

Incorporating A Multi-Mode Design Into A Random-Digit-Dialing Survey

Michael P. Battaglia¹, Larry Osborn¹, Michael W. Link², Martin R. Frankel³ and Ali H. Mokdad⁴

¹ Abt Associates Inc.
55 Wheeler St., Cambridge, MA 02138. Mike_Battaglia@abtassoc.com,
Larry_Osborn@abtassoc.com

² Nielsen Media Research
3784 Ardsley Ct., Marietta, GA 30062. Michael.Link@Nielsen.com

³ Baruch College, CUNY and Abt Associates Inc.
14 Patricia Ln., Cos Cob, CT 06807. Martin_Frankel@abtassoc.com

⁴ Centers for Disease Control and Prevention
4770 Buford Highway NE, MS K-66, Atlanta, GA 30341, AMokdad@cdc.gov

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Abstract

Random-digit-dialing (RDD) surveys are typically conducted using only the telephone survey mode of data collection. However, because RDD survey response rates have been declining over the past ten years it is important to examine alternatives to the single-mode approach. This paper describes a test of one multi-mode alternative conducted as part of the Behavioral Risk Factor Surveillance System (BRFSS), a monthly state-based RDD survey that measures health conditions and risk factors. In six states, a list-assisted RDD sample was selected and matched with a database of residential telephone numbers and addresses. For the sampled telephone numbers with an address match, a mail survey with telephone survey follow-up of mail nonrespondents was employed. For sampled telephone numbers with no address match, the survey was conducted by telephone alone. After discussing the design and implementation of the six-state pilot survey, including procedures for the selection of the adult respondent(s) from the sample households, we focus on response rates and respondent characteristics by mode using the ongoing, single-mode BRFSS survey in each state as a comparison sample. The paper also discusses weighting and estimation issues for multi-mode RDD designs and examines potential mode effects.

Key words: Behavioral Risk Factor Surveillance System, Mail Survey, Telephone Survey, Response Rates, and Mode Effects

Introduction

The Behavioral Risk Factor Surveillance System (BRFSS), one of the world's largest random-digit-dialing (RDD) telephone surveys, tracks the health practices and risk behaviors of adults in

the United States. State health departments conduct the BRFSS via continuous monthly telephone interviews using a standardized questionnaire, with technical and methodological assistance provided by the Centers for Disease Control and Prevention. BRFSS data are used to identify emerging health problems; establish and track health objectives; develop, implement, and evaluate a broad array of disease prevention activities; and support health-related legislative efforts.

RDD telephone survey response rates have been declining over the past several years (Battaglia et al. 2007), as there is increasing use of call-screening devices coupled with increasing mistrust of unknown callers. In addition, there are growing threats to the validity of RDD sampling frames from cell phone-only households and telephone number portability. As part of efforts to explore alternative data collection methodologies for the BRFSS, and building on results from the BRFSS Mail Pilot Survey conducted in 2005 (Link et al. 2006), we designed and implemented the 2006 Mixed Mode Pilot Survey (MMPS). The MMPS was designed to assess the effect of multiple data collection modes—specifically a mail survey with telephone follow-up—on BRFSS response rates, by using state-based sampling frames that accurately represent the adult population. Two sampling frames were selected for comparison. The first was a standard landline RDD frame. The second was an address-based frame: the U.S. Post Office's Delivery Sequence File, which contains all addresses serviced by the U.S. Postal Service. Results from the MMPS are intended to provide information about using multiple data collection modes within alternative sampling frames for conducting cost-effective, reliable surveys of the general public, thus helping to guide future decisions about the implementation of the BRFSS. This article focuses on the RDD multi-mode pilot survey.

