Subunit Nonresponse in the National Health Interview Survey (NHIS): An Exploration Using Paradata

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Abstract

While the National Health Interview Survey (NHIS) household and family response rates remain high (87% in 2007), the sample adult response rate has dropped to under 70%. Since critical health information is collected from sample adults, more attention should be given to their participation rates and the potential for bias in key health estimates. In this paper, we use 2007 paradata, including measures of respondent reluctance, along with frame, family-level, and sample adult data (health and sociodemographic data collected with the family interview), to model sample adult participation and explore bias due to sample adult nonresponse.

Key Words: Paradata, subunit nonresponse, response propensities, nonresponse bias

1. Introduction[1]

The National Health Interview Survey (NHIS), like many other large national sample surveys, has experienced a decline in response rates over the past 10 to 15 years.[2] Low participation rates in surveys matter to the extent that they introduce a potential bias in survey estimates. Bias is a function of both the degree to which nonrespondents and respondents differ on a survey estimate and the proportion of nonresponse. Until recently survey analysts could rely on high response rates as buffers against bias, even if respondents and nonrespondents differed greatly on an estimate of interest.

As response rates have declined, survey methodologists have described the problem, proposed and tested interventions designed to improve response (such as incentives), and, most recently, for any given survey estimate, explored methods for determining the degree of bias attributable to nonresponse (Singer, 2006).

Previous NHIS studies have focused on nonresponse at the household level (unit nonresponse), with less attention given to the participation of sample persons within responding households (subunit nonresponse). With the NHIS, attempts are made to interview each family within a responding household. For each family, additional health information is collected from one randomly selected adult aged 18 or older (sample adult), and on one randomly selected child under age 18 (if children are present). While household and family response rates continue to hover around 87%, the final sample adult response rate dropped to 68% in 2007. Since many key NHIS survey estimates come from sample adult interviews (located at the end of the NHIS questionnaire), more analysis of sample adult participation and the potential for nonresponse bias in key sample adult estimates is warranted.

[1] The findings and conclusions in this paper are those of the authors and do not necessarily reflect the views of the National Center for Health Statistics, Centers for Disease Control and Prevention.
[2] The household response rate, for example, dropped from 91.8% in 1997 to 87.1% in 2007.

Utilizing sample frame, paradata (data about the data collection process), and family module data from the 2007 NHIS, we examined the following questions: What factors are related to sample adult participation? More specifically, what are the associations between a set of paradata-based measures (e.g., concerns or reluctance expressed by householders, level of interviewer effort) and sample adult participation, net of social environmental, family-level, and sample adult measures? Do these measures have similar impacts on sample adult participation as found at the household level, once the interviewer has gained entrée and completed portions of an NHIS interview (see Bates, Dahlhamer, and Singer, 2008)? And what can sample adult response propensities tell us about potential nonresponse bias in key sample adult health estimates? That is, how do key estimates change as sample adults with lower response propensities are included in the sample?

2. Data and Analysis

2.1 The NHIS

The NHIS is a multi-purpose health survey and is the principal source of information about the health of the civilian, noninstitutionalized, household population of the United States. Conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC), the NHIS utilizes a multi-stage, clustered sample design, with oversampling of black, Hispanic, and Asian persons. The survey produces national estimates on health insurance coverage, health care access and utilization, health status, and health behaviors.

Roughly 600 interviewers with the U. S. Census Bureau conduct the in-person interviews (some telephone follow-up is allowed[3]) using computer assisted personal interviewing (CAPI). For 2007, interviews were conducted in 29,266 households, yielding data on 75,764 persons. The survey instrument contains four main modules: household composition, family, sample child, and sample adult. A household respondent provides demographic information on all members of the household in the household composition module. For each family within a household, the family module or interview is completed by one family respondent who provides sociodemographic and health information on all members of the family. Additional health information is collected from one randomly selected adult (sample adult) aged 18 years or over, and from the parent or guardian of one randomly selected child under age 18 (if there are children in the family).

