Assessing the feasibility and sample quality of a national random digit dial cell phone survey of young adults

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Abstract:

The majority of adults aged 18–34 years have only cellular phones, making random-digit dialing of landline telephones an obsolete methodology for surveillance of this population. However, 95% of this group has cellular phones. This article reports on the 2011 National Young Adult Health Survey (NYAHS), a pilot study conducted in the 50 US states and Washington, DC, that used random-digit dialing of cellular phones and benchmarked this methodology against that of the 2011 Behavioral Risk Factor Surveillance System (BRFSS). Comparisons of the demographic distributions of subjects in the NYAHS and BRFSS (aged 18–34 years) with US Census data revealed adequate reach for all demographic subgroups. After adjustment for design factors, the mean absolute deviations across demographic groups were 3 percentage points for the NYAHS and 2.8 percentage points for the BRFSS, nationally, and were comparable for each census region. Two-sided *z* tests comparing cigarette smoking prevalence revealed no significant differences between NYAHS and BRFSS participants overall or by subgroups. The design effects of the sampling weight were 2.09 for the NYAHS and 3.26 for the BRFSS. Response rates for the NYAHS and BRFSS cellular phone sampling frames were comparable. Our assessment of the NYAHS methodology found that random-digit dialing of cellular phones is a feasible methodology for surveillance of young adults.

Keywords: cellular phone | random-digit dialing | sample quality | sampling | single-frame sampling design | surveillance | survey methodology | young adults

Article:

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; NYAHS, National Young Adult Health Survey; RDD, random-digit dialing.

Young adults are a diverse population subgroup, making up 30.6% of the US adult population and, as such, are of importance to public health (1). Indeed, the transition to adulthood represents a challenging time of life when young adults may experiment with risky behaviors involving alcohol, tobacco, and drugs (2). Young adults have a relatively high mobility rate and move at more than twice the rate of all other adults (3). In addition, approximately 42.9% of those aged 18–24 years in the United States are enrolled in colleges or universities (4).

Such factors make it difficult to reach young adults for population research. For example, the Behavioral Risk Factor Surveillance System (BRFSS) saw a decline in its reach of young adults between 2001 and 2005 (5). Because of the challenges of reaching this population, common sampling designs have historically been either college-based surveys, which exclude the noncollege population, or household-based interviews of the adult population, which often exclude those living in college dormitories or other group living quarters (6). The limitations of this dichotomy are obvious; young adults in college differ notably from their noncollege counterparts in their health behaviors (2). Thus, either approach is likely to produce estimates of health indicators that are not representative of the general population of young adults.

Recent decades have seen a shift in telephone ownership from landlines to cellular phones. The shift from traditional household telephones to individual cellular phones has introduced a myriad of challenges for those conducting telephone-based research (7). Most notably, sampling coverage is problematic for landline random-digit dialing (RDD) telephone surveys, given that 34% of all adults and more than 50% of young adults now own only a cellular phone (8) and, thus, would not be reachable via a household landline. The subsequent impact of this on producing biased health estimates has been documented (5, 9–13).

A rapid increase in the prevalence of wireless telephone substitution among young adults has rendered traditional RDD sampling approaches obsolete for this population. Paradoxically, although the shift to cellular phones has created a challenge for traditional RDD sampling, it may actually prove to be beneficial with respect to sampling young adults. Almost all Americans live in an area covered by at least 1 wireless telephone service provider (14), and approximately 95% of those aged 18–29 years owned a cellular phone in 2012 (15). The high rate of cellular phone ownership may minimize and potentially eliminate sampling challenges for this population. Indeed, the rate of cellular phone coverage in this population subgroup is approximately equal to that of landline coverage in the late 1960s, which, combined with the standardization of telephone numbers, created a methodological shift from face-to-face surveying with area-based probability sampling to RDD as a dominant probability sampling approach. To this effect, we implemented the National Young Adult Health Survey (NYAHS) to assess the feasibility of using RDD of cellular phones only to reach those aged 18–34 years.