Background On Multi-Mode Survey Designs

Multi-mode surveys combine different ways of collecting data. The modes of data collection include in-person, telephone, mail, Web, etc. In terms of cross-sectional surveys, there are three primary types of multi-mode survey designs. In the first, often referred to as “mode assignment,” a sample can be divided into subsets defined in some manner, and different modes can be applied to the subsets. In the research presented here, we used a mode assignment design. A second multi-mode design is “sequential.” The American Community Survey is the largest example of a sequential multi-mode survey. The first phase of data collection in such a design uses a mail survey. Households that do not respond to the mail mode are contacted via telephone at the second phase of data collection. Households that do not respond to the telephone survey are subsampled, and the subsample is sent to field interviewers who attempt an in-person interview at the third phase of data collection. The third type of multi-mode design is a “concurrent” mode approach. This involves offering the respondent multiple channels at once for completing the survey (e.g., telephone, Web). The respondent then chooses the preferred mode of responding.

In deciding to use a multi-mode design instead of a more traditional single-mode design, one must assess the potential costs and benefits. Within a given survey budget, the goal of using a multi-mode approach is to decrease the total survey error of the key estimates. Multi-mode designs may raise response rates, but compared with a single-mode design, the increase may not occur across the entire sample. Some multi-mode designs can potentially shorten the time frame for data collection; however, a sequential approach could substantially lengthen the field period. A multi-mode design can reduce survey costs, provided that less costly modes are used before using the

more expensive modes. The use of multiple modes may raise issues of comparability across modes. For example, questions asked by a person, as opposed to on paper, may be more likely to invoke socially desirable responses (Turner et al. 1998). Questions asked on paper are more likely to ensure privacy and allow the respondent to complete the survey at his or her convenience. However, complex forms in which some questions are to be skipped cannot be used, and literacy issues should be considered. Often in a multi-mode design, different modes are used for various subsets of the sample, making it difficult to determine if there is a mode effect. This can be overcome by building randomized experiments into the survey design. Another way around this issue is to take a “unimode design” approach, as suggested by Dillman (2000). The unimode approach may, however, limit the full potential of the modes used in a survey.

The use of multi-mode survey designs has increased for cross-sectional surveys. Will they make single-mode designs a thing of the past? This is currently unknown, but it is clear that research needs to be conducted on multi-mode designs so that better design decisions can be made. The survey on which this article is based contributes to that discussion through its use of an RDD multi-mode design as part of a six-state pilot survey.

Design And Implementation Of The RDD Multi-Mode Pilot Survey

Six states were selected for participation in the RDD multi-mode pilot survey: California, Florida, Massachusetts, Minnesota, South Carolina, and Texas. These states were selected for a number of reasons. First, the states typically have yearly BRFSS response rates below 50%. Second, they are representative of the major U.S. geographic regions. Finally, combined, the states provided a good representation of the racial and ethnic mix of the U.S. population.

For the landline RDD sample for each state, we selected 10-digit telephone numbers by using the GENESYS Sampling System. Each sample was selected from 100 telephone number banks with at least one residential, directory-listed telephone number per bank, an RDD sampling methodology commonly referred to as the list-assisted design. A telephone number bank consists of 100 consecutive numbers within working exchanges. The sample from each state was divided into two strata: 1) directory-listed, residential telephone numbers and 2) non-directory-listed, residential telephone numbers (sometimes referred to as unlisted numbers). For each state, a proportionate stratified sample design was used to select a sample of telephone numbers from each stratum. The sample was divided into 30 random subsamples called replicates. The GENESYS Sampling System's CSS procedure identified and flagged any selected telephone numbers that were determined to be business numbers, nonworking numbers, or fax/modem lines. These numbers were not called by interviewers but remained a part of the overall sample. A total of 23,580 telephone numbers (between 3,840 and 4,020 per pilot state) was drawn for the RDD sample. After flagging business numbers, nonworking numbers, and fax/modem lines, 12,187 remaining numbers were released for data collection.

Sampled RDD telephone numbers were matched against the TargusInfo database in order to identify cases with a usable mailing address. An address match of 61.9% was obtained for the overall sample.

The RDD MMPS mail questionnaire consisted of the same questions asked in the core section of the BRFSS telephone interview and covered the following topics: General Health, Health Practices,

Demographic Information, Health Problems, Diet, Activity Level, HIV/AIDS, and Life Satisfaction.

