

Increasing Cell Phone Usage Among Hispanics: Implications for Telephone Surveys

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The population trend of dropping landline telephone service and switching to cellular phones is a well-known threat to landline random-digit-dialed telephone surveys, in which cell phone numbers are not part of the sample.¹⁻⁶ According to the National Health Interview Survey (NHIS), the rate of cell-only usage for the US adult (aged ≥ 18 years) general population was 27.8% in the second half of 2010, more than double the rate in 2007 (12.6%).⁷ This increasing cell-only usage implies that the proportion of the population without a landline telephone is much larger than when traditional landline random-digit-dialed surveys became popular in the 1970s. This decreases the proportion of the general population covered by the landline telephone frame, which is the listing of telephone numbers used to draw the samples. If we assume that those who have both cell and landline telephones but mostly use cell phones are difficult to reach over landline telephones, close to half of the adult population (45.2%) would be classified as unreachable via landline telephones.⁷

Greater cell phone usage also implies greater noncoverage bias. As defined in literature, the noncoverage problem arises from failure to include some elements of the population in the frame.⁸ Noncoverage bias is the difference in estimates derived from those who are covered by the frame and those who should be covered. It can also be calculated by multiplying the noncoverage rate and the difference between those who are covered and those who are not. For telephone surveys, bias may arise not only at the population level but also at the sub-population level when the cell-only users are not accounted for in the data collection.^{3,9} For example, for low-income young adults, ignoring cell-only users is likely to incur bias in health risk behavior variables, and for young adults in general, the estimates for alcohol consumption have been found to be subject to such noncoverage bias.^{3,9}

Objectives. We examined whether the widespread assumption that Hispanics are subject to greater noncoverage bias in landline telephone surveys because they are more likely than other ethnic groups to use cell phones exclusively was supported by data.

Methods. Data came from the 2010 National Health Interview Survey and the 2009 California Health Interview Survey. We considered estimates derived from surveys of adults with landline telephones biased and compared them with findings for all adults. Noncoverage bias was the difference between them, examined separately for Hispanics and non-Hispanic Whites.

Results. Differences in demographic and health characteristics between cell-only and landline users were larger for non-Hispanic Whites than Hispanics; cell usage was much higher for Hispanics than non-Hispanic Whites. The existence, pattern, and magnitude of noncoverage bias were comparable between the groups.

Conclusions. We found no evidence to support a larger noncoverage bias for Hispanics than non-Hispanic Whites in landline telephone surveys. This finding should be considered in the design and interpretation of telephone surveys. (*Am J Public Health.* 2012;102:e19–e24. doi:10.2105/AJPH.2012.300681)

Besides age and lifestyle characteristics, ethnicity/race is considered to be an important correlate of telephone usage. The cell phone usage rates differ by ethnicity/race, and often non-Hispanic Whites report a lower cell-only rate than do other groups. Among minority groups, Hispanics are associated with the highest cell-only rate.^{1,7,10} Figure A (available as a supplement to the online version of this article at <http://www.ajph.org>) summarizes cell phone usage estimates for the adult general population, Hispanics, and non-Hispanic Whites from the 2008, 2009, and 2010 NHIS, as reported in Blumberg and Luke.⁷ Hispanics consistently reported much higher cell-only and cell-mostly usage than the rest of the population. Their cell-only rate was close to 40%, and their combined cell-only and cell-mostly rate was higher than 55% in the second half of 2010, both about 13.4 percentage points higher than those of non-Hispanic Whites.

The documented difference in cell phone usage leads many researchers to believe that noncoverage bias is larger for Hispanics than for other ethnic groups. However, this belief

requires further investigation, because discussions about noncoverage bias need to address both noncoverage rates and differences between persons who are and are not covered by the frame.⁸ Even with a high noncoverage rate, noncoverage bias may be trivial, if those who are covered by the frame are similar to those who are not. The reverse is also true. A low noncoverage rate does not guarantee low noncoverage bias. It is therefore essential to evaluate noncoverage bias rather than merely accounting for noncoverage rates. We examined potential noncoverage bias in landline telephone surveys for Hispanics by assessing their telephone usage and associated health characteristics. We further compared telephone usage and noncoverage bias between Hispanics and non-Hispanic Whites in 2 independent data sources.