This article has 3 objectives. First, we summarize the NYAHS methodology, including its sampling design and weighting approach, survey development, and data collection. Second, we present an assessment of sample quality based on common survey response metrics. We benchmark the NYAHS against the 2011 BRFSS, which allows us to assess the quality of the NYAHS relative to a widely used RDD surveillance system that includes sampling of both landlines and cellular phones (16, 17). Finally, we discuss lessons learned from collecting data through this methodology. This is done in the context of broader issues and challenges for the practice of RDD cellular phone surveys. This should be of interest to researchers who are planning or using RDD surveys, particularly those with an interest in young adults or other populations with high cellular phone coverage rates.

METHODOLOGY OF THE NYAHS

Sampling

The NYAHS was designed to provide representative estimates of health behaviors stratified by US Census regions (Northeast, South, Midwest, and West) with random selection of cellular phone numbers from cellular-dedicated thousand-level blocks (NPA-NXX-Z000 to NPA-NXX-Z999) originating from the Telcordia Local Exchange Routing Guide (iconectiv, Piscataway, New Jersey). Because of the disproportionate stratified design, sampling weights were required. A base weight, which adjusts for unequal probabilities of selection, was calculated as the inverse of the ratio of numbers of cellular phones selected and the total number of cellular phones within each region. This value was divided by the number of working cellular phones each respondent owned.

In an ideal scenario, the base weight is sufficient adjustment and no further weighting is required because, once applied, the distribution of the sample will be very close to the population on key indicators. However, because of nonresponse and/or coverage error, a second stage of weighting (i.e., poststratification) is often necessary to bring the weighted sample distribution in line with the population. This adjustment allows analysts to calculate health estimates that are representative of the population. The NYAHS poststratification was calibrated to cellular phone users aged 18–34 years in the United States on the basis of the 2010 National Health Interview Survey (18) via an iterative raking procedure based on phone status (cellular only, cellular mostly, or true dual user), race/ethnicity, educational attainment, and age group within sex.

The precision of estimates from complex samples is based on effective rather than actual sample sizes. The effective sample size is the sample size divided by a design effect (i.e., the ratio of the variance under complex sampling vs. a simple random sample). The approximate design effects, calculated according to Kish (19), were 2.09 for the NYAHS and 3.26 for the BRFSS when restricted to those aged 18–34 years.

Instrumentation

The survey was primarily designed to collect data on tobacco use and cessation behaviors, brand preference, attitudes toward tobacco control policies, and susceptibility and exposure to tobacco advertising. In addition to asking about traditional tobacco products, the survey included questions about the awareness and use of electronic cigarettes, snus, and dissolvable tobacco. The survey also included questions about obesity and physical activity, internet and social media use, and several demographic characteristics. When possible, questions about tobacco use and cessation behaviors were adapted from standard tobacco surveys (6). New questions were pretested via telephone by using cognitive interviewing techniques (20). Pretest respondents were young adults of diverse backgrounds, including college students, non–college students, men, women, whites, blacks, and Latinos.

Data collection

Data were collected between June and November 2011 via computer-assisted telephone interviewing. Per Federal Communications Commission (Columbia, Maryland) requirements, interviewers manually dialed selected telephone numbers (21). A screening questionnaire was used to identify eligible participants, who were defined as adults between the ages of 18 and 34 years. A total of 2,871 interviews were completed.

Interviews were conducted in Spanish when language barriers were encountered. Interviews took an average of 16.8 minutes to complete and were comparable in length in both English and Spanish. Because of the pricing structure of cellular phone contracts, which may deduct minutes used from a monthly total or may charge on a "pay as you go" basis, participants were offered a $10 electronic gift card to a major online retailer as remuneration. The institutional review board at Rutgers Biomedical and Health Sciences approved the procedures.