In many RDD studies, including the BRFSS, a single adult respondent is chosen at random from all the adults in a household for a detailed interview. However, very little is known about such random selection processes in surveys that are mailed, with the 2005 BRFSS Pilot Mail Survey being one of the few studies to test such procedures (Battaglia et al. 2006). Building on results of the earlier study, three techniques for within-household respondent selection were tested as part of the RDD MMPS. Sampled records were randomized to one of the following respondent-selection methods:

- Version A—The household member 18 years of age or older with the *next* birthday was instructed to complete the questionnaire (a variant of an approach commonly used in RDD surveys);
- Version B—The household member 18 years of age or older with the *last* birthday was instructed to complete the questionnaire (a variant of the Version A approach); and
- Version C—Every household member 18 years of age or older was asked to complete the questionnaire.

Version A and B households were sent one questionnaire and one pre-paid reply envelope. Version C households were sent three questionnaires and three pre-paid reply envelopes. Version C households with more than three adults were asked to call the project's toll free telephone number to request additional materials.

The telephone questionnaire used the standard within-household respondent-selection process, that is, random selection of one adult in the household based on an implicit household roster.

RDD cases that did not have an address match were immediately released to a telephone center. Trained interviewers dialed these cases and conducted the interview over the telephone as applicable. The interviews followed standard procedures in place for ongoing BRFSS RDD data collection, including the random selection of one adult in the household as the subject of the interview. Dialing of these cases began on June 20, 2006, and was completed on August 22, 2006, by which point the cases had been sufficiently dialed. A total of 4,742 RDD sample cases without an address match were released.

An initial questionnaire package was prepared for each address-matched case in the RDD sample. The packages were bundled and sent to the health department in each state. Health department staff then mailed out the packages immediately upon receipt. This process was used so that the state's postmark would appear on the outer envelope. Using the state's postmark was another way to reinforce the state's sponsorship of the study.

For mail survey cases, a series of follow-up contacts (postcard reminders and second questionnaire mailings) was made prior to releasing cases for telephone follow-up. Telephone follow-up for nonrespondents began approximately four weeks following the second questionnaire mailing. The purpose of telephone follow-up was to immediately conduct the interview over the telephone. A total of 4,720 RDD sample cases with an address match were released for telephone follow-up.

In the RDD-based sample, 3,918 surveys were eventually completed (3,046 via mail and 872 via telephone) from 3,263 unique households.

An RDD-specific interview file was created by retaining all completed RDD sample cases. Five cases in which the ages of the respondents were reported to be less than 18 years were dropped from the interview file. Cases were categorized depending on their address-matched status and how they had completed the interview: address-matched cases that completed by mail, address-matched cases that completed by telephone, and non-matched cases that completed by telephone. As described earlier, cases that were completed by telephone involved random selection of one adult from the household to be the interviewee, while cases completed by mail were randomized to one of three within-household respondent-selection methods: next birthday, last birthday, or all adults.

To facilitate the weight calculations, the following variables were imputed for cases in which no valid response was available: the number of adults in the household, the respondent's age, the respondent's Hispanic/Latino status, and the respondent's education level. Two additional variables were imputed for the RDD weight calculations: the number of telephone lines in the household and interruption in telephone service of a week or longer in the past year.

The base sampling weight (BSW) for a state equals the number of telephone numbers in the sampling frame for the state divided by the sample size of telephone numbers in the state. The total number of telephone numbers in the six states is 84,673,400. Dividing that total by six (the number of pilot states) equals 14,112,233.333. For each state, the values of BSW for the completed interviews were summed (Z). For the completed interviews in each state, BSW_EQUAL was calculated as $BSW \times (14,112,233.333/Z)$. The sum of the weights in each pilot state was the same such that no one state dominated the weighted estimates.

Next, a design weight (BSW_NUM_PHONE) was calculated to adjust for the number of non-fax/modem only telephone lines in each sampled household. $BSW_NUM_PHONE = BSW$ divided by the number of non-fax/modem only telephone lines in the household, with the maximum telephone lines capped at three.

A nonresponse adjustment (BSW_2) was next made for the number of interviews completed in a household, calculated as $BSW_2 = BSW_NUM_PHONE$ multiplied by the number of adults in the household, with the maximum number of adults capped at five.

