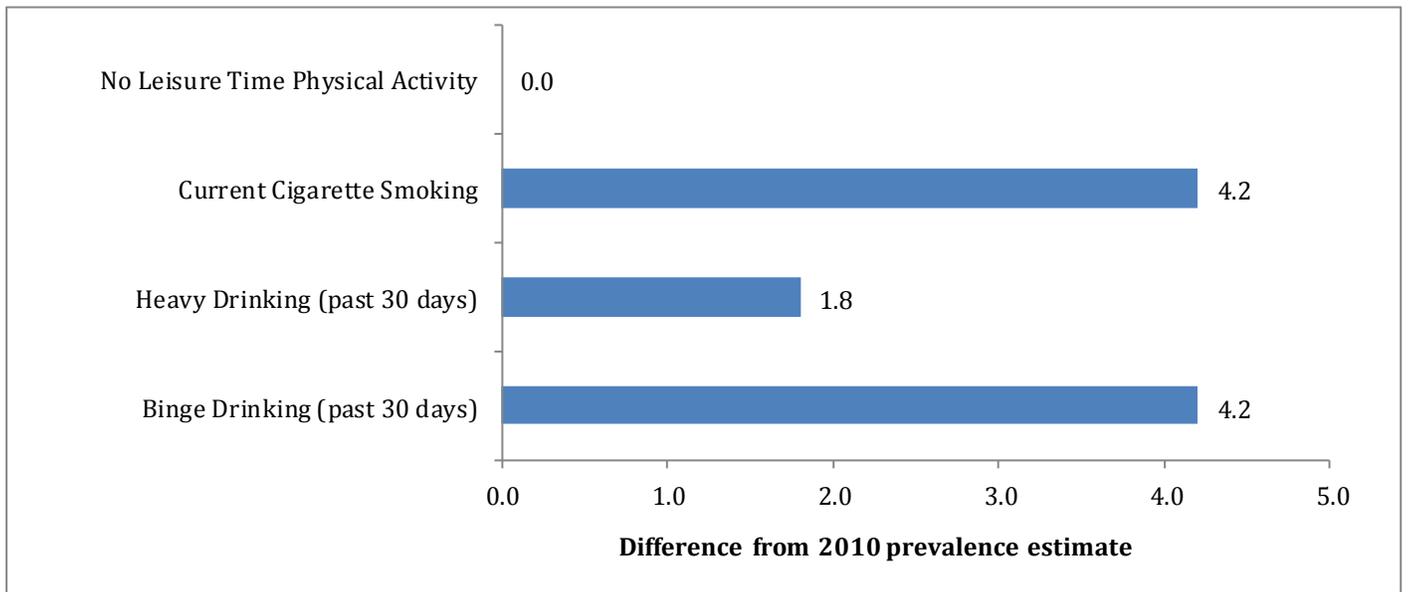


Figure 2: Chronic conditions — Percent changes in 2011 prevalence estimates (raking weights, landline & cell phone) compared to 2010 prevalence estimates (post-stratification weights, landline only), KY BRFSS

