

ARTICLES

Health Behaviors and Chronic Conditions of Movers: Out-of-state Interviews Among Cell Phone Respondents, BRFSS 2014

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Since 2011, the Behavioral Risk Factor Surveillance System (BRFSS) has been conducting telephone surveys using landline and cell phones from all U.S. states. Due to the portability of cell phones, residents in one state can retain cell phone numbers with area codes from other states. Protocol dictates that BRFSS must interview such out-of-state respondents to complete the core BRFSS interview and collected data must then be transferred to the state of current residence. We used cell phone data from 2014 BRFSS to compare the demographic factors, health care access, health behaviors, history of chronic disease, and chronic conditions among out-of-state interview (movers) with those respondents whose cell phone numbers matched their current state of residence (did not move). The estimated weighted population percentage of movers was 10% nationwide and ranged from 1.5% in Hawaii to 21.0% in Nevada (median: 5.8%). Compared with respondents who did not move, movers were significantly more likely to be younger, white non-Hispanic, college graduate, never married, and more likely to have health care coverage. After adjusting for demographics, movers were 16% less likely to report no leisure time physical activity, 17% less likely to smoke, 7% less likely to be overweight or obese, 33% less likely to report diabetes, and 12% less likely to report having arthritis than respondents who did not move. Persons who might be left out of cell phone samples due to moving in or out of state may therefore represent a potential for bias in estimation of health behaviors and chronic conditions where transfer of data across state lines is not possible.

Introduction

In the United States, telephone surveys had traditionally been conducted with landline telephones only. With declining response rates in landline phone surveys and increasing use of cell phones, telephone surveys have had to add cell phones into their samples to reduce nonresponse and undercoverage bias. However, cell phone respondents are difficult to reach due to safety concerns (such as driving while using); technology barriers (caller ID, call blocking); and number portability (Kempf and Remington 2007). Earlier surveys that included cell phone respondents were more expensive than similar surveys conducted by landline phone only (Guterbock et al. 2011). Currently, cell phone numbers are not tied to respondents' residence or locations, so some of the numbers in the cell phone sample could reach respondents who

have moved out of the sampling geography. Therefore, persons who might otherwise be excluded from cell phone samples due to moving may represent a potential for bias in cell phone surveys. Although screening questions can remove respondents from sample jurisdictions where they no longer reside, using them in the sample can make sampling less efficient and will contribute to coverage error (Lavrakas et al. 2007). Incorporation of persons who have moved into a sampling geography is more difficult and can open the door to undercoverage of populations.

Earlier studies have examined the sociodemographic characteristics of this mobile population and its effect on cell-phone sampling and survey estimates. (Christian, Dimock, and Keeter 2009) assessed whether the sample information from cell phone samples matched geographic data derived from respondents' self-reported zip codes. They estimated the geographic inaccuracy rates for cell phone samples (cell only, cell mostly, and landline mostly or dual users) for all adult users to be 6% at the census region level, 10% at the state level, and 41% at the county level. Similarly, (Skalland and Khare 2013) estimated the national geographic inaccuracy (as sampling state vs. true state) of cell phone samples for adults in cell-only households to be 11.5% at the national level, with inaccuracy rates varying widely among states. (Marken, Chattopadhyay, and Chan 2016) reported an increase in cell phone mobility (described as "overcoverage" and "undercoverage") across states from 2013. The out-of-state respondents were more likely to be male, young, non-Hispanic white, college graduate, have high income, live in a household with no children, and living in Northeast census region (Christian, Dimock, and Keeter 2009; Marken, Chattopadhyay, and Chan 2016; Skalland and Khare 2013). Inaccuracy in cell telephone sampling or over- and undercoverage possesses a significant challenge in sampling, increases the costs of surveys, and can increase the variance (Skalland and Khare 2013) of state-level survey estimates.

The Behavioral Risk Factor Surveillance System (BRFSS) is an ongoing, state-based, random-digit dialed telephone survey of noninstitutionalized adults aged ≥ 18 years residing in the United States. BRFSS had traditionally been conducted with landline phones only but has been conducting a dual-frame telephone survey using both landline and cell phones since 2011. Because the BRFSS draws samples independently from each state, protocols dictate that when cell phone respondents indicate they do not reside in the sampled state, a core portion of the interview is conducted and data are transferred to the state of current residence; therefore, the number of persons who have moved into and out of each state while retaining their cell phone numbers can be tracked. The purpose of this study was to compare respondents whose sampling state differs from the state of residence by moving in or out of the sampled state (movers) with other respondents (did not move) using the 2014 BRFSS cell phone data.