2.2 Sources of NHIS Paradata: The Contact History Instrument (CHI) and "Back" Section of the Survey Instrument

A primary source of NHIS paradata is the Contact History Instrument (CHI), a stand-alone, Blaise-based instrument developed by the U. S. Census Bureau. For each attempt to contact a sample household, interviewers enter information on the day and time of the attempt, the mode of attempt (in-person or telephone), and the outcome of the attempt (contact or noncontact). For attempts resulting in contact, interviewers complete a

[3] Once a personal visit has occurred, telephone follow-up is permissible if a personal visit follow-up is not possible. At the end of an interview, interviewers are asked to report which main sections (household composition, family, sample child, sample adult), if any, were conducted primarily by telephone.

questionnaire screen on their laptops that includes 21 categories of respondent concerns, questions, and statements of reluctance—"concerns"—that may be expressed during interviewer-respondent interactions. The questionnaire utilizes a mark-all-that-apply format, and includes a "no concerns" and an "other-specify" category (see Figure 1 for 15 categories that apply to the NHIS). For all attempts, interviewers can report on strategies (e.g., leaving notes, using an informational brochure) they used to make contact or gain cooperation.

In addition to CHI, questions are posed directly to interviewers in the "Back" section of the NHIS instrument. Here it is ascertained if any main sections of the interview were conducted primarily by telephone, the reasons for a break-off or partial interview, and assessments of respondent cooperativeness. This information is typically collected on the subset of households where an interview was at least started.

2.3 Data Used in the Modeling of Sample Adult Participation and the Nonresponse Bias Analysis

Data on interviewed families, including sample frame, contact history, and responses to the family module, were used in a logistic regression analysis of participation among eligible sample adults (n=29,875). By focusing on interviewed families, a variety of measures could be constructed for both responding and nonresponding sample adults.[4] For the nonresponse bias analysis, data were limited to participating sample adults (n=23,393). All analysis was weighted using the sample adult base weight and performed in SUDAAN (Research Triangle Institute, 2005) to account for the complex sample design.

2.3.1 Dependent and Independent Variables for Ordinary Logistic Regression of Sample Adult Participation

The dependent variable of sample adult participation was defined as "interview" (n=23,393; 78.3%) versus "noninterview" (n=6,482; 21.7%), a rather rudimentary measure of participation. Ideally, we would have explored contact propensities among eligible sample adults, and then explored cooperation propensities conditional on contact. While we have information on nonparticipation for many sample adults, the information is not easily codable into traditional nonresponse categories. Scenarios traditionally coded as noncontacts at the unit level, for example, appeared to be more indicative of passive refusals at the subunit level. Other cases lacked sufficient documentation to determine their nonresponse disposition.

The independent variables included in our model were broken into five components: paradata measures, social environmental measures, family-level measures, sample adult sociodemographics, and sample adult health measures. Paradata measures selected for inclusion have been found to be predictive of interim and final refusals in a previous analysis of unit nonresponse in the NHIS (Bates, Dahlhamer, and Singer, 2008), including a set of householder "concern" variables. Figure 1 presents the percentage of participating families where concerns were expressed at one or more contacts. Factor

[4] It is important to note that the final family response rate for 2007 was 86.7%. Thus, we have no information on adults from the 13% of families that failed to participate.

[7] Using tetrachoric correlations as an input, a factor analysis of the 15 concerns was performed. Using a promax rotation of the initial factor solution, four factors were derived from the analysis.