ASSESSMENT OF SAMPLE QUALITY

Demographic benchmarking

A comparison of the demographic makeup of the NYAHS sample relative to the 2010 US Census is a useful indicator of sample quality. As noted previously, we make the same comparison for the 2011 BRFSS to assess the NYAHS relative to a widely used public health RDD surveillance system that samples both landlines and cellular phones. BRFSS comparisons were limited to participants aged 18–34 years, who represented 14.3% of all BRFSS participants in 2011.

National comparisons were made on unweighted and base-weighted samples, whereas only base-weighted comparisons were made by US Census region. The unweighted comparison allows for an assessment of how well the sampling methodology reached important population subgroups. Because the base weights adjust only for design factors, their application allows for isolation of the combined effects of coverage and nonresponse on the sample demographics. To assess the overall quality of the sample, we calculated the mean absolute deviation across sex, age, and racial/ethnic groups for the NYAHS and BRFSS relative to the US Census for the base-weighted comparisons. The mean absolute deviation was calculated by subtracting the sample proportion from the US Census proportion for each demographic subgroup, summing the absolute value of the deviations across all subgroups, and dividing by the number of subgroups.

Table 1 shows demographic distributions of participants in the NYAHS, BRFSS, and US Census. The unweighted comparisons show that all demographic subgroups were reached via the NYAHS; the distributions across demographic characteristics were close to those of the US Census, with the largest deviations occurring among the "other" racial/ethnic group (7.6% vs. 3.3%), Latinos (13.6% vs. 20.3%), and those aged 30–34 years (21.7% vs. 27.8%). The BRFSS demographic distribution similarly matched that of the US Census with deviations in the same demographic subgroups.

Table 1. National Demographic Distribution of Young Adults Aged 18–34 Years, 2010 US Census, 2011 NYAHS, and 2011 BRFSS

		Unweighted %		**Base-weighted %**	
Characteristic	**2010 US Census, %**	**NYAHS (*n* = 2,871)**	**BRFSS (*n* = 70,662)**	**NYAHS (*n* = 2,871)**	**BRFSS (*n* = 70,662)**
Sex					
Men	50.6	47.8	43.6	48.0	47.9
Women	49.4	52.2	56.4	52.0	52.1
Age group, years					
18–21	25.0	27.3	16.9	28.8	18.7
22–24	17.7	20.5	14.6	20.5	17.8
25–29	29.4	30.4	30.3	30.0	32.4
30–34	27.8	21.7	38.2	20.7	31.1
Race/ethnicity[a]					
White (non-Latino)	57.5	58.9	67.8	57.7	62.3
Black (non-Latino)	13.4	11.6	10.2	12.7	11.1
Latino	20.3	13.6	13.1	13.7	17.4
Asian	5.5	6.9	3.2	6.9	4.2
Other	3.3	7.6	6.0	7.7	5.0
Mean absolute deviation				3.0	2.8

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; NYAHS, National Young Adult Health Survey.

[a] NYAHS totals less than 100% because of 1.3% who declined to provide information on race/ethnicity.

After applying the base weights, we found that the NYAHS demographic distribution remained closely matched to that of the US Census with the largest deviations occurring for the “other” racial/ethnic group (7.7% vs. 3.3%), Latinos (13.7% vs. 20.3%) and those aged 30–34 years (20.7% vs. 27.8%). The BRFSS similarly matched the US Census, except for a notable deviation among those aged 18–21 years (18.7% vs. 25.0%). The mean absolute deviations relative to the US Census were 3 percentage points for the NYAHS and 2.8 percentage points for the BRFSS.