METHODS

We analyzed data from the NHIS 2010 and the 2009 California Health Interview Survey (CHIS).^{11,12} Both surveys collect data on a wide

range of health issues, but their coverage properties differ. The NHIS is a face-to-face survey. The coverage of the NHIS frame is not affected by telephone usage, and its data on telephone usage provide an opportunity to examine population-level health characteristics by phone usage. However, estimates may reflect theoretical noncoverage bias and may not reflect what would be observed in telephone survey practice, where nonresponse patterns may differ by respondents' telephone usage.^{13–15} For instance, those who use cell phones exclusively may be more cooperative if requested to participate in a survey on their cell phones than are dual users, introducing differential nonresponse. This may also vary by ethnicity/race.

Detection of Differential Responses

We used CHIS data to complement the NHIS data because the CHIS is the largest random-digit-dialed telephone health survey that uses a sample from a dual frame, combining both landline and cell phone numbers. We analyzed the CHIS data for potential effects of differential survey nonresponse by ethnic group. Differences in noncoverage between the NHIS and CHIS can be attributed to differential nonresponse. Results from the CHIS are likely to reflect the experiences of actual telephone surveys, which cannot be examined with the NHIS. (We also considered using the Behavioral Risk Factor Surveillance System as an additional source. As of 2010, its samples were drawn from the landline-only frame, except for a pilot cell-only sample in 2010 that was not publicly available.)

For simplicity, we analyzed data for Hispanics and non-Hispanic Whites aged 18 years and older and excluded other groups. The NHIS 2010 interviewed 5158 Hispanic and 15 570 non-Hispanic White adults. The CHIS 2009 had 8156 Hispanic and 30 965 non-Hispanic White adult respondents.

We used the NHIS standard classification of telephone usage to group the sample into cell-only, dual, and landline-only users. The dual users were further classified as cell mostly, landline–cell equally, and landline mostly. (Although NHIS reports use the term *wireless telephones*, we used *cell phones* instead to maintain the actual wording of questions in the survey.)

Analysis

We first examined the following demographic characteristics associated with telephone usage separately for Hispanics and non-Hispanic Whites: gender, age, education, income, housing ownership, and family structure. We further examined the relationship between demographics and telephone usage in a multivariate logit model separately for Hispanics and non-Hispanic Whites to determine whether the same set of demographic variables was related to phone usage and whether the level of relationship differed between the 2 groups.

We then examined key health variables: chronic conditions (ever diagnosed with asthma, diabetes, or hypertension), health risk behaviors (smoking, binge drinking, and obesity), and health care access (health insurance coverage, having a usual source of care, and getting a flu shot in the past year). We compared these characteristics across telephone usage groups by ethnicity. We considered that the landline frame covered all landline users, both landline-only and dual users, but not cell-only users. We further considered the estimates based only on data from landline users as biased, demonstrating what would have happened if those who had only cell phones were ignored in a telephone survey. We calculated the benchmark unbiased estimates from the full sample, which comprised all adults regardless of telephone usage. The difference between the biased and benchmark estimates was the bias. We separately examined bias for Hispanics and non-Hispanic Whites to test how differential landline coverage rates translated into magnitudes of noncoverage bias.

Because the CHIS asked questions on telephone usage similar to those in the NHIS, we used the same classification of usage groups. We examined noncoverage bias on a wide range of health variables, such as mental health and delay in health care, in addition to the factors analyzed with the NHIS data. Because the CHIS is a telephone survey, we expected results to reflect differential nonresponse patterns by telephone usage and ethnicity. One assumption was that the theoretical noncoverage bias by ethnicity examined with the NHIS at the national level would hold true at the state level. Although no data were available to assess

this assumption, we had no reason to believe, for example, that Hispanic cell-only users in California would have sufficiently different characteristics than Hispanic cell-only users in United States as a whole to produce differential noncoverage bias.

We accounted for the complex nature of sampling in both the NHIS and CHIS in all analyses by using appropriate adjustment weights and incorporating sample design information. We used SAS version 9.2 (SAS Institute, Cary, NC) for the analysis. All estimates were weighted by the final adjustment weight, in which the selection probabilities and adjustments for nonresponse and noncoverage were considered. A description of the technical aspect of dual-frame weighting in the CHIS is available elsewhere.¹⁴

RESULTS

Most Hispanics and non-Hispanic Whites in the United States reported having either cell or landline telephones (97.8% and 99.1%, respectively). Figure B (available as a supplement to the online version of this article at <http://www.ajph.org>) presents telephone usage by ethnicity. Non-Hispanic Whites reported a higher rate of landline usage than did Hispanics (74.6% vs 61.3%); they were more likely to be covered by landline telephone frames. Hispanics were less likely than their counterparts to be dual users, owning both landline and cell phones (50.4% vs 64.0%).