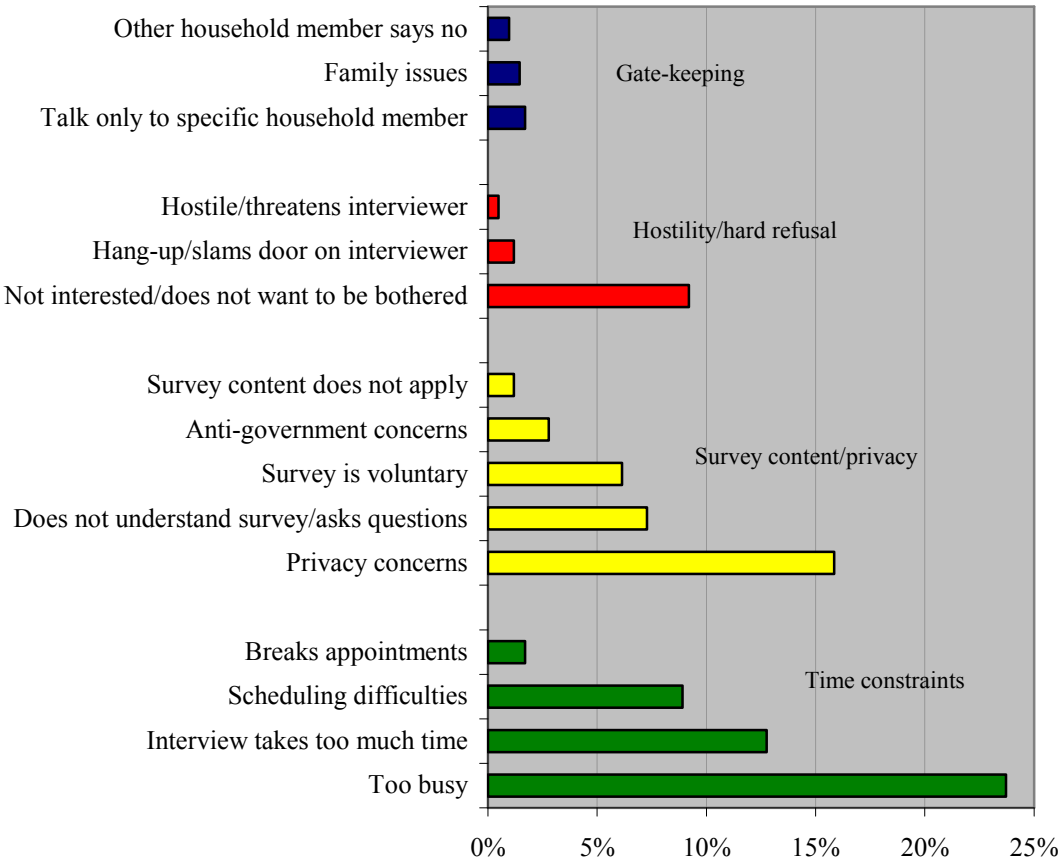

Figure 1. Percentage of Participating Families Where Concerns/Reluctance Were Expressed at One or More Contacts: NHIS, 2007 (n=29,875)

analysis of these concerns yielded four conceptual groups.[7] The categories at the top of the graph (shown in blue) comprise "gate-keeping" concerns and include such statements as "other household member says no" and "talk only to specific household member." The next group of concerns we termed "hostility/hard refusal," and these include categories (shown in red) such as "not interested/does not want to be bothered" and "hang-up/slams door on interviewer." The third set of concerns (shown in yellow) we labeled "survey content/privacy." Examples include "survey is voluntary," "survey content does not apply," and "privacy concerns." Finally, the most prevalent concerns mentioned (shown in green) are "time constraints" (bottom of graph). Mentions include "too busy," "interview takes too much time," and "scheduling difficulties." For each group of concerns we created a dichotomous measure: concerns mentioned at one or more contacts versus concerns not mentioned.[8]

Other paradata-based measures included in the model were: number of noncontacts prior to first contact with the family (a measure of accessibility); whether or not the interviewer was unable to complete the interview at one or more contacts due to a health problem;

[8] There was little difference in the impact of factor scores versus dichotomous summary measures on sample adult participation. We chose to present the simple dichotomous measures due to their ease of interpretation.

whether or not the interviewer was unable to complete the interview at one or more contacts due to a language problem; whether or not the case was reassigned to a different interviewer (an indicator of difficulty/interviewer effort); mode of the family interview (primarily by telephone or primarily in-person); and whether or not the sample adult was also the family interview respondent. We expected this last measure to be a particularly strong predictor of sample adult participation.