Table 2 presents the base-weighted demographic distributions for the NYAHS, BRFSS, and US Census by region. The NYAHS closely matched the US Census when evaluated by Census region. There were some notable deviations from the Census in the following demographic subgroups: those aged 30–34 years in all regions, those aged 18–21 years in the South (29.9% vs. 24.9%) and West (30.7% vs. 24.3%), and Latinos in the South (12.7% vs. 19.7%) and West (21.4% vs. 33.7%). The BRFSS showed similar patterns of deviation from the US Census, as did the NYAHS, except for a more closely matched distribution of Latinos. The mean absolute deviations for the NYAHS were 3.3 percentage points in the Northeast, 2.9 percentage points in the Midwest, 2.9 percentage points in the South, and 4.5 percentage points in the West. The mean absolute deviations for the BRFSS were 2.6 percentage points in the Northeast, 2.2 percentage points in the Midwest, 3 percentage points in the South, and 3.0 percentage points in the West.

Table 2. Demographic Distribution of Young Adults Aged 18–34 Years by US Census Region, 2010 US Census, 2011 NYAHS, and 2011 BRFSS

	Northeast Region, %			Midwest Region, %			South Region, %			West Region, %		
Characteristic	**2010 US Census**	**NYAHS (*n* = 698)**	**BRFSS (*n* = 13,117)**	**2010 US Census**	**NYAHS (*n* = 682)**	**BRFSS (*n* = 19,423)**	**2010 US Census**	**NYAHS (*n* = 777)**	**BRFSS (*n* = 19,968)**	**2010 US Census**	**NYAHS (*n* = 714)**	**BRFSS (*n* = 18,154)**
Sex												
Men	50.1	45.9	48.7	50.5	48.7	48.8	50.3	48.4	45.7	51.4	48.3	50.2
Women	49.9	54.1	51.4	49.5	51.3	51.3	49.7	51.7	54.3	48.6	51.6	49.8
Age group, years												
18–21	25.7	25.8	16.4	25.6	27.4	19.9	24.9	29.9	18.8	24.3	30.7	18.5
22–24	17.9	20.9	18.0	17.7	23.5	17.8	17.7	19.2	17.9	17.6	19.8	17.6
25–29	29.0	31.6	32.8	29.2	28.5	31.5	29.4	29.6	32.7	29.9	30.8	32.6
30–34	27.4	21.8	32.8	27.6	20.7	30.8	28.0	21.4	30.6	28.2	18.8	31.4
Race/ethnicity[a]												
White (non-Latino)	61.5	55.2	63.8	73.5	71.0	76.8	53.7	52.7	57.3	46.8	55.5	54.5
Black (non-Latino)	12.3	11.7	9.3	11.4	9.6	8.6	20.7	20.8	18.8	4.7	4.0	2.8
Latino	16.6	13.9	17.3	9.1	6.3	7.4	19.7	12.7	16.4	33.7	21.4	29.3
Asian	7.1	8.3	6.5	3.5	5.8	3.3	3.3	5.0	2.6	9.3	9.7	6.3
Other	2.6	9.0	3.1	2.5	6.2	3.9	2.6	7.5	5.0	5.5	8.4	7.1
Mean absolute deviation		3.3	2.6		2.9	2.2		2.9	3.0		4.5	3.0

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; NYAHS, National Young Adult Health Survey.
[a] NYAHS totals less than 100% because of 1.3% who declined to provide information on race/ethnicity.