Demographic Characteristics

We first examined demographics by phone usage. Table 1, with cell-only users as the comparison group, presents estimates for the comparison group and the differences between the comparison and other telephone usage groups separately for Hispanics and non-Hispanic Whites. Overall, cell-only users differed significantly from both dual and landline-only users regardless of ethnicity. Dual users were less likely than cell-only users to be male, young, low in educational status, poor, living alone, and unmarried, but more likely to own homes. Landline-only users were similar to dual users except that they were less educated, poorer, more likely to live alone, and less likely to have children in the household than were cell-only users.

TABLE 1—Demographic Characteristics of Cell-Only Users and Difference From Dual and Landline-Only Users Among Hispanic and Non-Hispanic White Adults: National Health Interview Survey, 2010

Characteristic	Hispanics			Non-Hispanic Whites		
	Cell Only (n = 2003), % or No.	Difference Between Cell Only and Dual	Difference Between Cell Only and Landline Only	Cell Only (n = 4142), % or No.	Difference Between Cell Only and Dual	Difference Between Cell Only and Landline Only
Male	54.5	-4.7**	-6.5**	52.2	-4.7***	-7.9***
Aged 18-34 y	54.4	-19.1***	-25.1***	53.6	-34.6***	-42.0***
Education ≤ high school	63.5	-6.4***	11.2***	31.6	0.7	25.0***
Income < \$35 000	54.8	-21.2***	14.3***	40.2	-20.5***	19.2***
Home owner	35.6	28.2***	13.0***	48.1	38.1***	22.5***
Living alone	12.9	-7.2***	2.1	24.9	-13.3***	14.1***
Children in household	57.9	0.9	-9.8***	31.7	2.1*	-18.5***
Unmarried	53.5	-13.2***	-12.0***	59.4	-26.3***	0.5
Family size	3.4	0.6***	0.1	2.3	0.5***	-0.4***

* $P < .1$; ** $P < .01$; *** $P < .001$.

For most variables, when we compared the magnitude of differences, Hispanic cell-only users differed from other phone users less than did non-Hispanic White cell-only users. For example, age was a strong correlate of cell phone usage, and slightly more than 50% of cell-only users of both ethnic groups were between 18 and 34 years old. These rates were 19.1 percentage points and 25.1 percentage points lower for Hispanic dual and landline-only users, respectively. For non-Hispanic Whites, the respective figures were 34.6 and 42.0 percentage points lower. The differences between cell-only and other phone usage groups were much larger for non-Hispanic Whites than for Hispanics. We saw this discrepant pattern in home ownership, living alone, and the presence of children in the household.

We examined which of the characteristics shown in Table 1 were more strongly and significantly associated with phone usage status and whether the discrepancy between Hispanics and non-Hispanic Whites persisted after we controlled for all relevant variables in a multinomial logit model. The dependent variable was phone usage, with 3 categories: cell-only, dual, and landline-only users. For consistency, we used cell-only users as the reference group. We used the independent variables shown in Table 1. For both Hispanics and non-Hispanic Whites, gender, age, income, home ownership, and household structure appeared to be important correlates

of phone usage (Table A, available as a supplement to the online version of this article at <http://www.ajph.org>).

Age had the largest coefficient estimates and appeared to be the strongest independent correlate. Respondents aged 18 to 34 years were less likely than those aged 35 years and older to be dual or landline-only users. Overall, the coefficient estimates for non-Hispanic Whites tended to be larger than for Hispanics. The effect of age on both dual and landline-only phone usage was substantively and significantly larger for non-Hispanic Whites than for Hispanics. This suggested that age was a stronger determinant of telephone usage for non-Hispanic Whites than for Hispanics. Home ownership had a similar pattern, although not as striking as for age: effects were larger for non-Hispanic Whites' phone usage than for Hispanics'. These findings suggested that the demographic difference between cell-only users and other phone users was larger for non-Hispanic Whites than Hispanics.