The remaining model components and measures drew from various theoretical perspectives on survey participation, such as social integration/isolation, discretionary time, topic interest, and authority heuristics (see Groves and Couper, 1998; Olson, 2007). Social environmental measures included metropolitan statistical area (MSA) status (a measure of population density as defined by the U.S. Census Bureau), and Census region of residence. The two family-level measures were presence of children (under age 18) and total family income for the prior calendar year.

As noted previously, limiting our analysis to participating families allowed us to construct a variety of sample adult measures. Several sample adult sociodemographic measures were included in the model: age, sex, race and ethnicity, education, marital status, employment status, citizenship status, veteran status (whether or not the sample adult had been honorably discharged from the U. S. Army, Navy, Air Force, Marine Corps, or Coast Guard), and receipt of government assistance in the prior calendar year (Supplemental Security Income; cash and other kinds of assistance from a state or county welfare program; food stamps; benefits from the Women, Infant, and Children program).

A final model component, sample adult health measures, was of particular interest to us, as it provided a means to assess the role of topic saliency or interest in survey participation. Measures included reported health status, whether or not the sample adult has a functional limitation, whether or not the sample adult delayed or did not receive care in the past 12 months due to cost, whether or not the sample adult had an overnight hospital stay in the past 12 months, whether or not the sample adult received some type of care in the past two weeks, whether or not the sample adult received care 10 or more times in the past 12 months, whether or not the sample adult had an injury and/or poisoning episode in the past three months, and health insurance coverage status. The coding for all variables is presented in Table 1.

2.3.2 Item Nonresponse

The paradata measures based on CHI data were subject to a small amount of item nonresponse (~ 1-2%). Additionally, a handful of variables based on family interview data were subject to item nonresponse, which varied by item. A two-step process was utilized to address item-level nonresponse. First, for measures based on family interview data, "unknown" categories combining don't know and refusal responses were included in the logistic regression analysis.[9] Second, we used the IMPUTE module in IVEware (Raghunathan, Solenberger, and Van Hoewyk, 2002) to multiply-impute missing values (five replacement values) of the CHI-based measures as well as "not ascertained" values of interview-based measures. For all measures, the percentage of imputed values did not exceed 2%. Comparisons of item-level distributions and logistic regression results revealed no substantive differences pre- and post-imputation.

[9] This had a two-fold effect of preserving sample for the analysis, as well as permitting an assessment of the extent to which item nonresponse was predictive of sample adult participation.

3. Results

3.1 Logistic Regression Results

3.1.1 Results for Paradata Measures

Table 1 presents the results for two logistic regressions predicting sample adult participation: model 1, which excludes the paradata measures, and model 2 (full model), which includes the paradata measures. The discussion that follows will focus on the full model (model 2), unless otherwise stated.

Significant effects were observed for all four summary concern measures (toward bottom of Table 1). Regardless if time constraints, gate-keeping concerns, hostility/hard refusal concerns, or privacy/content-related concerns were expressed, the result was significantly lower odds of sample adult participation. The results were strongest for time constraints (adjusted odds ratio (AOR) = 0.39; 95% confidence interval (CI) = 0.36-0.43) and hostility/hard refusal concerns (AOR = 0.40; CI= 0.35-0.47). In addition, as the number of noncontacts prior to first contact increased, the odds of a sample adult interview decreased. For example, compared to making contact with a family on the first attempt, four or more noncontacts prior to first contact (AOR = 0.67; CI=0.58-0.78) reduced the odds of sample adult participation by over 30%. A data collection period for the NHIS lasts 17 days. The longer it takes to make initial contact with a household, the less time there will be to complete all components of an NHIS interview. Typically, the sample adult module is the last of all main modules to be completed.

