Cell Phone-Only Households in a National Mail Survey Who Are They?

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Abstract

Previous studies have shown that individuals with access to a cell phone only are different from those with access to a landline telephone in terms of demographics and important outcomes. This makes it important to cover the cell phone-only group for many different types of surveys. However, random digit dialing (RDD) telephone surveys have traditionally included only those with a landline. One way to cover this group is through a cell phone RDD survey. An alternative is through a mail survey. The purpose of this paper is to examine the success of using a mail survey to generate national estimates that include the cell phone-only population. The Health Information National Trends Survey (HINTS) was conducted through the mail using a national address frame. In this paper, we first study the demographic characteristics of cell phone-only HINTS respondents and then compare the health-related measures between cell phone-only respondents and those with landlines. Results are also compared to the external benchmark of an in-person survey of cell phone-only respondents with high response rate. Such comparisons allow us to assess the degree to which a mail survey can be used to generate estimates for the cell phone-only population.

Key Words: Mail survey, USPS delivery sequence file, cell phone-only population

1. Introduction

Telephone random digit dialling (RDD) surveys have traditionally included only the households with a landline. In recent years, landline surveys have faced several challenges including declining response rates and undercoverage. One important source of undercoverage is the growing cell phone-only population. A recent national in-person survey has estimated that 15.8 percent of the US households did not have a landline telephone during the period of July – December 2007. Approximately 14.5 percent of all adults – more than 32 million adults – lived in households with only cell phones (Blumburg, et al., 2008). Traditional RDD frames do not include these individuals.

Previous studies have shown that cell phone-only individuals are different from those with access to a landline residential telephone in terms of demographics and certain behaviour patterns (for example, general health status and involvement in risk behaviours). The exclusion of the cell phone-only population from a survey can result in potential bias in the estimates.

One approach to cover the cell phone-only population is to sample from known banks of cell phone numbers directly and combine this sample with the landline sample. Existing studies have used two different designs depending on how to handle the households with both landline phone(s) and cell phone(s). Although this approach has the advantage of reaching cell phone-only population directly and thus can improve the coverage of a survey, the implementation also poses several challenges. For example, cell phone surveys are usually more expensive and have lower response rates compared to landline studies. Besides the operational challenges, a crucial problem that survey researchers often face is the lack of universe estimates or population parameters against which to weight the survey data (Link, et al., 2008).

Given the challenges in telephone surveys, some researchers have started to explore other options for sampling and data collection. One solution is to use mail surveys. The main purpose of this study is to examine the possibility of characterizing the cell phone-only population through a national mail survey.

1.1 Using Address Based Sampling for General Population Surveys

Mail surveys have traditionally been used for surveying special population groups, for example, physicians in the United States, where a frame is available from American Medical Association. In recent years, US Postal Service (USPS) Delivery Sequence (DSF) File has made it possible to conduct general population surveys through mail. USPS DSF lists have very good coverage of the civilian household addresses across the nation except in very rural areas (Dohrmann, et al., 2006). Through private vendors, it is also possible to obtain landline phone numbers for some addresses for possible refusal conversion effort – the match rate is approximately 60 percent. Compared to cell phone surveys, the mail mode is less expensive, can achieve comparable response rate to landline surveys, and also provide an opportunity to use other data collection modes through an initial mail contact.

1.2 Data Source and Methodology

The data used for this research is from the Health Information National Trends Survey (HINTS) 2007 Mail survey. HINTS is a national survey sponsored by National Cancer Institute. The questionnaire consists of approximately 150 items with key measures on the prevalence of health information seeking and cancer related communication and behaviours among the US adult (age 18+) population. The previous two HINTS surveys had been conducted in 2003 and 2005 through landline RDD. The declining response rate and the eroding coverage of the population were the primary motivations for the implementation of an alternative methodology in 2007 by using both a landline RDD and a mail survey using the DSF frame. The landline RDD sample serves the purpose of trend analysis and evaluation of mode effects. One of the advantages of the mail sample is the potential coverage of the cell phone-only households that were not included in the landline RDD frame.