Health Characteristics

We further compared health characteristics of dual and landline-only users with those of cell-only users for Hispanics and non-Hispanic Whites (Table 2). For both groups, cell-only users appeared healthier but more likely to engage in health risk behaviors, such as smoking and drinking, and less likely to have health insurance, which was reflected in a lower level of access to health care than reported by other

respondents. This seemed to reflect the age differences we found. The differences in most health characteristics were larger for non-Hispanic Whites than for Hispanics. For example, 19.4% of non-Hispanic White cell-only users and 17.3% of Hispanic cell-only users reported having been diagnosed with hypertension. Among Hispanics, hypertension rates were 6.9 and 15.5 percentage points higher for dual and landline users, respectively, than for cell-only users. For non-Hispanic Whites, the figures were much larger: 14.3 and 23.1 percentage points, respectively. Smoking and drinking characteristics also had a similar pattern, with larger differences between cell-only users and other types of telephone users among non-Hispanic Whites than Hispanics. However, for health insurance coverage and access to care, we found a larger gap across phone usage for Hispanics than for non-Hispanic Whites.

Landline telephone coverage was much lower for Hispanics than for non-Hispanic Whites (Figure A, available as an online supplement). Yet the differences between cell-only users and landline users (including both dual and landline-only users) were much larger for non-Hispanic Whites than for Hispanics for many variables (Table 2). A similar pattern emerged in estimations of noncoverage bias in health-related variables for Hispanics and non-Hispanic Whites (Table 3). We calculated the potential noncoverage bias by multiplying the differences between cell-only users and landline users with the noncoverage rate. This can

TABLE 2—Health Characteristics of Cell-Only Users and Difference From Dual and Landline-Only Users Among Hispanic and Non-Hispanic White Adults: National Health Interview Survey, 2010

Characteristic	Hispanics			Non-Hispanic Whites		
	Cell Only (n = 2003), % or kg/m ²	Difference Between Cell Only and Dual	Difference Between Cell Only and Landline Only	Cell Only (n = 4142), % or kg/m ²	Difference Between Cell Only and Dual	Difference Between Cell Only and Landline Only
Asthma ever	10.6	0.6	-4.1***	13.6	-0.8	-1.7*
Diabetes ever	7.2	3.9***	7.8***	4.2	5.0***	10.6***
Hypertension ever	17.3	6.9***	15.5***	19.4	14.3***	23.1***
Heart disease ever	3.3	-0.1	2.0*	5.6	4.0***	6.7***
Current smoker	14.6	-4.2***	-2.7	30.6	-13.6***	-7.9***
Binge drinking in past y	44.0	-7.5**	-10.1***	50.6	-19.3***	-23.5***
Obese	33.1	0.4	4.1*	25.9	4.7***	2.1
Body mass index	30.2	0.4	1.5*	28.9	1.4***	0.8*
Currently insured	51.7	18.0***	13.7***	78.1	12.8***	8.4***
No place to go when sick	40.1	-16.8***	-16.6***	24.5	-15.6***	-12.3***
Flu shot receipt, past y	28.6	9.2***	11.1***	36.1	20.3***	28.2***

*P < .1; **P < .01; ***P < .001.

also be calculated by taking the differences in the estimates derived from the full sample (i.e., all types of telephone users) and those who can be reached over landline telephones. If data collection were to exclude cell-only users, who are healthier but engage in more health risk behaviors and are less likely to have health insurance and access to care than their counterparts, the result would be biased, producing

poorer health status, less risk behavior, and higher health insurance coverage and access to health care than would be found in a sample that included cell-only users.

Overall, the size of such potential noncoverage bias appeared similar between Hispanics and non-Hispanic Whites. For hypertension, smoking, drinking, and flu shot receipt, we found a slightly larger bias for non-Hispanic