If the interviewer recorded at one or more contacts that he/she was unable to conduct or complete the interview due to a health problem, the odds of sample adult participation were reduced (AOR = 0.61; CI = 0.44-0.85). As a sign of nonignorable nonresponse, this clearly suggests that bias may be present for health conditions and other health-related measures in the sample adult interview. If the case had been reassigned to a different interviewer, the odds of sample adult participation were, as expected, also reduced (AOR = 0.71; CI = 0.62-0.82). Normally, cases are not transferred between interviewers unless the initial interviewer encountered difficulties in persuading householders to participate. Mode of the family interview was also a significant predictor, with family interviews conducted primarily in-person having increased the odds (AOR=1.48, CI=1.33-1.63) of sample adult participation. Given the reduced "social presence" of interviewers, telephone interviews tend to be much shorter and easier to "break-off" than face-to-face interviews (Groves et al., 2004). Finally, and as hypothesized, if the sample adult was also the family interview respondent, the odds of sample adult participation were greatly increased (AOR = 4.37; CI = 3.97-4.79). This, by far, was the strongest predictor in the model. If the interviewer is able to complete the family interview with the sample adult, it is easy and straightforward to continue with the sample adult interview.

Overall, nine of the 10 paradata measures included in the model were significant predictors of sample adult participation. The variance in participation explained by the model nearly doubled when the paradata measures were added to the analysis (see Table 1; Cox and Snell R^2 = .126 for model 1, Cox and Snell R^2 = .239 for model 2), and a number of existing effects were either diminished or eliminated (compare, for example, the odds ratios from model 2 to model 1 for the variables age, receive government assistance, and received care 10 or more times in the past 12 months).

Table 1. Results from Logistic Regressions Predicting Sample Adult Participation (n=29,875)

Model Variables	Model 1: Without Paradata Measures		Model 2: With Paradata Measures	
	AOR[1]	95% CI[2]	AOR[1]	95% CI[2]
Intercept	1.29	1.00-1.65	1.28	0.95-1.72
Social Environmental Measures				
MSA Status				
MSA, central city[3]	1.00	---	1.00	---
MSA, non-central city	0.98	0.88-1.09	1.00	0.88-1.13
Non-MSA	1.18	0.99-1.41	1.08	0.89-1.31
Census Region				
Northeast	0.97	0.85-1.10	1.07	0.93-1.25
Midwest	1.50	1.32-1.72	1.76	1.50-2.08
South	1.22	1.09-1.37	1.15	1.00-1.31
West[3]	1.00	---	1.00	---
Family Measures				
Presence of Children				
Yes[3]	1.00	---	1.00	---
No	1.42	1.29-1.56	1.28	1.15-1.41
Total Family Income				
$0 - $34,999[3]	1.00	---	1.00	---
$35,000 - $74,999	0.95	0.86-1.06	1.16	1.04-1.30
$75,000 - $99,999	0.85	0.73-1.00	1.13	0.95-1.33
$100,000 or more	0.74	0.65-0.85	1.06	0.92-1.24
Unknown	0.33	0.29-0.38	0.44	0.38-0.50
Sample Adult Sociodemographics				
Age				
18-24[3]	1.00	---	1.00	---
25-34	1.40	1.20-1.63	1.15	0.97-1.36
35-44	1.38	1.18-1.60	1.10	0.93-1.31
45-54	1.49	1.28-1.74	1.30	1.09-1.56
55-64	1.47	1.24-1.75	1.25	1.03-1.52
65+	1.80	1.49-2.18	1.56	1.26-1.95
Sex				
Male[3]	1.00	---	1.00	---
Female	1.36	1.26-1.47	1.28	1.17-1.40
Race/Ethnicity				
Hispanic	1.19	0.96-1.48	1.18	0.94-1.46
Non-Hispanic white	1.38	1.11-1.73	1.28	1.03-1.58
Non-Hispanic black	1.19	0.95-1.50	1.15	0.91-1.45
Non-Hispanic Asian[3]	1.00	---	1.00	---
Non-Hispanic other	1.63	1.10-2.42	1.47	0.98-2.20
Education				
Less than high school	1.18	1.04-1.33	1.18	1.03-1.34
High school/GED[3]	1.00	---	1.00	---
Some college/AA degree	1.18	1.07-1.31	1.09	0.98-1.22
Bachelor's degree	1.23	1.10-1.38	1.11	0.98-1.26
Master's/Doctorate/Professional degree	1.45	1.25-1.69	1.26	1.07-1.49
Unknown	0.36	0.27-0.48	0.42	0.32-0.56
Marital Status				
Married/cohabiting[3]	1.00	---	1.00	---
Divorced/separated	1.30	1.15-1.47	0.89	0.77-1.02