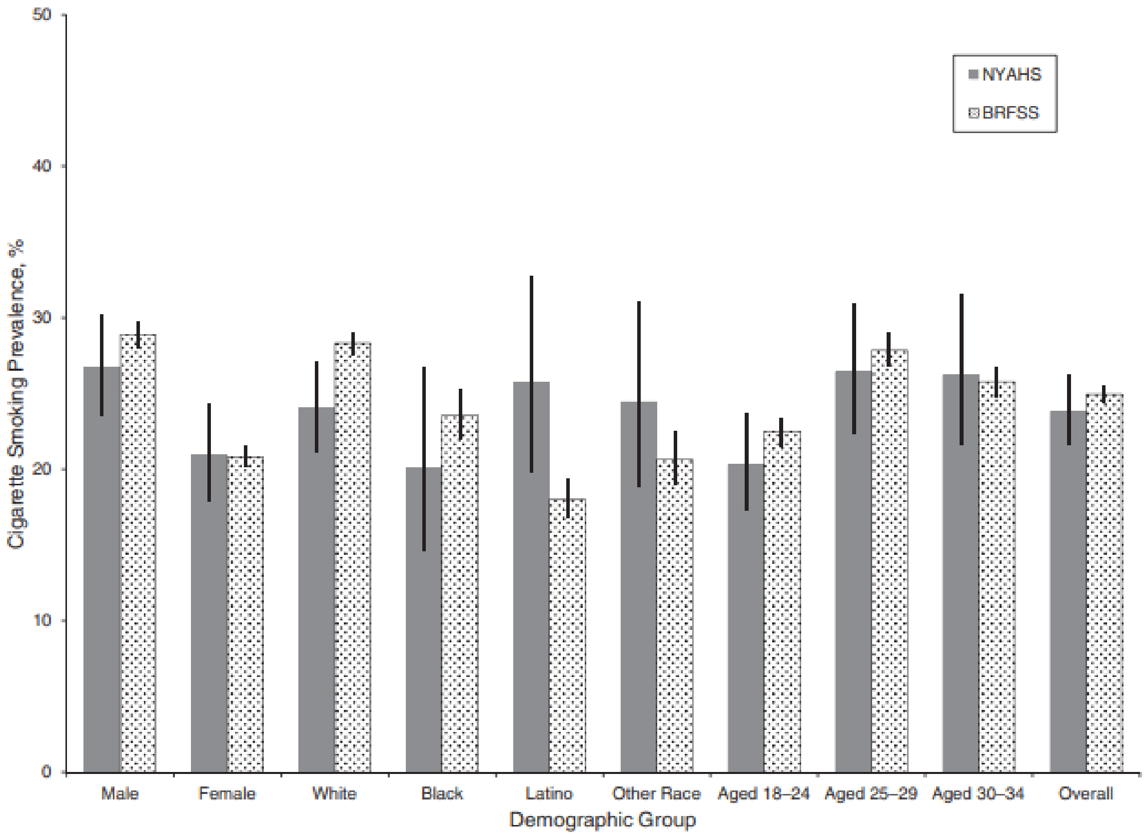

Figure 1. Cigarette smoking prevalence among young adults (18–34 years of age) overall and by subgroups, 2011 National Young Adult Health Survey (NYAHS) (n = 2,871) and 2011 Behavioral Risk Factor Surveillance System (BRFSS) (n = 70,662). Vertical lines represent 95% confidence intervals. Two-sided z tests (2-sample) found no significant differences at $P < 0.005$, which is a Bonferroni adjusted study-wise α of 0.05.

Comparison of cigarette smoking prevalence

The survey questions that measure cigarette smoking are identical in wording for the NYAHS and BRFSS, which allows the comparison of estimates on an important health indicator without the possible problem of wording effects. Current smokers were defined as having smoked 100 cigarettes in their lifetimes and currently smoking every day or on some days. Nonsmokers were defined as those who reported not having smoked 100 cigarettes in their lifetimes or having smoked 100 cigarettes but currently smoking not at all.

The BRFSS was restricted to those aged 18–34 years, and comparisons were made overall and by demographic subgroups. Statistical significance was assessed with a 2-sample *z* test (2-sided). The significance threshold was set at $\alpha = 0.005$ for each comparison, which is a Bonferroni adjusted study-wise α of 0.05. Precision is indicated with 95% confidence intervals. The analyses used final sampling weights (i.e., adjusting for design factors and poststratification) and were conducted by using SUDAAN statistical software (RTI International, Research Triangle Park, North Carolina) (22).

Figure 1 presents the cigarette smoking prevalence overall and by sex, age, and race/ethnicity. We observed no significant differences overall or by subgroup. The overall rates of smoking in the NYAHS and BRFSS were similar (23.8% vs. 24.9%, respectively, 2-sided $P = 0.34$). The largest differences were observed among Latinos (25.7% vs. 18%, 2-sided $P = 0.02$) and whites (24% vs. 28.3%, 2-sided $P = 0.006$).