To assess how well the HINTS Mail survey had captured the cell phone-only population, we used National Health Interview Survey (NHIS) as the benchmark to evaluate the HINTS estimates. NHIS is sponsored by National Center for Health Statistics and had a response rate of approximately 68 percent for the 2007 adult survey. Since the NHIS data were collected through a personal household interview, the survey has better coverage and response rates than HINTS, especially in younger age group, minority group, and those without landline telephones. Since 2004, selected estimates of phone coverage have been released twice a year as part of the NHIS Early Release Program. The most recent information was for the period of July – December 2007.

After a more detailed description of the design of the Mail survey in Section 2, the remainder of the paper mainly describes the cell phone-only respondents in the mail sample. We first examine the demographic measures and assess whether the HINTS Mail survey has successfully characterized the demographics of the cell phone-only population (Section 3). Then we compare the HINTS general health measures to those in NHIS, looking at both the raw differences between the estimates and the adjusted differences after controlling for demographic variations (Section 4). Finally, we focus on the important HINTS-specific measures and evaluate the necessity to obtain cell phone-only respondents in order to reduce the potential bias in the key estimates for HINTS (Section 5).

2. The HINTS Mail Survey

2.1 Methodology Issues – Experience from Previous Studies

The Mail survey had drawn experience from several other studies. One was the work by Link and colleagues which conducted several state-specific general population surveys as part of the Behaviour Risk Factor Surveillance System (Battaglia, et al., 2008). The final design was based on preceding mail studies conducted at Westat – the Minnesota Alcohol and Tobacco Study (MATS) and the Pilot Mail survey for HINTS 2007. Both surveys had used the approach of taking all adults for within-household selection. The results from those two surveys were encouraging. One area of concern was the low number of cell phone-only individuals responding to the surveys. Since neither MATS nor the Pilot Mail survey had incorporated any special procedures to control the distribution of the questionnaires within a household, we suspect that young people, especially those living in unrelated households were less likely to respond to the mail survey than those living in related households. As an effort to gain higher cooperation from the cell phone-only households and persons living in unrelated households and thus reduce potential nonresponse bias, the HINTS Mail survey instituted a pre-incentive of $2 for each sampled household and used express delivery to mail the refusal conversion package.

2.2 Sample Design and Data Collection

Through the services of an address-sample vendor, the HITNS Mail survey applied stratified design with a higher sampling rate for higher minority areas. To avoid any complications related to within-household selection, all the adults in the sampled households were invited to participate the survey (Battaglia, et al., 2008).

The data collection lasted for approximately four months. An advance letter was sent to all the sampled addresses. A week later the questionnaires, with a $2 incentive, were mailed out. One week after the mailing of the questionnaires, a post card reminder was sent to the households that had not completed the survey. Two weeks later, a second batch of questionnaires was mailed to non-responding households through FedEx as an attempt for refusal conversion. Finally, a telephone reminder was used for the nonresponding households where a landline phone number could be found through a private vendor for further refusal conversation.

The overall weighted response rate for the Mail survey was 31 percent, which was 7 percentage points higher than the landline RDD. Among the 2,563 responding households, approximately 65 percent returned one questionnaire, 30 percent returned two questionnaires, and 5 percent returned three or more. 442 adults (approximately 12 percent of all the respondents) reported living in a cell phone-only household, which provided a reasonable sample size for this study. To reduce the potential bias due to nonresponse and under-coverage, the data were weighted by accounting for density of the minority population in the area, Census region, respondent age, gender, race/ethnicity, marital status and education.

2.3 Distribution of Household Phone Status

HINTS 2007 mail questionnaire included two consecutive questions for household phone status:

(1) Is there at least one telephone inside your home that is currently working and is not a cell phone? (Yes/No)
(2) Does anyone in your family have a working cell phone? (Yes/No)

Any respondent who answered “No” to the first question and “Yes” to the second question was categorized as living in a cell phone-only household. The second question was exactly the same as in the NHIS questionnaire. The NHIS family was defined as an individual or a group of related persons living together in the same housing unit. In the HINTS questionnaire, however, the term family was not clearly defined, so a respondent could include his/her family members who did not live with them. For example, a father living in a landline-only household in Maryland could think of his cell phone-only son who was studying in Denver and answered “Yes” to the second question. This would lead to an overestimate of the number of persons living in households with cell phones.