Table 1. (continued)

Model Variables	Model 1: Without Paradata Measures		Model 2: With Paradata Measures	
	AOR[1]	95% CI[2]	AOR[1]	95% CI[2]
Widowed	1.19	1.00-1.43	0.80	0.65-0.99
Never married	1.03	0.92-1.15	0.92	0.80-1.05
Unknown	0.38	0.27-0.54	0.36	0.24-0.52
Employment Status				
Not working	1.37	1.23-1.53	1.26	1.12-1.41
Working less than 35 hours a week	1.13	0.98-1.30	1.09	0.94-1.27
Working 35 hours or more a week[3]	1.00	---	1.00	---
Unknown	0.80	0.58-1.09	0.87	0.62-1.23
Citizenship Status				
Native citizen	0.95	0.82-1.10	0.98	0.84-1.16
Naturalized citizen	0.78	0.66-0.93	0.86	0.71-1.05
Not a citizen[3]	1.00	---	1.00	---
Unknown	0.34	0.19-0.58	0.38	0.22-0.66
Veteran Status				
Veteran	1.40	1.20-1.63	1.31	1.11-1.55
Not a veteran[3]	1.00	---	1.00	---
Unknown	0.20	0.09-0.44	0.23	0.10-0.50
Receive Government Assistance				
Yes	1.24	1.04-1.48	1.15	0.95-1.39
No[3]	1.00	---	1.00	---
Unknown	0.38	0.28-0.51	0.35	0.26-0.48
Sample Adult Health Measures				
Reported Health Status				
Poor	1.02	0.76-1.37	1.16	0.85-1.59
Fair	1.07	0.92-1.24	1.10	0.94-1.30
Good[3]	1.00	---	1.00	---
Very good	1.26	1.15-1.39	1.22	1.09-1.36
Excellent	1.22	1.11-1.35	1.13	1.02-1.26
Unknown	0.32	0.10-1.02	0.38	0.12-1.19
Functional Limitation				
Yes	1.12	0.96-1.30	1.13	0.95-1.33
No[3]	1.00	---	1.00	---
Unknown	0.49	0.21-1.10	0.81	0.32-2.00
Delayed/Did Not Receive Care Due to Cost in Past 12 Months				
Yes	1.38	1.21-1.58	1.29	1.11-1.50
No[3]	1.00	---	1.00	---
Unknown	0.20	0.05-0.85	0.19	0.04-0.87
Overnight Hospital Stay in Past 12 Months				
Yes	1.02	0.88-1.18	0.95	0.81-1.12
No[3]	1.00	---	1.00	---
Unknown	0.94	0.44-2.02	0.94	0.43-2.04
Received Care in Past Two Weeks				
Yes	1.21	1.08-1.36	1.13	1.00-1.28
No[3]	1.00	---	1.00	---
Unknown	0.45	0.23-0.85	0.51	0.27-0.97
Received Care 10 or More Times in the Past 12 Months				
Yes	1.23	1.08-1.42	1.14	0.98-1.33

Table 1. (continued)