Methods

The BRFSS completes interviews of all cell phone respondents who are adults, using overlapping sample frames. Persons contacted by cell phone are eligible even if they also have landline phones. We compared movers with respondents who did not move from cell phone survey by demographic factors, health care access, health status, health behaviors and chronic disease and conditions.

Two questions in the screening section of the BRFSS determined whether the respondent was in the correct sample. Respondents were asked whether they live in the sample state, and if they responded no, they were then asked about their state of residence. Data from out-of-state interviews were then transferred to the appropriate states at the end of each data-collection period and weighted to the state population. Due to lack of data on movers in the samples of Vermont (VT), Minnesota (MN), and the District of Columbia (DC), they were excluded from some of the analyses.

Demographic factors included gender (male and female); six age groups (18–24, 25–34, 35–44, 45–54, 55–64, and 65 or older); race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic, and other non-Hispanic); four categories of educational attainment (< high school, high school/GED, some post high school, and college graduate); and marital status (married or member of an unmarried couple, previously married, never married). General health status was dichotomized into good (included excellent, very good, or good health) and fair or poor health. Health-care coverage was defined as respondents having reported that they had private health insurance or prepaid plans among adults 18–64 years. Respondents who had one or more personal doctor or health care provider(s) were categorized to have specific source(s) of ongoing care.

No leisure time physical activity was defined from the respondents' indication of no participation in any physical activities or exercise (e.g., running, calisthenics, golf, gardening, or walking for exercise) other than their regular job during the preceding month. Respondents were classified as current smokers if they reported having smoked at least 100 cigarettes during their lifetime and indicated that they smoked every day or some days at the time of survey participation. Binge drinking was defined for men aged ≥ 18 years as having on average 5 or more drinks during one occasion and for women aged ≥ 18 years as having on average 4 or more drinks on one occasion during the preceding month. Self-reported weight and height were used to calculate body mass index (BMI) into categories of overweight and obese. We also looked at some self-reported chronic disease conditions including ever having arthritis, ever being diagnosed with diabetes or asthma, and/or depressive disorders. (For a full set of BRFSS questions and calculated variables, see Centers for Disease Control and Prevention 2015).

Respondents who did not answer, or refused, or answered “Do not know/not sure” to any study variables were excluded from analyses. SUDAAN (release 11.0, Research Triangle Institute, Research Triangle Park, NC) was used to account for the complex sample design of BRFSS. Chi-square tests ($P \leq 0.05$) were used to compare groups of respondents. The unadjusted and adjusted (for demographics—sex, age, race/ethnicity, education, and marital status) prevalence ratio (PR) were obtained using LOGLINK (log-binomial) procedures to test the association of movers with health behaviors and chronic conditions.

Results

Data from 162,880 cell phone interviews were available from 2014 BRFSS for analyses. There were 10.1% out-of-state interviews ($N = 10,103$); 54% of them were male, 43% aged 18 to 34 years, 12% were black non-Hispanic, 20% were Hispanics, 25% were college graduates, and nearly 50% were married or member of an unmarried couple (Table 1). The estimated weighted population percentage of movers widely varied among participating states and ranged from 1.5% in Hawaii to 21.0% in Nevada, with a median of 5.8% (not shown in Table 1).

Compared with the respondents who did not move, movers were significantly more likely to be younger, disproportionately white non-Hispanics, college graduates, never married, and were more likely to have health care coverage. Movers were less likely to report poor health and a specific source for care than their counterparts did (Table 1). A significant difference (<0.05) persisted between movers and who did not move for demographic factors including age, race/ethnicity, education, marital status, health status, health care coverage (for 18 to 64 years), and specific source of care.

We extended our analyses to include health behaviors, history of chronic disease and chronic conditions (Table 2). Movers were significantly less likely to report no leisure time physical activity, to be current cigarettes smoker, overweight or obese, had been diagnosed with diabetes or arthritis or depression than those who did not move. However, movers were significantly more likely to binge drink than their counterpart.

We have also calculated the unadjusted prevalence ratio and adjusted prevalence ratio (APR) for movers. After adjusting for demographics, movers were 16% less likely (APR = 0.84 95% confidence interval [0.78–0.91]) to report no leisure time physical activity, 17% less likely (APR = 0.83 [0.77–0.89]) to be current cigarettes smoker, 7% less likely (APR = 0.93 [0.91–0.96]) to be overweight or obese, 33% less likely (APR = 0.77 [0.68–0.87]) to report diabetes, and 12% less likely (APR = 0.88 [0.83–0.95]) to report arthritis compared to respondents who did not move.

