December, 2008

CHIS Working Paper Series

CHIS 2005 Neighborhood Response Propensity Study

Sunghee Lee, UCLA Center for Health Policy Research
E. Richard Brown, UCLA Center for Health Policy Research
David Grant, UCLA Center for Health Policy Research
Thomas Belin, UCLA Department of Biostatistics
J. Michael Brick, Westat

Suggested citation:
California Health Interview Survey. *CHIS 2005 Neighborhood Response Propensity Study. CHIS Working Paper Series.* Los Angeles, CA: UCLA Center for Health Policy Research, 2008.

INTRODUCTION

Declining response rates over the last decade may raise concerns regarding public health research using population-based survey data. Response rates are commonly considered the most important indicator of the representativeness of a survey sample and overall data quality, and low response rates are viewed as evidence that a sample suffers from nonresponse bias.[1,2]

Recent survey research literature, however, suggests that response rates are a poor measure of not only nonresponse bias, but also data quality.[3-7] This article explores nonresponse bias in a large, population-based telephone health survey in California. Data from the California Health Interview Survey (CHIS) are linked to Census data at the tract level to compare respondents and nonrespondents across a broad range of neighborhood characteristics.

The decline of survey response rates over the past several decades has led to a number of rigorous studies and innovative methods to explore the relationship between survey response rates and bias. A meta analysis that examined response rates and nonresponse bias in 59 surveys found no clear association between nonresponse rates and nonresponse bias.[8] Some surveys with response rates under 20% had a level of nonresponse bias that was similar to surveys with response rates over 70%. This is because nonresponse bias is a function of both the response rate and the difference in a variable of interest between respondents and nonrespondents[9] or a function of covariance between response propensity and a variable of interest.[10] Thus, response rates alone are not the determinant of nonresponse bias of the survey estimates. Although it may be

convenient to use the response rate as a single indicator of a survey's representativeness and data quality, nonresponse bias is a property of a particular variable, not of a survey.

Nonetheless, declining survey response rates increase the potential for nonresponse bias and may raise questions about for the representativeness of inferences made from probability sample surveys. Inferences from surveys are based on randomization theory and assume a one hundred percent response from the sample. While the gap between theory-based assumptions and the reality of survey administration has always been a concern, the increasing deviation from the full response assumption increases this concern.

Nonresponse is multidimensional, not a unitary outcome, and can be divided into three components: noncontact, refusal and other nonresponse.[9] The majority of nonresponse is comprised of the first two components. A study by Curtin and his colleagues found that refusal rates remained constant in a telephone survey between 1979 and 2003, while the contact rates decreased dramatically.[11] Another study by Tuckel and O'Neill found the same pattern.[12]

Arguably, different dynamics lead to noncontact and refusals.[13, 14] Noncontact (unanswered phone calls in RDD surveys) is related to accessibility. Call screening devices and phone usage and at-home patterns affect accessibility.[7, 12] Among the correlates examined above, calling strategy (e.g., number of call attempts and timing of calls) directly influences contact rates. Refusal occurs only after contact is made. The decision to participate or not is an indicator of the respondent's amenability to the survey and is also influenced by other factors.

The types of potential biases differ between noncontact and refusal, and the respective biases may offset one another.[7, 15] For example, measures on volunteerism may be biased due to noncontact because those who spend much time volunteering may be hard to reach in RDD surveys. On the other hand, those who refuse to participate in the same survey may have opinions and behaviors related to volunteerism that differ dramatically from those of persons who are never contacted. Aggregating noncontact and refusal may obscure our understanding of nonresponse bias. Therefore, understanding detailed response behaviors along with overall nonresponse bias is important.

The decline in response rates is more rapid for random digit dial (RDD) telephone surveys compared to other survey types. The difficulties inherent in examining nonresponse bias arise from the absence of data on nonrespondents. Unlike face-to-face surveys, in which interviewers make direct observation of the sample and have an opportunity to gather contextual information regardless of response status, such information is scarce in telephone surveys as interviewers do not visit the sample and the interviewer-respondent interaction, if there is any at all, remains oral and on the phone. Follow up with nonrespondents in a telephone survey can be conducted to study its nonresponse bias, but such efforts are resource intensive and some level of nonresponse is still likely to remain.