Response metrics

Call outcome and response metrics were calculated and compared with the 2011 BRFSS to assess sample quality. It should be noted that age-specific metrics are not available for the BRFSS because the characteristics of those whose eligibility could not be determined are not known. This prevents a direct comparison with the NYAHS population of those aged 18–34 years. Nonetheless, a comparison with the BRFSS is still informative because it allows a comparison of the quality of the NYAHS methodology with a major and widely used RDD health survey.

The BRFSS outcomes and response rates were obtained from the 2011 data quality report (23). Dispositions were aggregated into the following 3 broad groups: eligible, eligibility undetermined, and not eligible. We report the American Association for Public Opinion Research's response rate 4, cooperation rates 2 and 4, and refusal rate 2 (24). Briefly, the response rate 4 is calculated as the number of completed and partially completed interviews divided by the total number of eligible respondents, including an estimate of the number of eligible respondents among the “eligibility undetermined” group. The cooperation rate 2 is calculated as the number of completed and partially completed interviews divided by the total number of interviews in which contact was made with an eligible respondent. Cooperation rate 4 is calculated similarly, but excludes from the denominator those not able to take part in an interview for various reasons, including physical and mental inability, language problems, and communication problems. Finally, the refusal rate 2 is calculated as the number of refusals and breakoffs divided by the total number of interviews and noninterviews among eligible respondents, including an estimated number of eligible respondents among the "eligibility undetermined" group. We report overall response rates for the NYAHS and median rates among the 50 US states and Washington, DC, for the BRFSS.

Table 3 presents the call outcomes and response rates for the NYAHS and the 2011 BRFSS by landline and cellular phone sampling frames. Among all telephone numbers dialed, 3.1% reached respondents who were eligible to participate in the NYAHS. This compares to 7.7% in the BRFSS cellular phone frame and 12.5% in the BRFSS landline frame. The higher eligibility rate in the BRFSS is largely because the study does not have an age restriction for eligibility. Moreover, 53.6% of dialed numbers in the NYAHS reached respondents who were classified as "eligibility undetermined" compared with 54.4% in the BRFSS cellular phone frame and 19.6% in the BRFSS landline frame. Lastly, 43.3% of dialed numbers reached ineligible respondents, which compares to 37.9% in the BRFSS cellular phone frame and 67.9% in the BRFSS landline frame.

Table 3. Response Metrics for the 2011 BRFSS and the 2011 NYAHS

	BRFSS				**NYAHS**	
	Landline Survey		**Cellular Phone Survey**			
Response Metric	**No.**	**%**	**No.**	**%**	**No.**	**%**
Disposition						
Eligible	695,392	12.5	108,734	7.7	5,557	3.1
Eligibility undetermined	1,089,907	19.6	764,772	54.4	95,040	53.6
Not eligible	3,774,099	67.9	532,138	37.9	76,779	43.3
Total	5,559,398		1,405,644		177,376	
Response rate[a]						
Response rate 4[b]		53.0[c]		27.9[c]		24.0
Cooperation rate 2[d]		74.2[c]		74.9[c]		51.7
Cooperation rate 4[e]		77.0[c]		76.6[c]		64.2
Refusal rate 2[f]		16.0[c]		9.4[c]		13.4

Abbreviations: BRFSS, Behavioral Risk Factor Surveillance System; NYAHS, National Young Adult Health Survey.

[a] Response rates are based on the American Association for Public Opinion Research (Deerfield, Illinois) categories.

[b] Response rate 4 is the number of completed and partially completed interviews divided by the total number of eligible respondents, including an estimate of the number of eligible respondents among the "eligibility undetermined" group.

[c] Median rate among 50 US states and Washington, DC, reported for BRFSS.