Table 1 shows the distribution of household phone status among US adults in both HINTS and NHIS. HINTS estimated that 17.5 percent of the adults lived in cell phone-only households. The weighting mechanism had helped bring the HINTS estimates closer to NHIS. The higher estimate of the proportion of persons living in households with both landline(s) and cell phone(s) was partly due to the lack of clear definition of family in the HINTS questionnaire.

Our research mainly focused on the cell phone-only population. The impact of the unclear definition of family on the estimate of the cell phone-only population was conditional on the household having no landline and thus should be relatively small. It is also important to note that the HINTS data was collected nearly half a year later than NHIS. The cell phone-only population has been growing approximately 2 percent every year (Blumberg, et al., 2008). When this factor is taken into account, the HINTS estimate of the proportion of adults living in cell phone-only households can be considered very close to the estimate from NHIS.

Table 1: Percent of adults living in households with different phone ownership status: HINTS versus NHIS

		Landline/cell phone %	*Landline-only %*	*Cell phone-only %*	*Sample size*
HINTS Mail survey Jan-April 2008	*With base weight*	77.6	9.4	12.1	3,582
	With final weight	72.0	9.2	17.5	
NHIS July - Dec 2007		64.0	19.4	14.7	24,514

3. Demographic Characteristics of the Cell Phone-Only Population

To understand how well the HINTS Mail survey had characterized the cell phone-only population, we examined the demographic distribution of the cell phone-only population in HINTS and compared the pattern to that in NHIS. Eight out of the ten demographic measures published in the NHIS Early Release of Estimates had also been covered by the HINTS questionnaire, as shown in Table 2.

Table 2: Percentage and 95 percent confidence intervals (CI) of adults living in cell phone-only households, by demographic characteristics that were surveyed in both HINTS and NHIS

		HINTS Mail survey		*NHIS*	
		Estimate	*95% CI*	*Estimate*	*95% CI*
Ages	*18-24*	35.5	(25.6, 45.39)	30.6	(26.72, 34.74)
	25-29	39.1	(29.07, 49.2)	34.5	(31.48, 37.62)
	30-44	20.5	(15.74, 25.21)	15.5	(14.06, 16.96)
	45-64	9.6	(7.19, 11.98)	8.0	(7.13, 8.97)
	65 and above	2.5	(1.09, 3.85)	2.2	(1.67, 3.01)
Gender	*Male*	19.9	(16.71, 23.07)	15.9	(14.37, 17.47)
	Female	15.5	(13.00, 17.91)	13.2	(12.12, 14.26)
Race/ethnicity	*Hispanic*	19.5	(12.06, 27.02)	19.3	(16.86, 22.07)
	Non-Hispanic white	16.3	(13.74, 18.86)	12.9	(11.54, 14.32)
	Non-Hispanic black	20.5	(13.72, 27.37)	18.3	(15.9, 20.88)
	Non-Hispanic Asian	16.6	(5.56, 27.59)	12.1	(9.14, 15.8)
	Non-Hispanic multiple race	29.0	(12.38, 45.62)	22.8	(17.22, 29.53)
Education	*Less than high school*	20.6	(12.36, 28.77)	15.4	(13.48, 17.43)
	High school or vocation school	15.9	(11.70, 20.18)	13.4	(12.17, 14.77)
	Some college with no degree	19.2	(16.08, 22.25)	17.0	(14.76, 19.56)
	College graduate and above	15.4	(12.60, 18.15)	12.7	(11.13, 14.39)
Occupational status	*Employed*	18.1	(15.92, 20.37)	16.6	(15.26, 17.96)
	Homemaker	15.0	(4.97, 25.01)	12.8	(11.09, 14.72)
	Student	33.3	(19.02, 47.53)	28.9	(20.01, 39.73)
	Other	13.3	(8.55, 18.08)	7.6	(6.69, 8.69)
Poverty Status[1]	*Poor*	33.2	(24.02, 42.48)	27.4	(23.02, 32.36)
	Near poor	27.3	(20.01, 34.52)	20.8	(18.36, 23.49)
	Not poor	13.7	(11.54, 15.88)	11.9	(10.79, 13.18)
Tenure	*Owning*	8.7	(6.83, 10.63)	7.3	(6.49, 8.12)
	Renting	36.7	(31.63, 41.74)	30.9	(28.32, 33.52)
	Other arrangement[2]	14.8	(4.99, 24.54)	23.2	(15.48, 33.35)
Census region	*Northeast*	11.4	(7.19, 15.54)	10.0	(7.12, 13.26)
	Midwest	20.3	(15.88, 24.65)	15.3	(13.56, 17.31)
	South	19.8	(15.26, 24.39)	17.1	(15.05, 19.40)
	West	16.1	(11.36, 20.81)	12.9	(10.70, 15.48)