Alternatively, nonresponse can be studied by utilizing the geographic identifiers associated with sampled telephone numbers. Phone numbers from RDD sampling frames can be associated with a limited number of geographic identifiers, such as ZIP codes. Also, most phone numbers can be matched to a postal address, and consequently, census

tract and county. This provides a unique opportunity to evaluate patterns of nonresponse as a function of neighborhood characteristics. A few recent nonresponse bias studies have used the contextual data.[16-19]

This study examines potential nonresponse bias in CHIS 2005, a large RDD telephone survey, by comparing response rates across a wide range of neighborhood characteristics at the census tract level. While these characteristics are not specific to individual cases, neighborhood characteristics at the census tract level serve as useful proxy indicators of differences in the population. This is because census tracts are designed to be homogeneous with respect to socio-demographic characteristics and their boundaries are revised according to the population changes.[20] Unlike previous studies mentioned above which focused on statistical significance, this study discusses substantive significance.

METHODS

The data for this study is a product of four different data sources: (1) California Health Interview Survey (CHIS) 2005 call history data, (2) Census 2000 SF-3, (3) Census 2000 administrative data, and (4) 2004 General Election data. CHIS is a biennial RDD survey of California's population and is one of the largest RDD telephone surveys in the United States. In CHIS 2005, interviewers made up to 15 call attempts to each of 225,229 eligible telephone numbers for the screener interview conducted with a household informant to obtain roster information for selecting the adult respondent. When adjusted for the sampling design, the screener interview response rate was 49.8% using Response Rate 4 defined by American Association for Public Opinion Research

(AAPOR).[21] The response rate for selected adults was 54.0%, and the overall response rate for adults was 26.9%.

CHIS call history data include all sample cases, and information for those samples on response behavior at the screener interview and on geographic location. In this paper, we focus on nonresponse at the screener interview stage because a greater number and proportion of the sample failed to be captured at that stage. We exclude cases released at later parts of the data collection from the analysis to eliminate any potential confounding effects. These cases did not necessarily receive the same level of refusal conversion efforts and calling attempts in order to meet the project timeline. The total sample size for this study is 143,731.

All telephone numbers were matched to the addresses to the extent possible which were in turn geocoded to the corresponding census tracts. For those without exact addresses, we used the most likely ZIP code included in the sample frame and assigned the census tract of the corresponding ZIP code's centroid. This was done for 29.1% of the total sample. Additionally, each sample was also linked to county.

For each case in the CHIS administrative data set, we had identical contextual information with which to compare (1) respondents, (2) persons who were contacted but refused to respond, and (3) phone numbers at which there no contact was made. The contextual information was drawn data from 2000 Census and data from the November 2004 General Election in California. Census 2000 SF-3 provides a series of detailed demographic, socio-economic and other characteristics of individuals, families, households and housing units in the population. It also includes some information on disability. Census 2000 administrative data include the response rates of the Census 2000

mail version and hard-to-count score. The hard-to-count score is a composite of twelve variables summarizing enumeration difficulty.[22] The last data source, 2004 General Election data, was obtained from UC Berkeley Institute of Governmental Studies Statewide Database (http://swdb.berkeley.edu) and includes voter registration, registered voters' party identification and voting behavior.

While the CHIS call history data are specific to each individual, the rest are aggregate characteristics at what we refer to as the neighborhood level. All census data were used at the tract level; and the election data at the county level. These four data files were merged so that each of 143,731 cases in the CHIS administrative data has variables from three other data sources. For example, an unemployment variable indicates the population proportion of unemployed persons within the census tract where the sample is located rather than whether or not the person in the sample is unemployed.