Table 1 Demographic factors, health status, and health care access among movers and respondents who did not move, Behavioral Risk Factor Surveillance System (BRFSS) cell telephone survey 2014.

	All cell phone adults			Did not move (N = 152,777)			Movers (N = 10,103)		
	N	%	95% CI	N	%	95% CI	N	%	95% CI
Total	-	-	-	152,777	89.9	(89.6–90.1)	10,103	10.1	(9.9–10.4)
Gender									
Male	80,572	53.8	(53.4–54.2)	75,346	53.7	(53.2–54.1)	5,226	55.1	(53.6–56.5)
Female	82,308	46.2	(45.8–46.7)	77,431	46.4	(45.9–46.8)	4,877	44.9	(43.5–46.4)
Age group *									
18–24 years	18,237	18.6	(18.2–19.0)	16,658	18.2	(17.8–18.6)	1,579	22.1	(20.8–23.4)
25–34 years	29,367	24.9	(24.5–25.3)	26,251	23.7	(23.3–24.1)	3,116	35.2	(33.8–36.6)
35–44 years	25,902	18.2	(17.9–18.6)	24,319	18.4	(18.0–18.8)	1,583	16.7	(15.6–17.8)
45–54 years	29,958	16.1	(15.8–16.5)	28,823	16.9	(16.6–17.3)	1,135	9.2	(8.4–10.0)
55–64 years	30,833	12.4	(12.1–12.7)	29,590	12.8	(12.6–13.1)	1,243	8.7	(8.0–9.5)
65 or more years	26,917	9.8	(9.5–10.0)	25,577	9.9	(9.7–10.2)	1,340	8.2	(7.5–8.9)
Race/ Ethnicity *									
White non-Hispanic	119,067	58.1	(57.7–58.6)	11,561	57.3	(56.9–57.8)	7,506	65.1	(63.5–66.6)
Black non-Hispanic	12,163	12.5	(12.1–12.8)	11,553	12.8	(12.5–13.1)	610	9.3	(8.4–10.2)
Hispanic	16,365	20.1	(19.7–20.5)	15,674	21.1	(20.7–21.5)	691	11	(10.0–12.2)
Other non-Hispanic	12,689	9.4	(9.1–9.7)	11,581	8.8	(8.5–9.1)	1,108	14.6	(13.4–15.9)
Education *									
< High school	13,061	16	(15.6–16.4)	12,682	17	(16.6–17.5)	379	7.3	(6.4–8.4)
High school/ GED	43,863	27.8	(27.4–28.2)	41,974	28.5	(28.1–28.9)	1,889	20.9	(19.8–22.1)
Some post high school	46,261	31.6	(31.2–32.1)	43,662	31.6	(31.1–32.0)	2,599	32.1	(30.6–33.5)
College graduate	58,198	24.6	(24.3–24.9)	53,054	22.9	(22.5–23.2)	5,144	39.7	(38.4–41.1)
Marital status *									
Married †	93,019	49.9	(49.4–50.3)	87,515	50.1	(49.6–50.5)	5,498	48.4	(47.0–49.9)
Previously married	33,407	18.3	(18.0–18.7)	31,746	18.7	(18.4–19.0)	1,661	15	(14.0–16.1)
Never married	34,940	31.8	(31.3–32.2)	32,106	31.2	(30.8–31.7)	2,834	36.6	(35.1–38.0)
Health status and health care coverage									
Reported fair or poor health *	25,210	16.4	(16.1–16.8)	24,236	17.3	(16.9–17.6)	974	9.1	(8.3–10.0)
Had health care coverage 18–64 yrs. *	113,302	79.4	(79.0–79.8)	105,749	78.8	(78.4–79.3)	7,553	84.6	(83.4–85.8)
Had specific	124,152	69.4	(69.0–69.8)	117,605	70.5	(70.1–71.0)	6,547	59.5	(58.0–61.0)

source of care *	All cell phone adults	Did not move	Movers
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CI = Confidence interval.

*Factors significantly different between movers and respondents who did not move (chi-square test P-value <0.05).

† Married or member of an unmarried couple.

Table 2 Association of health behaviors and chronic conditions with movers and respondents who did not move, BRFSS cell telephone survey 2014.