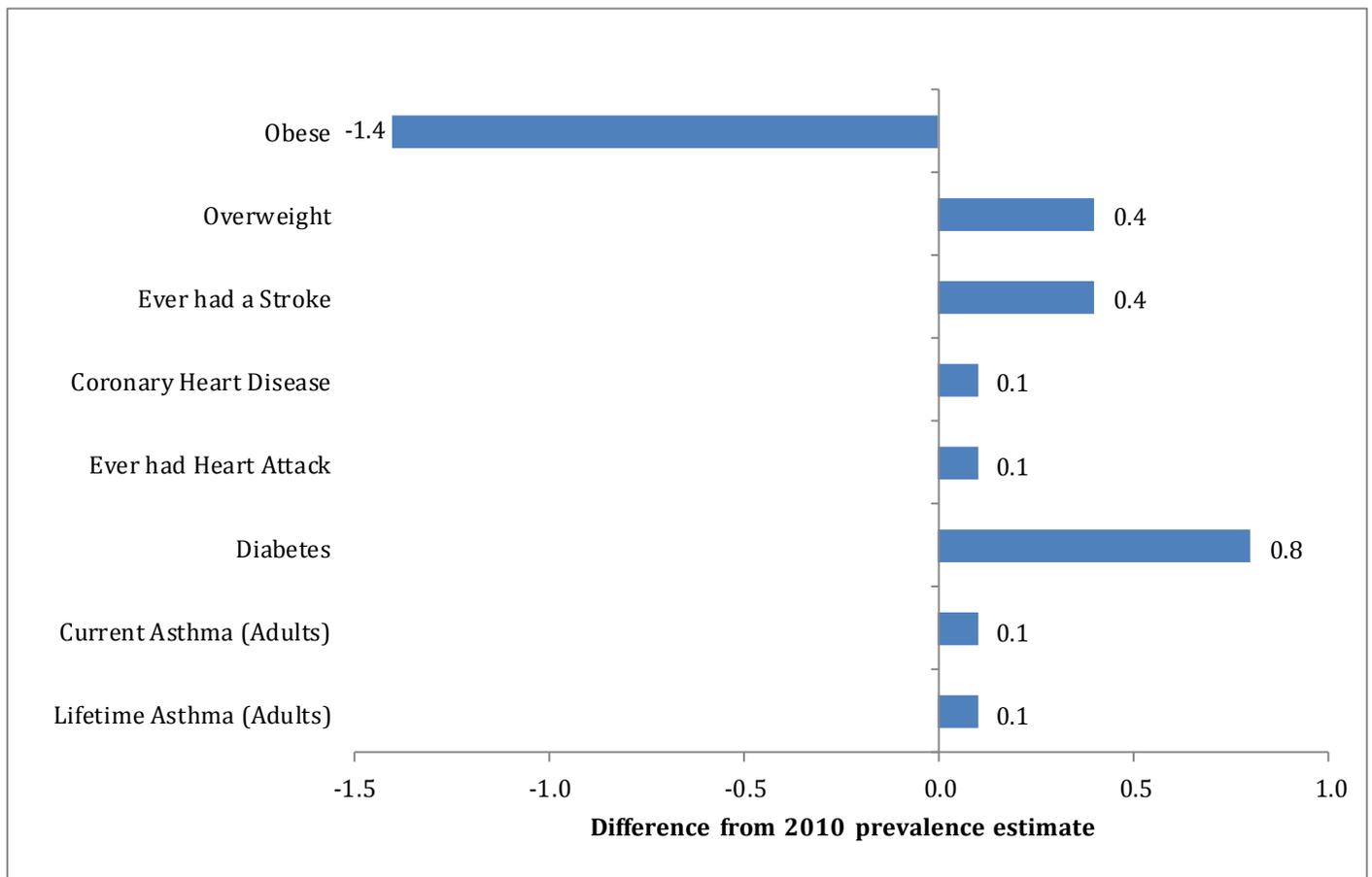


Figure 3: Health status, and health care access — Percent changes in 2011 prevalence estimates (raking weights, landline & cell phone) compared to 2010 prevalence estimates (post-stratification weights, landline only), KY BRFSS