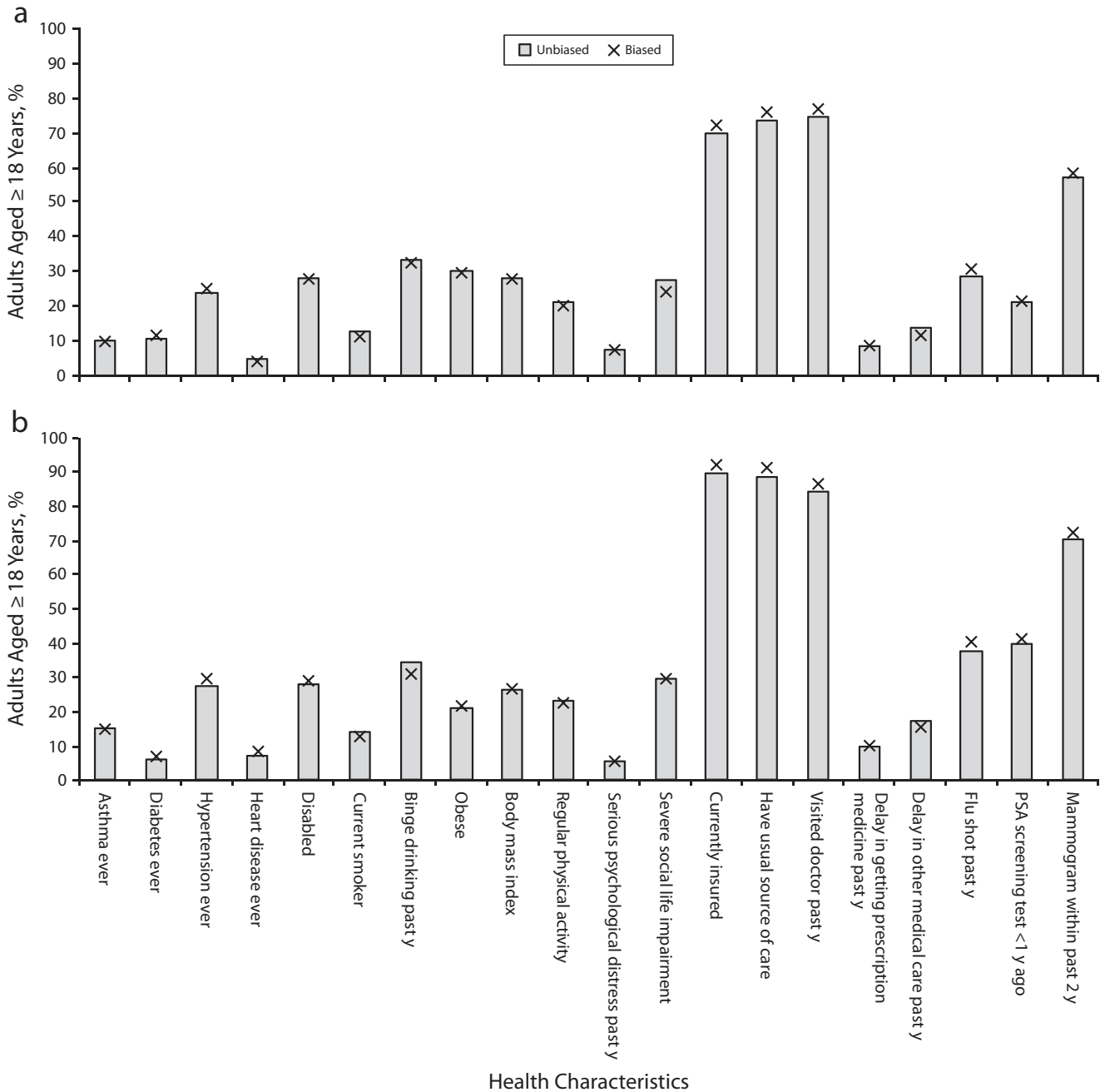
Whites than for Hispanics, but we observed an opposite pattern for heart disease, health insurance coverage, and access to care. Only heart disease and smoking variables showed statistically significant biases (results not shown). We also made weighting adjustments to the landline user group for the population distribution of age, gender, education, and home ownership to increase the representativeness

TABLE 3—Health Characteristic Differences Between Cell-Only, Landline, and All Users Among Hispanic and Non-Hispanic White Adults: National Health Interview Survey, 2010

Characteristic	Hispanics				Non-Hispanic Whites			
	Cell Only (n = 2003), % or kg/m ²	Landline (n = 2021), ^a % or kg/m ²	All (n = 5158), ^b % or kg/m ²	Bias Estimate	Cell Only (n = 4142), % or kg/m ²	Landline (n = 8623), ^a % or kg/m ²	All (n = 15 570), ^b % or kg/m ²	Bias Estimate
Asthma ever	10.6	9.7	10.2	0.5	13.6	12.7	12.8	0.2
Diabetes ever	7.2	12.8	9.9	-2.9	4.2	11.3	8.5	-2.8
Hypertension ever	17.3	27.3	22.4	-4.9	19.4	38.3	31	-7.3
Heart disease ever	3.3	4.1	3.5	-0.7	5.6	11.1	8.9	-2.2
Current smoker	14.6	10.6	12.5	1.8	30.6	17.0	21.1	4.1
Binge drinking in past y	44.0	33.4	38.9	5.5	50.6	27.4	36.6	9.2
Obese	33.1	34.8	33.7	-1.2	25.9	30.5	29.2	-1.3
Body mass index	30.2	30.9	30.8	-0.1	28.9	30.2	29.9	-0.2
Currently insured	51.7	67.9	61.8	-6.0	78.1	91.0	87	-3.9
No place to go when sick	40.1	22.8	30	7.2	24.5	8.5	13.4	4.9
Flu shot receipt, past y	28.6	39.4	34.3	-5.1	36.1	61.4	52.5	-8.9

^aBiased, both landline-only and landline-cell dual users.