Potential nonresponse bias was evaluated in two ways. First, we divided the sample by response behavior and computed respective means of neighborhood characteristics. Nonresponses were further classified into three groups: refusals (e.g., refusal, call back appointment or request for advance letters), noncontacts (e.g., ring no answer, reached the maximum call number, answering machine or questionable ring) and other nonresponse (e.g., hearing and speech problem, language difficulty or other nonresponse). The second evaluation used the total sample mean of each neighborhood characteristics from the first evaluation and divided the sample into high and low groups (for example, low proportion of urban population vs. high proportion of urban population). We then calculated response rates for respective groups. Both analyses were expected to show neighborhood characteristics associated with response behaviors.

We expect even small differences to be statistically significant due to large sample sizes. Consequently, tests of statistical significance may not be meaningful, and we do not report them. We conducted both weighted and unweighted analyses using SAS 9.2. As unweighted results showed larger differences, we report them to be more conservative.

RESULTS

Out of 143,731 cases, 54,976 completed the screener interview and 88,755 did not. More specifically, nonresponses were comprised of 46,623 refusals, 40,769 noncontacts and 1,362 other nonresponses. This gives an unweighted response rate of 38.2%. The samples were located in 6,968 out of 7,049 tracts and all 58 counties in California. Table 1 shows the distribution of the sample sizes and response, refusal and noncontact rates at the census tract level. On average, 20.6 telephone numbers were sampled from each tract with a standard deviation of 27.1. The response rate at the census tract level was 43.8%. The percentile figures show that there is a dispersion in tract-level response rates, where the 10^{th} and 90^{th} percentiles fall on 20.0% and 66.7%, respectively. The average refusal rate was 34.0%; and that of noncontact 21.1%. From this, we can see that census tracts behave differently with respect to responding to survey requests.

Table 1 about here

Table 2 shows the means of thirty different neighborhood characteristics for respondents and nonrespondents. Throughout all the characteristics reported, CHIS respondents and nonrespondents appear very similar - there is almost no difference between these two groups in population and housing unit sizes and gender, age, education,

income, employment and disability distributions. In terms of race, nonrespondents tend to live in areas with more Hispanics and non-Hispanic Asians and fewer non-Hispanic whites than respondents. Nonrespondents are more likely to live in urban areas and areas with higher proportions of renters and never-married single persons. The imputation rates for income in Census 2000 do not differ between respondents' and nonrespondents' neighborhoods, and neither do Census 2000 mail survey response rates. The census hard-to-count score indicates that respondents tend to live in areas easier to count. From Appendix 1, which shows the detailed sample distributions of these characteristics, we can see that the similarity between respondents and nonrespondents is not due to the similarity across census tracts as tracts appear to vary one from another. (Note: Comparisons were done on over 90 variables. Characteristics shown in this paper tend to present larger differences between respondents and nonrespondents than those not shown.)

When examining detailed nonresponse types, respondents and refusals appear very similar–practically identical. On the other hand, noncontacts show larger differences from respondents than nonrespondents as a whole do, in that they are more likely to be living in areas that are urban, with more minority populations, single persons, one-person households, linguistically isolated persons, renters, older housing units, and higher Census hard-to-count scores. This indicates that not all nonrespondents are the same and that the similarity between respondents and nonrespondents in this study is not due to the offsetting characteristics of refusals and noncontacts. Other nonrespondents show characteristics different from respondents as well as refusals and noncontacts, as they are substantially more likely to be associated with ethnic and linguistic minorities.

This is not surprising as CHIS does not provide all languages spoken by California's population. Given the small proportion of other nonrespondents among all nonrespondents, their distinctive characteristics are unlikely to distort the implications about nonresponse bias.