A further adjustment (BSW_3) was made to Version C cases completed by mail, since more than one questionnaire could be completed in those households. BSW_3 was calculated as BSW_2 multiplied by the ratio: (number of adults in the household/number of adults in the household who completed a questionnaire), with the maximum value for number of adults in a household capped at five. For Version A- and B-completed questionnaires, and for Version C questionnaires completed by telephone, $BSW_3 = BSW_2$.

A nonresponse adjustment was next made to account for address-matched cases having a higher response rate. Cases with an address match were initially approached by mail, with nonrespondents later contacted by telephone. Cases without an address match were approached

only by telephone, resulting in a lower response rate for this group. Thus, a unit nonresponse rate was made in each pilot state. First, all sampled telephone numbers with an address match and a case disposition indicating known households were counted, by state ($R+NR_{\text{address}}$). Next, all sampled, address-matched numbers with a case disposition specifically indicating a completed interview were counted, by state (R_{address}). Afterward, a ratio was formed: $RATIO_{\text{address}} = R+NR_{\text{address}} / R_{\text{address}}$. Following the same procedures, but using only sampled telephone numbers without an address match, a second ratio was formed: $RATIO_{\text{no_address}} = R+NR_{\text{no_address}} / R_{\text{no_address}}$. In each state, for address-matched cases, $BSW_3_NR = BSW_3 \times RATIO_{\text{address}}$. In each state, for cases without an address match, $BSW_3_NR = BSW_3 \times RATIO_{\text{no_address}}$.

For all completed questionnaires in a state combined, BSW_3_NR was raked to population control totals (provided by Claritas, Inc.) for twelve age-by-gender cells (males and females aged 18-35, 25-34, 35-44, 45-54, 55-64, and 65+ years) to produce a poststratified weight (BSW_4). Though initially kept separate, males aged 18-24 were combined with males aged 25-34, and females aged 18-24 were combined with females aged 25-34 because of the small sample size in the younger age groups. Race/ethnicity (white/non-Hispanic versus all other race/ethnic groups) was also included as a raking margin. The raking was run using the median weight plus five times the interquartile range of the weights as the maximum weight value.

For the completed interviews in each state, BSW_4_EQUAL (an equalized BSW_4) was calculated as $BSW_4 \times (68,565,464 / \text{sum of } BSW_4)$.

A second raking was run in each of the pilot states, again using BSW_3_NR as the input weight. The margins included in this raking were age by gender and race/ethnicity (provided by Claritas, Inc. and using the categories described earlier), and education (from the 2006 March Current Population Survey Supplement and using four categories—less than High School; High School graduate; some college; college graduate). In addition, an interruption in telephone service margin was included (created using data from the 2006 March Current Population Survey Supplement and completed RDD interviews, and having interruption/no interruption values). For the raking convergence criterion, a difference in percent of 0.025 was used. We ran the raking using the median weight plus five times the interquartile range of the weights as the maximum weight value until no weights exceeded the threshold. The raking weight was BSW_5 .

For the completed interviews in each state, BSW_5_EQUAL was calculated as $BSW_5 \times (68,565,464 / \text{sum of } BSW_5)$. The sum of the weights in each state was the same such that no one pilot state dominated the weighted estimates. BSW_5_EQUAL is used in the demographic and risk factor comparisons presented below.

Response Rates

A key issue is whether the RDD multi-mode design approach resulted in a substantial increase in the response rate compared with a single-mode RDD survey. For comparison, we used the BRFSS survey conducted by the pilot states as the single-mode RDD survey, applying the AAPOR RR 4 response rate formula to the BRFSS sample that was taken in the six states during the same time period as the RDD multi-mode survey (AAPOR 2006 – 4th edition available at www.aapor.org). It

was also applied to the RDD multi-mode survey in the six states. We took the additional step of first matching the BRFSS RDD sample with a commercial database of residential addresses, allowing us to separate the BRFSS sample into two subsets: address-matched sample telephone numbers and sample telephone numbers without an address match. We calculated the response rate separately for each of the two subsets. For each subset, we determined the value of “e” (the estimated proportion of unresolved telephone numbers that are residential) by using the ratio of residential sample numbers to total resolved sample telephone numbers.