[d] Cooperation rate 2 is the number of completed and partially completed interviews divided by the total number of interviews in which contact was made with an eligible respondent.

[e] Cooperation rate 4 is calculated as for cooperation rate 2, but excludes from the denominator those not able to take part in an interview for various reasons, including physical and mental inability, language problems, and communication problems.

[f] Refusal rate 2 is the number of refusals and breakoffs divided by the total number of interviews and noninterviews among eligible respondents, including an estimated number of eligible respondents among the "eligibility undetermined" group.

The response rate 4 was 24% in the NYAHS, 27.9% in the BRFSS cellular phone frame, and 53% in the BRFSS landline frame. The cooperation rate 2 was 51.7% in the NYAHS compared with 74.9% and 74.2% in the BRFSS cellular phone and landline frames, respectively. Similarly, the cooperation rate 4 was 64.2% in the NYAHS compared with 76.6% and 77% in the BRFSS cellular phone and landline frames, respectively. Lastly, the refusal rate 2 was 13.4% in the NYAHS, and 9.4% and 16% in the BRFSS cellular phone and landline frames, respectively.

LESSONS LEARNED

The methodological assessment of the NYAHS revealed notable strengths of the cellular phone RDD approach for reaching adults between the ages of 18 and 34 years. In particular, our analysis revealed variance efficiencies of the cellular phone–only RDD approach and comparable sample quality as benchmarked against the BRFSS, which, as of 2011, uses a dual-frame (i.e., cellular phone and landline) sample. Our findings demonstrate that RDD of cellular phones only is a feasible sampling and data collection methodology for reaching a representative sample of young adults.

Notable findings were the wide reach among all population subgroups and the closely matching profile of the NYAHS participants to the US Census distributions on demographic characteristics that are of interest to public health researchers and that are typically used in poststratification. The NYAHS was comparable to the BRFSS in regard to sample quality nationally and, although somewhat poorer in some regions, still closely matched the US Census in each region. Moreover, no significant differences in smoking prevalence were observed. This is noteworthy because if there had been substantial coverage bias in the NYAHS because of not sampling landlines, we would expect this to be reflected in these comparisons. This suggests that coverage and nonresponse biases were not a large problem in the NYAHS relative to the BRFSS and that an RDD survey of cellular phones only can be used to obtain representative samples of a broad cross-section of young adults both nationally and regionally.

An important implication of obtaining a representative sample without sampling landlines is that it eliminates concern about how to handle respondents who own both cellular phones and landlines for sample selection and weighting. Decisions about integrating landline and cellular phone samples have important impacts on both operations and weighting. In particular, in a dual-frame design, survey questions on the nature of landline connectedness and the number of eligible adults in a household would have to be included for both landline and cellular phone respondents (7). With a single-frame design such as the NYAHS, many of these questions can be eliminated, which reduces the length of the survey and the overall respondent burden. This may reduce the total cost per completed interview, which is currently 50% higher for cellular phone surveys (25). This is important, because many of the added costs of cellular phone interviews are not within the survey planners' control. These include Federal Communications Commission restrictions on the use of automatic dialers and the need for remunerating respondents because of the cost structure of cellular phone contracts (7, 21).

The NYAHS used a relatively simple single-frame design. Variability in the probability of selection was due to only 2 factors, which were differential sampling rates by region and the number of cellular phones on which each respondent received calls. This was reflected in the small design effect compared with the BRFSS, in which variability of the probability of selection depended on additional factors, including the number of landlines and adults in the household. The variance efficiency in the NYAHS is consistent with that reported by Peytchev and Neely (26), who found that RDD of cellular phones only produced smaller design effects than a dual-frame design. This is important because a smaller design effect results in a larger effective sample size and greater statistical precision for a given sample. This could theoretically offset some of the costs associated with surveying via cellular phones by requiring relatively fewer numbers of completed interviews. Indeed, recent research found that the cost difference between cellular phone and landline surveys has become smaller (25). If this trend continues, it may become cheaper to conduct a single-frame cellular phone survey than a dual-frame survey for an equal effective sample size.