Table 3 about here

Table 3 provides response rates by neighborhood characteristics. As mentioned previously, the quartile points of each variable in Appendix 1were used to divide samples into four groups. For instance, areas with a total population size smaller than 4,073 persons are categorized into the first quartile, those between 4,073 and 5,372 into the second, those between 5,372 and 6,757 into the third and the rest into the fourth. Response rates in respective quartiles were calculated. Overall, the response rates do not vary substantially among the four groups across a majority of the neighborhood characteristics. However, characteristics that showed differences between respondents and nonrespondents in Table 2 again show differing response rates. The response rates tend to be higher in the areas with higher proportions of non-Hispanic whites, English-only speaking populations, and newer housing, and lower proportions of non-Hispanic Asians, singles, one-person householders, linguistically isolated persons, and renters and lower Census hard-to-count scores. Additional characteristics, such as higher proportion of those receiving social security income and those having available vehicle, and lower proportions of registered Democrats, appear associated with positive response rates.

Nonetheless, these response rate differences were less than a 9% point except for single marital status and renter status.

DISCUSSION

In this study, we evaluated nonresponse bias in an RDD telephone survey using neighborhood characteristics as proxy measures. As noted earlier, nonresponse bias differed by variables. We found that the estimates of this survey may understate proportions of urban area residents, single persons, renters, and racial and linguistic minorities. Potentially, health estimates associated with these characteristics may have been affected. However, the degree of potential underestimation was rather small. Characteristics, such as age, gender, income, education, and employment status, did not show much association with response behaviors. While it seems reasonable to expect that census-tract-level response rates would be highly associated with census mail response rates and missing rates of income in census, the results did not support this. Most importantly, neighborhood disability status estimates, the most-likely correlate of many health characteristics, were almost identical between respondents and nonrespondents.

This study examined characteristics at the neighborhood level and has its limitations. First, the diversity at the individual level may be lost in the aggregate data. Second, estimates from census SF-3 are subject to sampling errors. Therefore, the findings should be interpreted cautiously as proxy measures with sampling variability not as direct measures of nonresponse bias. Third, while the survey was conducted in 2005, the majority of the neighborhood data were from 2001. Although it is likely that there

have been changes during that period, the changes at the census tract level may not be large.

In spite of these limitations, the findings are compelling. Unlike prevailing assumptions about nonresponse bias arising from low response rates, this study finds that the neighborhood characteristics of respondents differ little from those of nonrespondents and most of the observed difference is among households that could not be contacted, as distinguished from those that refused to participate in the screener interview. Our findings are consistent with most previous studies on survey nonresponse. At least for the California Health Interview Survey, relatively high refusal rates do not appear to result in a biased sample. Even differences between noncontact households and respondent households are small, but because this is the fastest growing segment of nonresponse, it should remain an important focus of efforts to boost response rates.

By no means are survey data free from error. Nonresponse is merely one of four error sources: noncoverage, sampling, nonresponse, and measurement, according to the total survey error paradigm.[9] High response rates do not necessarily produce high quality data. For instance, one may use large financial incentives to increase response rates. This may attract a certain group in the population more than other groups and lead to systematic measurement error. The overall error may decrease, increase or stay the same. Response rates are simply one of the many ways to summarize characteristics of a survey and may be a convenient, but not necessarily a scientific, tool to summarize nonresponse bias. This is well reflected in a statement by AAPOR (http://aapor.org/responseratesanoverview): "…… consumers of survey results should treat all response rates with skepticism, since these rates do not necessarily differentiate

reliably between accurate and inaccurate data." It is evident that a broader spectrum of error sources should be taken into consideration when evaluating survey data quality.

REFERENCES

1. Federal Judicial Center *Reference Manual on Scientific Evidence. Second Edition.* Washington, DC: Federal Justice Center;2000. (http://www.fjc.gov/public/pdf.nsf/lookup/sciman00.pdf/$file/sciman00.pdf). (Accessed December 2, 2006).

2. Office of Management and Budget. (2006). *Guidance on Agency Survey and Statistical Information Collections: Questions and Answers When Designing Surveys for Information Collections.* Washington, DC:Office of Information and Regulatory Affairs. (http://www.whitehouse.gov/omb/inforeg/pmc_survey_guidance_2006.pdf). (Accessed December 2, 2006).