For calculating the RDD multi-mode survey household-level response rates, the sample was first divided into two subsets: (1) sample numbers with an address match that were included in the mail survey mode of data collection and did not move onto the telephone mode of data collection (mail only cases) and sample numbers with an address match that were included in the mail survey mode of data collection and moved onto the telephone mode of data collection (mail/phone cases), and (2) sample numbers without an address match (phone-only cases).

The response rate was calculated separately for each subset. For each subset the value of “e” was calculated from the resolved sample. Response rates were also calculated for the overall BRFSS sample and for the overall RDD multi-mode sample (Table 1). For all six states combined, the BRFSS response rate was 35.3% compared with 45.3% for the RDD multi-mode survey (+10.0 percentage points). A higher response rate for the multi-mode survey was seen in each state except South Carolina. The response rate for the RDD multi-mode survey differed considerably by subset: 49.9% for the address-matched sample, and 21.7% for the no address-match phone-only sample.

The use of the two modes of data collection has raised the response rate in the address-matched part of the sample, while having no impact on the part of the sample without an address match. We can judge the size of the increase by comparing the response rate for the address-matched sample with the response rate in the BRFSS for the address-matched sample: 49.9% versus 35.3% (+14.6%). We can see that the multi-mode approach led to a substantial increase in the response rate compared with a single-mode RDD approach, but the increase occurred only in the address-matched part of the sample. Adults in address-matched household may differ in important ways from adults in households that are not in commercial address databases. It is, therefore, possible that in increasing the response rate, we have increased nonresponse bias rather than decreased it. We investigated this topic by focusing on the characteristics of the adults who completed the RDD multi-mode survey.

Demographic Comparisons

We compared the weighted demographic and socioeconomic characteristics of the BRFSS interviewees with those of the adults who completed the RDD multi-mode survey. The RDD multi-mode estimates are based on BSW_5_EQUAL. The BRFSS survey followed its current standard weighting methodology. The BRFSS design weights are poststratified to Claritas population control totals based on age-by-gender cells. In some states, the poststratification is based on age-by-gender-by-race/ethnicity cells. The poststratified BRFSS weights were then ratio adjusted so that the weights in each of the six states summed to the same total. This “equalization” of the weights prevents a large state, such as California, from dominating the estimates. We also compared the RDD multi-mode demographic and socioeconomic characteristics with

Claritas/March CPS control totals. We also “equalized” the CPS weights so that the six states could be combined for comparison purposes.

The demographic and socioeconomic distributions of the RDD multi-mode survey and the BRFSS survey were very similar. The percent of never-married adults was lower in the multi-mode survey (17.7% versus 23.9%). Focusing on the address-matched sample, the demographic and socioeconomic distributions were also very similar. The RDD multi-mode survey still had a lower percent of never married adults than the BRFSS (17.7% versus 23.4%). The RDD multi-mode survey also had a lower percent of adults living by themselves (13.1% versus 19.3%).

When we compared the RDD multi-mode demographic and socioeconomic characteristics with the Claritas/March CPS control totals, we found that, as expected, the age, gender, and education distributions were in agreement—they were controlled in the weighting. The distributions across the five minority race/ethnicity categories were all close except for the multiracial non-Hispanic category (3.3% versus 0.8%). This difference could be attributable in part to slight differences in how CPS and BRFSS collect race information. Number of children in the household and number of adults in the household were not controlled in the RDD multi-mode weighting. Compared with the CPS, we did see some underrepresentation of adults in households without children (56.5% versus 59.6%), but the underrepresentation of adults living by themselves was smaller (14.0% versus 15.7%). Never-married adults were also underrepresented in the RDD multi-mode survey (17.7% versus 25.6%). By controlling on education, age, gender, and race/ethnicity, we could see that the multi-mode survey compared favorably with the Claritas/March CPS control totals.