[1] Poverty status is based on household income and household size using the U.S. Census Bureau's poverty thresholds. "Poor" persons are defined as those below the poverty threshold. "Near poor" persons have incomes of 100% to less than 200% of the poverty threshold. "Not poor" persons have incomes of 200% of the poverty threshold or greater.

[2] The wording of this option on the HINTS questionnaire was slightly different from that on the NHIS questionnaire.

Table 2 shows the proportion of adults living in cell phone-only households by the eight demographic characteristics that were measured by both studies. Both HINTS and NHIS suggested that cell phone-only status was highly correlated with variables such as age, employment status, income, and tenure status. For example,

- Adults aged 29 and under were more likely to live in a cell phone-only household than those aged 30 and above. The cell phone-only rate was negatively correlated with age for adults aged 25 and above. Although the HINTS estimates were slightly higher for the reasons described in Section 2.3, the differences between HINTS and NHIS were not statistically significant. The pattern of the differences across age groups in HINTS was similar to NHIS.

- By employment status, one in four students lived in a cell phone-only household. HINTS and NHIS exhibited very similar patterns, although the HINTS estimates were less stable due to its smaller sample size.

- Both HINTS and NHIS indicated that people renting their place were more likely to be in cell phone-only households than those who owned their homes

Although the race/ethnicity distribution of the cell phone-only population in HINTS was similar to that in NHIS in general, it is also worth focusing on the comparison between Hispanics and non-Hispanic white. Based on the NHIS estimates, a Hispanic person was significantly more likely than a non-Hispanic white to live in a cell phone-only household. Although the HINTS data suggested the same direction of the difference, the magnitude of the difference was smaller and insignificant. We suspect that HINTS underestimated the percent of cell phone-only adults among Hispanics – Although the estimated proportion (19.5%) was almost equal to that in NHIS (19.3%), we would expect the HINTS estimate to be higher due to the reasons described in Section 2.3.

The HINTS result on race/ethnicity distribution sheds light on a methodological issue. One explanation for the low estimate of the cell phone-only population among Hispanics is that HINTS did not send any questionnaires in Spanish. The contact letter included a short instruction for the target respondents who were Spanish speakers asking them to call the telephone center to complete the interview over the phone in Spanish. However, very few people called in to do the survey this way. Thus HINTS may have failed to obtain enough cooperation from the non-English speaking Hispanics who, compared to English-speaking Hispanics, may have been more likely to live in a cell phone-only household. The challenge of implementing multiple-language questionnaires is the trade-off between reaching non-English speakers and discouraging cooperation of English speakers, which can be a limitation of mail surveys.

Table 2 also shows the other demographic characteristics examined. The 95 percent confidence intervals suggest that none of the HINTS estimates in any demographic groups was significantly different from its NHIS counterpart, although the HINTS estimates were less stable in some demographic groups due to their small sample sizes. In all the eight measures, the HINTS demographic distributions of the adults living in cell phone-only households were very similar to NHIS.