Health behaviors and chronic conditions	Did not move	Movers
No leisure time physical activity		
Prevalence (%) *	23.3 (22.9–23.7)	15.2 (14.1–16.4)
UPR (95% CI) †	Referent	0.65 (0.61–0.70)
APR (95% CI) ‡	Referent	0.84 (0.78–0.91)
Current cigarette smoker		
Prevalence (%) *	20.3 (19.9–20.7)	14.8 (13.8–15.9)
UPR (95% CI) †	Referent	0.73 (0.68–0.79)
APR (95% CI) ‡	Referent	0.83 (0.77–0.89)
Engaged in binge drinking		
Prevalence (%) *	19.8 (19.4–20.2)	23.8 (22.6–25.1)
UPR (95% CI) †	Referent	1.20 (1.14–1.28)
APR (95% CI) ‡	Referent	1.05 (0.99–1.11)
Diagnosed with arthritis		
Prevalence (%) *	19.4 (19.0–19.7)	13.4 (12.5–14.4)
UPR (95% CI) †	Referent	0.69 (0.64–0.75)
APR (95% CI) ‡	Referent	0.88 (0.83–0.95)
Overweight or obese		
Prevalence (%) *	63.4 (62.9–63.9)	54.2 (52.7–55.7)
UPR (95% CI) †	Referent	0.85 (0.83–0.88)
APR (95% CI) ‡	Referent	0.93 (0.91–0.96)
Had diabetes		
Prevalence (%) *	8.2 (8.0–8.5)	4.4 (3.9–4.9)
UPR (95% CI) †	Referent	0.53 (0.47–0.60)
APR (95% CI) ‡	Referent	0.77 (0.68–0.87)
Ever had asthma		
Prevalence (%)	13.8 (13.5–14.1)	13.4 (12.4–14.5)
UPR (95% CI) †	Referent	0.97 (0.90–1.05)
APR (95% CI) ‡	Referent	0.98 (0.90–1.06)
Ever had a depressive disorder		
Prevalence (%) *	17.8 (17.5–18.2)	15.6 (14.7–16.8)
UPR (95% CI) †	Referent	0.88 (0.82–0.94)
APR (95% CI) ‡	Referent	0.96 (0.89–1.02)

* P-value for the chi-square test is significantly different.

† UPR, unadjusted prevalence ratio.

‡ APR, adjusted prevalence ratio for sex, age, race/ethnicity, education and marital status.

Discussion

In the United States, 10% of adults who use cell phones live in a state that is different from their sampling state. This state-level estimate of movers is lower than the previous studies conducted by (Skalland and Khare 2013) but very similar to state-level inaccuracy of cell phone samples reported by (Benford et al. 2012) and (Christian, Dimock, and Keeter 2009). Previous studies on the inaccuracy of cell phone samples included cell phone-only households where interviews are attempted only for adults in cell phone-households not accessible through the landline sampling frame. However, the BRFSS uses an overlapping or take-all design (A.A.P.O.R. Cell Phone Task Force 2010) where interviews are attempted for adults in cell phone-households regardless of their landline usage. Like the findings of previous studies, our study suggests similar demographic characteristics of this mobile population. The out-of-state respondents were significantly more likely to be younger, disproportionately white non-Hispanics, college graduates, as well as never married; movers also were more likely to have health care coverage than individuals who did not move.

Our study is the first population-based study to explore the association between this mobile population and their health behaviors (e.g., smoking, physical activity); chronic disease (diabetes, arthritis); and chronic conditions (overweight and obesity). Results indicate that this mobile population are more physically active, not a current smoker, not overweight or obese, and have lower prevalence of depression, diabetes, and arthritis compared to those who did not move. Thus, not including the out-of-state respondents in any population-based cell phone survey may bias the estimates of leisure time physical activity, smoking status, binge drinking, and chronic conditions like diabetes, arthritis, and depression. According to (Skalland and Khare 2013), in a single-state telephone survey, excluding the out-of-state respondents will increase the cost of the survey, as more cell phone samples are needed to complete the target number of interviews. They suggested adding a measure of mobility in the weight adjustment to reduce potential noncoverage bias. Since BRFSS data is collected from all the states, and the out-of-state respondents are transferred to the state of residence, this protocol helps avoid the potential for bias more effectively than surveys limited to individual state or sets of states. However, other surveys that do not include this transfer of data are likely to suffer bias on estimates of health-related outcomes.

Limitations

Our study does have some limitations. Two states (VT and MN) and the DC did not complete the screening question to identify out-of-state persons within their samples. Differing sample sizes and sampling designs among the states may have also had an effect on the percentages, especially among persons moving into states.

Conclusion

As the U.S. population continues to rely on cell phones (Blumberg and Luke 2016), telephone surveys will continue to increase the proportion of cell phone interviews, or rely on cell phones exclusively. BRFSS will continue to monitor the demographics, health behaviors, and chronic disease and conditions among persons who kept their cell phone numbers after moving from one geographic location to another, as well as continue to track the locations of movers both in and out of states.

Disclaimer

The findings and conclusions in this article are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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