Risk Factor And Health Condition Comparisons

We selected eight key risk factors and health conditions from the BRFSS questionnaire. Comparisons of the percentage of adults at risk/with the health condition were made between the RDD multi-mode survey and the BRFSS survey (Table 2). We found that the overall estimates for each of the two surveys were very similar, for example, the percent of adults with health care coverage (80.9% versus 81.9%). An exception was that the estimate for the binge drinking risk factor was noticeably higher in the RDD multi-mode survey (18.2% versus 15.1%). This may be attributable to the sensitive nature of the alcohol-use questions in the BRFSS interviewer-conducted telephone survey.

To gain a better understanding of the differences between the two surveys, we also compared risk factors for the address-matched subsets of the BRFSS and RDD multi-mode samples. We found that all of the estimates were similar except for the binge drinking risk factor (18.2% versus 15.2%). Other than that variable, there was no evidence of mode effects for the address-matched sample.

Another “face validity” comparison is to use the National Health Interview Survey (NHIS), which collects data on some of the same risk factors as the BRFSS. The NHIS is conducted in person and achieves a response rate considerably higher than that of the RDD multi-mode survey. A key limitation of using the NHIS for this purpose is that we are comparing estimates for the six pilot states with national estimates from the NHIS. Even with this limitation, the risk factor estimates from the two studies were close.

Our overall conclusion is that the multi-mode approach yields estimates that are reasonably close to the single-mode BRFSS estimates, and the differences are not large enough to suggest a change in key health care policies or prevention/education programs. Likewise, the comparison with the NHIS yields a similar conclusion.

Cost Comparison

Cost is an important component in the evaluation of any survey design. The data collection costs per 1,000 completed interviews were calculated for both the RDD telephone survey and RDD multi-mode survey, using (1) actual unit costs for materials and supplies based on the pilot survey experience, (2) production statistics from the pilot survey, and (3) estimates of industry averages for direct hourly rates and indirect cost rates (i.e., fringe benefits, general and administrative expenses, indirect technical costs, and materials support expenses). Other costs assumed to be nearly equivalent regardless of the survey design were not included, such as overall project management, survey design development, and post-data collection weighting and analysis.

We compared costs for the RDD single-mode and RDD multi-mode approaches assuming 1,000 interviews. The cost for the RDD multi-mode approach was only about 2.5% less than that of the RDD single-mode survey to obtain the same number of completed interviews (\$59,922 versus \$61,438). The small cost difference is due to the substantially higher material and supply costs for the RDD multi-mode survey.

Conclusions

The introduction of a mail survey component into a random-digit-dialing telephone survey offers several potential benefits:

- Respondents have more flexibility in completing the questionnaire compared with an interview-based survey;
- Materials that accompany the questionnaire mailing can be used to legitimize the survey;
- Higher reporting of some sensitive items can be expected compared with an interviewer-based survey;
- Different follow-up methods can be used (e.g., second questionnaire mailing);
- Incentives can be delivered more easily;
- There is a potential for lower costs.

These benefits come with some limitations:

- Within-household respondent selection is more difficult and error prone;
- Complex question-skip patterns and long questionnaires cannot be used;
- There may be literacy issues;
- A longer field period is required compared with a single-mode survey;
- The issue of “cellular phone-only” adults and adults living in households without telephones is not addressed.

The RDD multi-mode survey demonstrates that it is possible to raise response rates by at least ten percentage points. Thus, if one's objective is to achieve a response rate of at least 50%, the multi-mode design approach should be considered. A response rate at that level may be needed for "face validity" purposes or may be required by a journal for publication acceptance. But does raising the response rate reduce total survey error? For the RDD multi-mode survey, we only raised the response rate in the address-matched part of the sample. Adults living in households that are not in commercial address databases have different demographic and socioeconomic characteristics than address-matched adults. Thus, one is raising the response rate in one part of the sample relative to a part that has different characteristics. This differential could, therefore, actually have the opposite effect of increasing total survey error. At a minimum, one should strongly consider making a separate interview nonresponse adjustment for the address-matched sample versus the non-address-matched sample in the weighting procedures.