^bUnbiased.



Note. PSA = prostate-specific antigen.

FIGURE 1—Distribution of unbiased and biased estimates for (a) Hispanic and (b) non-Hispanic White adults aged 18 years and older: California Health Interview Survey, 2010.

of landline users. The results were consistent with our main analysis (not shown).

If these theoretical phone usage groups in the NHIS responded to telephone survey requests at a similar rate for both ethnicities, the magnitude of noncoverage bias observed in

telephone survey practice would be comparable between Hispanics and non-Hispanic Whites. For example, if data from a telephone survey lead to a different estimate than is produced from the NHIS data, with its theoretically comparable noncoverage bias

between Hispanics and non-Hispanic Whites, this is likely attributable to differential non-response patterns between the 2 ethnicities. We examined this question with the CHIS data.

Telephone usage for the 2 groups was similar in the CHIS and NHIS: Hispanics

reported much higher cell phone usage than did non-Hispanic Whites (results not shown). About 1 in 4 Hispanic adults in California was a cell-only user; the rate for non-Hispanic Whites was fewer than 1 in 6. Hispanics were also more likely than non-Hispanic Whites to be landline-only users (21.8% versus 9.4%).

We also calculated biased and unbiased estimates for a series of health characteristics for Hispanics and non-Hispanic Whites separately and compared them (Figure 1). Echoing the results from the NHIS, the direction and magnitude of estimated bias were comparable between the 2 groups. Except for hypertension, binge drinking, and social life impairment, biases between Hispanics and non-Hispanic Whites differed by less than 1.0%. Comparability in noncoverage bias between Hispanics and non-Hispanics was similar in the CHIS and NHIS. The CHIS added a dimension of non-response bias that occurred in actual survey practice. Therefore, this comparability in the implications of noncoverage bias between the NHIS and CHIS suggested that nonresponse patterns by telephone usage group were equivalent between the 2 ethnic groups. Theoretical expectations for noncoverage bias appeared to be realized in practice.

DISCUSSION

A larger proportion of Hispanics than non-Hispanic Whites are excluded from telephone surveys that use only landline frames. This, however, does not necessarily mean that estimates for Hispanics are subject to a larger bias than those for non-Hispanic Whites. Our results showed that noncoverage bias was comparable between these 2 groups, because the differences in various demographic and health characteristics between cell-only users and other telephone users were much larger for non-Hispanic Whites than for Hispanics. Moreover, we observed this not only in data reflecting true population telephone usage, but also in data from an actual dual-frame, random-digit-dialed telephone survey.

Of course, not collecting data from cell-only users in telephone surveys is likely to result in noncoverage bias at varying levels by variable, as shown in Table 3 and Figure 1. Variables such as hypertension, binge drinking, health insurance coverage, health care access,

and flu shot receipt correlated with a higher level of noncoverage bias than did other variables, regardless of respondents' ethnic backgrounds.

The environment for telephone surveys is becoming more and more challenging, with lower landline coverage rates and higher non-response rates than at any time since telephone surveys became popular as a data collection vehicle. Hence, greater noncoverage and non-response bias are likely. Higher cell-only usage among Hispanics leads to the assumption that estimates for Hispanics from landline-only telephone survey data suffer from more non-coverage bias than those for non-Hispanic Whites. We found no evidence to support this assumption. Both noncoverage rates and the differences between those who are covered and those who are not should be considered in discussions of noncoverage bias. Inferring noncoverage bias from the coverage rate alone is likely to cause researchers not only to misinterpret survey results, but also to conduct surveys with flawed designs. ■

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This article was accepted January 3, 2012.

Contributors

S. Lee originated the study, conducted analyses, and led the writing of the article. M. Elkasabi contributed to conceptualizing ideas, analyzing the data, interpreting the results, and writing the article. L. Streja played a critical role in data analysis and provided feedback on the draft of the article.

Acknowledgments

We are grateful to the California Health Interview Survey for their support with the data.

Human Participation Protection

The study protocol was approved by the institutional review boards of the University of Michigan and the University of California, Los Angeles.

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