4. Health-Related Characteristics of the Cell Phone-Only Population

Since HINTS is a health-related survey, the next research question would be how well the Mail survey had characterized the health-related characteristics of the adults living in cell phone-only households. There were four common health-related measures between HINTS and NHIS Early Release – currently uninsured, currently smoking, self-reported health status, and self-reported serious psychological stress. We compared these health-related characteristics of the cell phone-only group to the characteristics of those with a landline by first looking at the raw differences and then examining the adjusted differences once the demographic variables were controlled for. The NHIS estimates were used as the benchmark for both comparisons.

4.1 Raw Differences between Cell Phone-Only Population and hose with Landline Telephone

As shown in Table 3, for the variables “currently uninsured” and “currently smoking”, the estimates from the HINTS Mail survey were not significantly different from the NHIS estimates. Both surveys indicated that adults living in cell phone-only households were less likely to have access to health insurance and more likely to be current smokers.

For the measures on general health status and serious psychological distress, the picture was more complex – the HINTS Mail survey seemed to have gained more cooperation from individuals who were less healthy physically and emotionally. Table 3 shows that HINTS respondents were less likely to report having good or excellent health and more likely to have experienced serious psychological distress (in the past 30 days). This bias seemed to be inflated among the adults living in cell phone-only households – the cell phone-only group in HINTS was not significantly healthier than those with a landline, which was inconsistent with what NHIS data suggested. Both surveys indicated that adults living in cell phone-only households were more likely to have experienced serious psychological distress, but the HINTS estimate was much higher compared to NHIS.

The difference between the HINTS and the NHIS general health estimates could be attributed to under-coverage, nonresponse, or measurement error. As a cancer-related survey, the HINTS topic probably seemed more salient to less healthy individuals. There might also be a mode effect – NHIS respondents might be reluctant to admit their physical and psychological problems in the face-to-face interviews while the HINTS mail mode could make the individuals more comfortable to report their honest answers. Another possible factor was the under-coverage problem of the mail frame in very rural areas, where people might be less likely to feel psychologically distressed. Given that the HINTS Mail overall estimate of serious psychological distress is 3 – 4 times as large as the NHIS estimate, comparing the cell phone-only distributions between the two surveys is a bit difficult. Even in this case, however, the ratio of the estimate for the cell phone-only group to the non-cell phone-only group is in the same direction across the two surveys.

Table 3: Prevalence rates and 95 percent confidence intervals for health-related measures surveyed in both HINTS and NHIS, by household telephone status

	HINTS Mail survey		*NHIS*	
	Estimate	*95% CI*	*Estimate*	*95% CI*
Currently uninsured				
Adults in cell phone-only households	31.1	(23.66, 38.50)	28.7	(25.78, 31.76)
Adults in households with a landline	13.3	(11.01, 15.50)	13.7	(12.69, 14.68)
Currently smoking				
Adults in cell phone-only households	34.3	(27.40, 41.15)	30.6	(27.60, 33.68)
Adults in households with a landline	19.3	(17.20, 21.36)	18.0	(16.67, 19.35)
Health status self-described as excellent or good				
Adults in cell phone-only households	48.5	(40.76, 56.15)	67.5	(64.3, 70.56)
Adults in households with a landline	46.9	(43.81, 50.07)	59.5	(57.91, 61.03)
Experienced serious psychological distress- past 30 days[1]				
Adults in cell phone-only households	17.6	(11.63, 23.52)	4.1	(3.09, 5.39)
Adults in households with a landline	7.2	(6.02, 8.34)	2.4	(2.05, 2.89)

[1] Six psychological distress questions are included in the HINTS as in NHIS. These questions ask how often during the past 30 days a respondent experienced certain symptoms of psychological distress (feeling so sad that nothing could cheer you up, nervous, restless or fidgety, hopeless, worthless, that everything was an effort). The response codes of the six items for each person are summed to yield a scale with a 0-to-24 range. A value of 13 or more for this scale indicates that at least one symptom was experienced "most of the time" and is used here to define serious psychological distress.