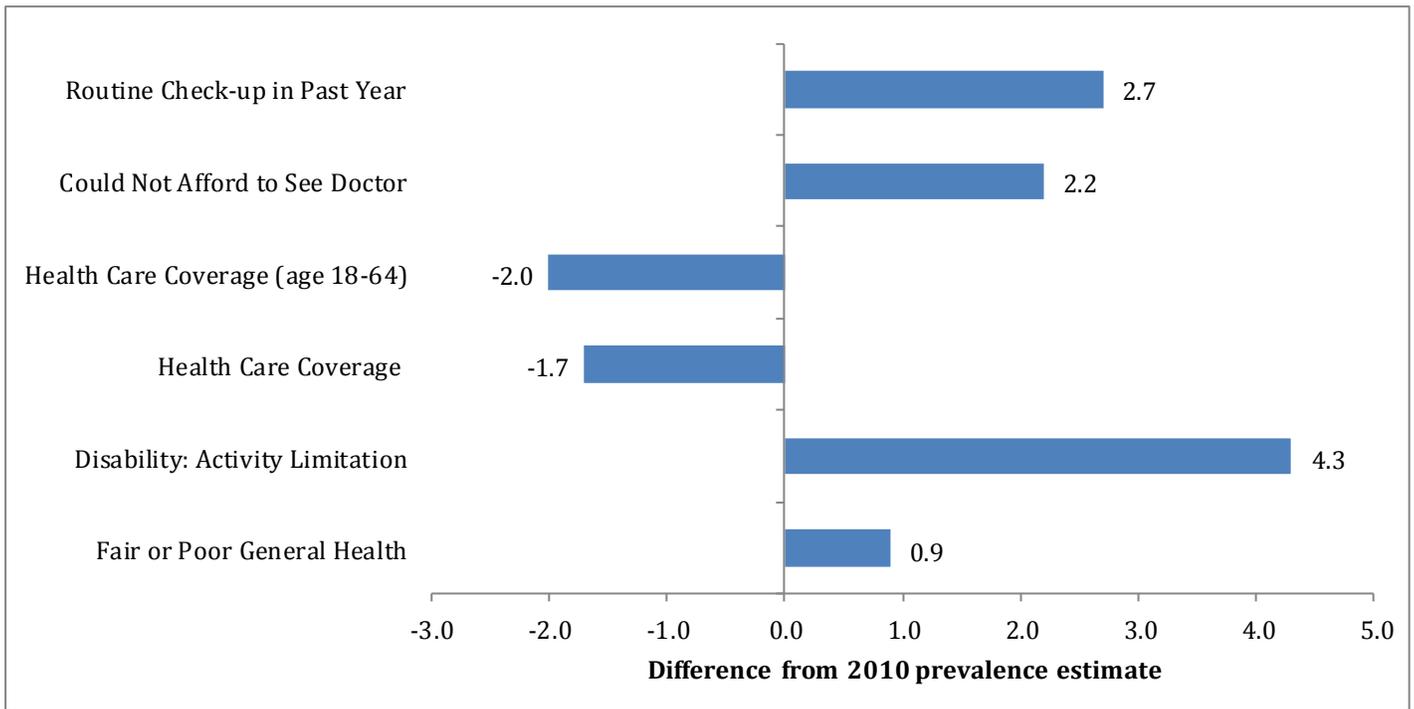
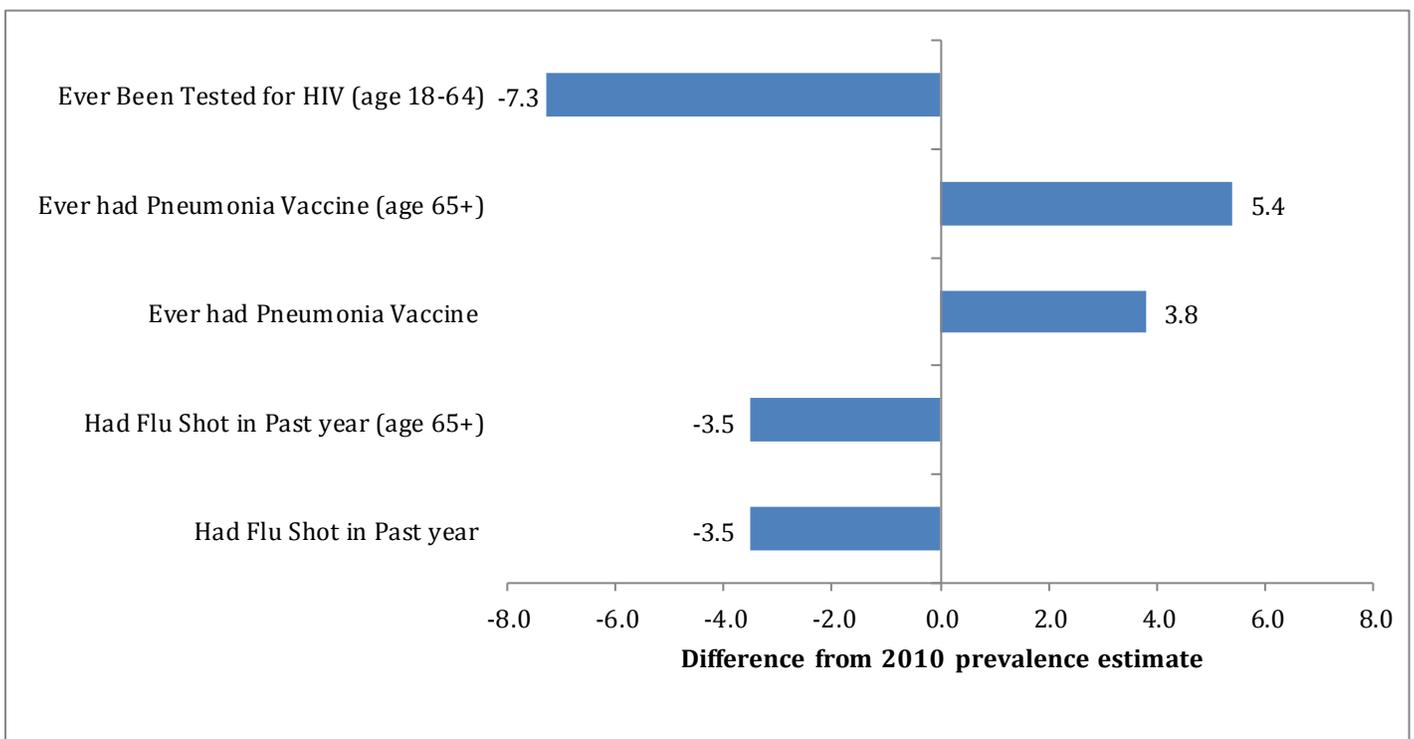