3. Curtin R, Presser S, Singer E. The effect of response rate changes on the Index of Consumer Sentiment. *Pub Opin Q.* 2000; 64(4):413-428.

4. Keeter S, Miller C, Kohut A, Groves R, Presser S. Consequences of reducing nonresponse in a large national telephone survey. *Pub Opin Q.* 2000;64:125-148.

5. Merkle D, Edelman M. Nonresponse in exit polls: A comprehensive analysis. In: Groves RM, Dillman DA, Eltinge JL, Little RJA, eds. *Survey Nonresponse*. New York: Wiley; 2002.

6. Blumberg S, Davis K, Khare M, Martinez M. The effect of survey follow-up on nonresponse bias: Joint Canada/United States Survey of Health, 2002-03. Presented at the annual meeting of the American Association for Public Opinion Association, Miami Beach, FL, 2005.

7. Montaquila J, Brick JM, Hagedorn MC, Kennedy C, Keeter S. Aspects of nonresponse bias in RDD telephone surveys. In: Lepkowski JM, Tucker C, Brick JM, De Leeuw E, Japec L, Lavrakas PJ, Link MW, Sangster RL, eds. *Advances in Telephone Survey Methodology*. New York: Wiley; 2007.

8. Groves RM, Peytcheva E. The impact of nonresponse rates on nonresponse bias. *Pub Opin Q.* 2008;72(2), 167-189.

9. Groves RM. *Survey Errors and Survey Costs*. New York: Wiley; 1989.

10. Bethlehem JG. Weighting nonresponse adjustments based on auxiliary information. In: Groves RM, Dillman DA, Eltinge JL, Little RJA, eds. *Survey Nonresponse*. New York: Wiley; 2002.

11. Curtin R, Presser S, Singer E. Changes in telephone survey nonresponse over the past quarter century. *Pub Opin Q.* 2005;69(1):87-89.

12. Tuckel P, O'Neill H. The vanishing respondent in telephone surveys. *J Advertising Res*. 2002;42(5):26–48.

13. Groves RM, Couper MP. *Nonresponse in Household Interview Surveys*. New York: Wiley; 1998.

14. Iannachione VG. Sequential weighting adjustments for location cooperation propensity for the 1995 National Survey of Family Growth. *J Off Stat.* 2003;19(1):31-43.

15. O'Neil MJ. Estimating the nonresponse bias due to refusals in telephone surveys. *Pub Opin Q.* 1979;43:218-232.

16. Triplett T, Abi-Habib N. Socio-demographic study of telephone survey nonrespondents. Presented at the Federal Committee on Statistical Methodology Research Conference. Arlington, VA, 2005.

17. English N, Schwartz L, Goble L. Where, exactly, are the RDD non-respondents: A GIS-based approach to quantifying potential bias. Presented at the annual meeting of American Association for Public Opinion Research, Montreal, Canada, 2006.

18. Johnson TP, Holbrook AL, Cho YI, Bossarte RM. Nonresponse error in injury-risk surveys. *Am J Prev Med.* 2006;31(5): 427-436.

19. Hubbard R, Guterbock TM. Community attachment and nonresponse: Bringing the community back into attachment. Presented at the annual meeting of American Association for Public Opinion Research, Montreal, Canada, 2006.

20. U.S. Census Bureau. *Geographic Areas Reference Manual*. Washington, DC: U.S. Census Bureau; 1994. (http://www.census.gov/geo/www/garm.html). (Accessed December 2, 2006).

21. The American Association for Public Opinion Research. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys. 5th edition*. Lenexa, Kansas: AAPOR; 2008. (http://aapor.org/uploads/Standard_Definitions_07_08_Final.pdf). (Accessed September 28, 2008).

22. Bruce A, Robinson JG, Sanders M. Hard-to-count scores and broad demographic groups associated with patterns of response rates in Census 2000. Presented at the Joint Statistical Meeting, Atlanta, GA, 2001.