4.2 Effect of Cell Phone-Only after Controlling for Demographic Characteristics

The analysis above shows the four general health-related measures are associated with household phone status. Since phone ownership is also correlated to demographic characteristics, it is useful to assess whether the cell phone-only group still differ from those with a landline when the demographic variables were accounted for. This addresses whether it is possible to develop statistical adjustments (e.g., weights) which could account for the omission of a cell phone-only population (e.g., in a landline survey) and eliminate the potential bias associated with it. Using logistic regressions, we studied the relationship between cell phone-only status and the health-related measures using the demographic characteristics as the control variables. As in the previous sections, NHIS estimates were utilized as the benchmark to evaluate the HINTS adjusted odds ratios.

Table 4: Relative odds ratios of health-related measures surveyed in both HINTS and NHIS, comparison between adults living in cell phone-only households and those living in households with landlines

	HINTS adjusted odds ratio for "cell phone-only"	*NHIS adjusted odds ratio for "cell phone-only"*
Currently uninsured	1.91*	1.41*
Currently smoking	1.27	1.49*
Very good or excellent health	1.15	1.03
Serious psychological distress	2.26*	1.03

1. All regressions used final weights and controlled for Census region, age, gender, race/ethnicity, marital status, education, and income.
2. * Indicates the adjusted odds ratio was significant at 5 percent level.

Table 4 shows that adults living in cell phone-only households were less likely to have access to health insurance even after the demographic variables were controlled for, which was consistent with the NHIS finding. For current smoking, the adjusted odds ratio for cell phone-only was close to the NHIS estimate, although the HINTS estimate was insignificant probably due to the small sample sizes. For self-reported health status, both surveys found phone status insignificant when the demographic characteristics were controlled for. For serious psychological distress, HINTS adjusted odds ratio was much higher and significant, which could be due to nonresponse bias, under-coverage or measurement error, as discussed in Section 4.1.

5. Effect of Cell Phone-Only on HINTS-Specific Measures

We also studied selected measures unique in the HINTS survey, including health information seeking and health-related communication, use of health service, and cancer-related variables. The research question was whether it was important for HINTS to obtain cell phone-only respondents for these measures.

A total of 58 measures in 5 categories were examined, as shown in Table 5, which include the differences before and after controlling for demographic variables. Prior to controlling, significant differences were found for 21 measures. Once controlling for demographic differences, 16 measures exhibited a significant difference between cell phone-only and non-cell phone-only households. This suggests that for HINTS it seems important to include the cell phone-only population in the survey, especially as this population grows larger.

Table 5: Differences between "cell phone-only" and "having a landline" on HINTS-specific measures

		Number of variables with significant differences between "cell phone-only" and "having-landline"		
Type of measures	*Total number of variables*	*Raw difference*	*When demographics were controlled for*	*Both in raw difference and when controlling for demographics*
Seeking information about health	16	4	6	3
Ways Internet has been used to obtain information	10	5	4	4
Use of health care service	15	7	4	3
View about medical information and research	7	1	0	0
Cancer history, cancer knowledge, and feelings about cancer	10	4	2	2
All the variables studied	58	21	16	12

6. Conclusions and Discussions

In summary, a mail survey is a reasonable alternative to obtain response from adults living in cell phone-only households. Our study shows that demographic characteristics of the cell phone-only population in the HINTS Mail survey were very similar to the benchmark. The general health-related measures in HINTS (i.e. currently uninsured, currently smoking and self-reported physical and emotional health) were also close to NHIS. For both general health-related measures and HINTS-specific outcomes that were of key interest, cell phone-only status seemed to have an impact on the estimates that was independent of demographic characteristics. It was essential to obtain cooperation from the cell phone-only population in order to reduce the potential bias in the survey.

Finally, it is important to point out that mail surveys may not be appropriate in all situations. One issue concerns the necessity to conduct complicated within-household selection (e.g., subsetting for particular age groups) – We currently do not have tested procedures to handle this situation. In addition, a mail survey is not appropriate if the instrument itself is extremely lengthy or has complicated skip patterns. These methodological issues, among others, pose RDD and the DSF as alternative frames (and sampling and data collection methodologies), rather than using one or the other under all circumstances.

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