Improving participation among subgroups of the sample that are underrepresented is perhaps a better yardstick for comparing alternative designs. Although the specific characteristics of the underrepresented groups can vary across populations of interest and survey designs, in most RDD surveys these groups tend to be younger adults (those 18 to 34 years of age), male, adults of lower education, and racial/ethnic minorities. Unfortunately, use of a multi-mode design did not appear to substantially improve responses among these particular subgroups. Finally, the cost difference between an RDD single-mode survey and an RDD multi-mode survey was relatively small.

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References

- American Association for Public Opinion Research (AAPOR). 2006. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*, 4th ed. Ann Arbor, MI: AAPOR.
- Battaglia, M., M. Link, M. Frankel, L. Osborn, and A. Mokdad. 2007. "An Evaluation of Respondent Selection Methods for Household Mail Surveys." *Public Opinion Quarterly* (forthcoming).
- Battaglia, M., M. Khare, M. Frankel, M.C. Murray, P. Buckley, and S. Peritz. 2007. "Response Rates: How Have They Changed and Where Are They Headed?" *Advances in Telephone Survey Methodology*, Edited by J. Lepkowski, C. Tucker, M. Brick, E. de Leeuw, L. Japen, P. Lavrakas, M. Link, and R. Sangster. New York: John Wiley & Sons, Inc. (forthcoming).
- Dillman, D. 2000. *Mail and Internet Surveys: The Tailored Design Method*. New York: John Wiley & Sons, Inc.

Link, M. M. Battaglia, M. Frankel, L. Osborn, and A. Mokdad. 2007. "Comparison of Address-based Sampling versus Random-Digit Dialing for General Population Surveys." *Public Opinion Quarterly* (forthcoming).

Turner, C., L. Ku, and S. Rogers. 1998. "Adolescent sexual behavior, drug use, and violence: increased reporting with computer survey technology." *Science*, 280:867-73.

Table 1: Response Rates

	BRFSS RDD:		No Address- Matched		RDD Multi- Mode:		Address- Matched	No Address- Matched
	Overall Response Rate	Sample Size ¹	Sample Response Rate	Sample Response Rate	Overall Response Rate	Sample Size ¹	Sample Overall Response Rate	Sample Response Rate
Combined States using "equalized design weights"	35.3%	67,976	35.3%	32.3%	45.3%	12,187	49.9%	21.7%

¹ Genesys CSS purged telephone numbers excluded.

Table 2: Comparison of Risk Factors and Health Conditions

Risk Factor		2005 NHIS (n = 31428 interviews)	BRFSS RDD: (n = 21743 interviews)	No Address- Matched		RDD Multi- Mode: (n = 3913 interviews)	Address- Matched, Mail Only Sample Estimate	Address- Matched, Mail/Phone Sample Estimate	Address- Matched Sample Overall Estimate	No Address- Matched Sample Estimate
		National (50 States and DC) Estimate (%)	Overall Estimate (%)	Address- Matched Sample Estimate (%)	Address- Matched Sample Estimate (%)	Overall Estimate (%)	(%)	(%)	(%)	(%)
Health care coverage		N.A.	81.9	82.6	76.0	80.9	85.0	74.7	81.7	75.9
Asthma		10.7	12.4	12.1	15.5	13.3	13.5	12.2	13.1	14.5
Diabetes		7.4	9.3	9.9	8.5	10.5	11.1	10.6	11.0	7.0
Cardiovascular disease		N.A.	8.3	8.5	6.5	8.7	9.9	8.7	9.5	3.8*
Obese (BMI > 30)		23.2	22.9	22.7	24.9	24.7	24.3	26.0	24.8	24.0
Current smoker		20.7	20.1	19.8	22.7	20.3	17.0	24.5	19.4	26.2
Binge drinking		N.A.	15.1	15.2	14.3	18.2*	17.9	18.8	18.2*	18.2
Tested for HIV (under age 65)		35.3	36.7	36.0	42.9	37.6	32.7	42.6	36.0	47.8

Note: * designates a difference between the RDD multi-mode survey and the BRFSS survey that is statistically significant at the individual 0.05 level.