Table 1. Distribution of Census Tract Level Sample Size, Response Rate, Refusal Rate and Noncontact Rate

	Sample Size	Response Rate	Refusal Rate	Noncontact Rate	Other Nonresponse Rate
(n)	6968	6968	6968	6968	6968
Mean	20.6	43.8	34.0	21.1	1.1
Std. Dev.	27.1	18.9	16.3	16.4	0.0
Std. Err.	0.3	0.2	0.2	0.2	60.0
Minimum	1.0	0.0	0.0	0.0	3.7
Maximum	452.0	100.0	100.0	100.0	0.0
1st Percentile	2.0	0.0	0.0	0.0	0.0
5th Percentile	3.0	13.6	7.7	0.0	0.0
10th Percentile	5.0	20.0	15.0	0.0	0.0
25th Percentile	8.0	31.8	25.0	10.0	0.0
Median	13.0	43.8	33.3	18.8	0.0
75th Percentile	21.0	55.6	42.9	29.4	0.0
90th Percentile	43.0	66.7	52.4	42.9	3.7
95th Percentile	67.0	75.0	60.0	51.9	7.7
99th Percentile	137.0	100.0	80.0	69.6	16.7

Table 2. Distribution of Neighborhood Characteristics by Response Behavior

	Response	Nonresponse			
Neighborhood Characteristics	Total	Total	Refusal	Noncontact	Other
(n)	54,969	88,752	46,621	40,769	1,362
Total population size (persons)	5613.3	5602.9	5629.0	5571.5	5649.0
Male (%)	49.4	49.4	49.3	49.5	49.4
Ages 0-17 (%)	26.3	25.7	26.3	25.1	25.0
Ages 65 and over (%)	12.0	12.0	11.9	12.0	12.3
Hispanic (%)	26.5	27.5	27.1	27.8	28.9
Non-Hispanic white (%)	54.6	51.9	52.9	50.9	45.0
Non-Hispanic African American (%)	5.0	5.3	5.2	5.3	5.4
Non-Hispanic Asian (%)	9.8	11.3	10.7	11.9	16.1
Urban population (%)	89.0	92.2	91.5	93.0	96.8
Never married (%)	28.0	29.5	28.5	30.5	31.3
1-person household (%)	22.1	23.5	22.4	24.8	24.8
Speak English only (%)	64.9	62.3	63.4	61.4	53.2
Linguistically isolated (%)	8.5	9.8	9.1	10.4	14.1
Living in the same house as 1995 (%)	51.0	50.2	50.8	49.5	50.3
Less than high school education (%)	21.3	22.1	21.7	22.3	25.0
Unemployed (%)	4.3	4.2	4.2	4.2	4.6
Not in labor force (%)	37.6	37.5	37.5	37.3	38.9
Median household income ($)	51927.1	51531.0	52418.4	50672.1	46870.0
FPL Under 1.00 (%)	12.9	13.4	12.9	13.9	15.4
With social security income (%)	23.8	22.9	23.4	22.4	22.3
With at least one disability (%)	19.0	19.2	19.1	19.4	20.9
Total housing units (no.)	2105.4	2124.1	2108.0	2142.7	2121.5
Vacant housing (%)	5.8	5.6	5.6	5.6	4.3
Renter occupied housing (%)	38.6	42.5	39.7	45.4	49.7
Housing built after 1990 (%)	14.9	13.4	14.1	12.5	10.6
Housing with no vehicle available (%)	8.3	9.7	8.8	10.7	12.6
Median gross rent ($)	844.3	858.3	861.2	856.2	821.0
Census 2000 Hard-to-count score (0~122)	38.3	41.3	39.2	43.5	49.1
Census 2000 mail participation (%)	76.5	76.3	76.6	75.9	76.0
No income imputed (%)	70.7	70.9	70.8	71.0	70.9
Voted in 2004 General Election (%)	75.7	75.9	75.9	76.0	75.0
Registered Democrat (%)	43.1	43.8	43.4	44.2	45.7