The NYAHS response rates were comparable to the BRFSS median cellular phone response rates, though both the NYAHS and BRFSS cellular phone rates were substantially lower than the BRFSS landline rate. However, the relatively low response rate on cellular phone RDD in general has been noted by the American Association for Public Opinion Research's Cell Phone Task Force (7). The task force indicated that the assumptions used for landline response rate calculations do not hold for cellular phones. This is due in large part to the extremely high rates of "undetermined eligibility" in cellular phone surveys, as observed in the NYAHS and the BRFSS cellular phone frames. There are several reasons for the increased difficulty in determining eligibility among cellular phone users. First, unlike landlines, for which it is relatively simple to identify a fax machine or business phone, it is difficult to do so for wireless numbers. Voicemail on corporate cellular phones may not identify the phone as a business phone, and there are no uniform telephone exchanges for corporate cellular phones as there are for landlines. Also, wireless cards (i.e., "aircards") for computers and tablets (e.g., iPads (Apple Inc., Cupertino, California)) are assigned a wireless phone number in the same manner as are regular cellular phones. When dialed, they can yield a vague message (e.g., "the Verizon customer you are trying to reach is unavailable") making it impossible to determine whether the selected number is connected to a functioning cellular phone or a nontelephone wireless device. Moreover, these messages are not standardized across cellular phone providers (7).

The way in which undetermined calls are treated in response rate calculations has a tremendous impact on calculated response rates (7). Martsolf et al. (27) demonstrated that one can obtain widely different response rates depending on the methodology used to estimate eligibility. It follows that in cellular phone RDD, where a large proportion of calls are classified as "eligibility undetermined," there is a greater potential for response rates to be affected by this disposition group. Indeed, the impact of "eligibility undetermined" calls on response rates was reflected in the NYAHS, and we believe it contributed to the low response rate 4. If one focuses on the cooperation rates 2 and 4, the NYAHS and BRFSS cellular phone surveys were more comparable to the BRFSS landline survey because these calculations rely solely on respondents identified as eligible, thus removing any impact of the way in which "eligibility undetermined" is calculated. It has been noted that proportional allocation to estimate the number of eligible respondents among undetermined cases, which is done in response rate 4, is conservative and overestimates eligibility (28). This lowers the apparent response rate and may unfairly give the impression of a poor methodology in terms of eliciting participation. Given the sensitivity of some response metrics to undetermined eligibility, it is insufficient for cellular phone RDD surveys to report a single response rate. It is beneficial to include multiple response rates, some of which should not depend on how "eligibility undetermined" is calculated, to adequately report on response quality in cellular phone surveys.

The approaches we used to evaluate the quality of the NYAHS are not without limitations. Although the BRFSS, a RDD telephone survey with a public health focus, is a logical comparison, it is a survey of all adults (≥18 years of age), whereas the NYAHS is restricted to adults aged 18–34 years. An age restriction to the BRFSS could not be made to calculate response rates because the ages of those in the "eligibility undetermined" group were not known. However, the BRFSS was restricted to those aged 18–34 years for demographic benchmarking, as well as comparison of smoking prevalence.

Additionally, our choice of demographic characteristics on which to compare with the US Census was based on those commonly used in poststratification adjustment, as well as those that are commonly reported in public health surveillance research. Although our data matched the US Census closely in these categories, it could be that the NYAHS differs more substantially on other factors.

In summary, we found that the NYAHS cellular phone RDD methodology is feasible for collecting health data from a broad and representative cross-section of young adults, and that it may have variance efficiencies that offset the additional costs of conducting cellular phone surveys. Presentation of data quality based on response metrics should include more than 1 "standard" response calculation. Indeed, it should include several response rates that reflect the impact of assumptions made about the "eligibility undetermined" category, preferably including both response and cooperation rates.

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