Figure 4 : Immunization, and HIV screening test — Percent changes in 2011 prevalence estimates (raking weights, landline & cell phone) compared to 2010 prevalence estimates (post-stratification weights, landline only), KY BRFSS



Survey Limitations:

The BRFSS relies on self-reported data. This type of survey has certain limitations: many times, respondents have the tendency to underreport some behaviors that may be considered socially unacceptable (e.g., smoking, heavy alcohol use); conversely, respondents may over report behaviors that are desirable (e.g., physical activity, nutrition). Cross-sectional design makes causal conclusions impossible. In addition, the sample sizes used to calculate the estimates in this report vary as respondents who indicated, “don’t know,” “not sure,” or “refused” were excluded from most of the calculation of prevalence estimates. BRFSS data collected through 2008 excludes households without landline telephones.

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Endnotes:

1. Centers for Disease Control and Prevention, Division of Behavioral Sciences. Understanding the Impact of Changes in BRFSS Weighting Protocols. Atlanta, GA. Accessed on upload/download site: <https://apps.nccd.cdc.gov/BRFSSStates/LoginV.ASP>

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4. Town M, Bartoli W. Weighting BRFSS Dual Frame Data. 2011 Behavioral Risk Factor Surveillance Conference, March 20, 2011, Atlanta, GA.

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6. Centers for Disease Control and Prevention (CDC). Methodologic changes in the behavioral risk factor surveillance system in 2011 and potential effects on prevalence estimates. MMWR Morb Mortal Wkly Rep. 2012 Jun 8;61:410-3.