Model Variables	Model 1: Without Paradata Measures		Model 2: With Paradata Measures	
	AOR[1]	95% CI[2]	AOR[1]	95% CI[2]
No[3]	1.00	---	1.00	---
Unknown	0.34	0.20-0.59	0.28	0.15-0.53
Injury or Poisoning Episode in Past 3 Months?				
Yes	1.56	1.29-1.89	1.33	1.09-1.63
No[3]	1.00	---	1.00	---
Unknown	0.61	0.27-1.36	0.53	0.23-1.22
Health Insurance Status				
Private coverage	1.06	0.94-1.19	1.02	0.90-1.15
Public coverage (only)	1.01	0.86-1.17	1.06	0.89-1.25
Not insured[3]	1.00	---	1.00	---
Unknown	0.35	0.22-0.57	0.51	0.29-0.89
Paradata Measures				
Time Constraints Expressed at One or More Contacts				
Yes			0.39	0.36-0.43
No[3]			1.00	---
Hostility/Hard Refusal Concerns Expressed at One or More Contacts				
Yes			0.40	0.35-0.47
No[3]			1.00	---
Gate-keeping Concerns Expressed at One or More Contacts				
Yes			0.65	0.51-0.82
No[3]			1.00	---
Content/Privacy Concerns Expressed at One or More Contacts				
Yes			0.75	0.67-0.83
No[3]			1.00	---
Number of Noncontacts Prior to First Contact				
0[3]			1.00	---
1			0.82	0.74-0.92
2-3			0.72	0.64-0.81
4+			0.67	0.58-0.78
Interview Not Conducted or Completed at One or More Contacts Due to a Health Problem				
Yes			0.61	0.44-0.85
No[3]			1.00	---
Interview Not Conducted or Completed at One or More Contacts Due to a Language Problem				
Yes			0.88	0.68-1.15
No[3]			1.00	---
Case Reassigned to a Different Interviewer?				
Yes			0.71	0.62-0.82
No[3]			1.00	---

Table 1. (continued)

Model Variables	Model 1: Without Paradata Measures AOR[1]	Model 1: Without Paradata Measures 95% CI[2]	Model 2: With Paradata Measures AOR[1]	Model 2: With Paradata Measures 95% CI[2]
Mode of Family Interview				
Primarily by telephone[1]			1.00	---
Primarily in-person			1.48	1.33-1.63
Sample Adult Also the Family Interview Respondent?				
Yes			4.37	3.97-4.79
No[3]			1.00	---
Model Chi-square (d.f.[4])	1459.82 (59), p < .001		3141.09 (71), p < .001	
Likelihood Ratio Chi-square (d.f.[4])	---		1681.27 (12), p < .001	
Cox and Snell R-square	.126		.239	

[1] AOR = adjusted odds ratio
[2] CI = confidence interval
[3] Reference category
[4] d.f. = degrees of freedom

3.1.2 Results for Other Model Components

While the paradata-based measures as a whole were the strongest predictors of sample adult participation, we did find support for the other model components. Census region of residence, a social environmental measure, was a significant predictor, with sample adults in the Midwest (AOR=1.76, CI=1.50-2.08) having greater odds of participation than sample adults in the West. At the family level, both presence of children and total family income were significantly related to participation. Sample adults from families without children had greater odds of participation (AOR=1.28, CI=1.15-1.41), most likely due to the more streamlined recruitment and interviewing process--no sample child interview for these families. While a rather minor effect emerged for middle income families ($35,000-$74,999) compared to low income families (less than $35,000), families with "unknown" incomes had greatly reduced odds of sample adult participation (AOR=0.44, CI=0.38-0.50). Similar findings emerged for many of the sample adult sociodemographic and health measures. Thus, item nonresponse in the family interview was a strong, negative predictor of sample adult participation.

Several of the sample adult sociodemographic measures were associated with participation, although most of the effects were moderate at best. Among the stronger predictors was age. Compared to sample adults aged 18-24, adults aged 45-54 (AOR=1.30, CI=1.09-1.56), 55-64 (AOR=1.25, CI=1.03-1.52), and 65 or older (AOR=1.56, CI=1.26-1.95) all had higher odds of participation. This is important considering the relationship between age and many of the health-related measures generated from the sample adult interview. Other noteworthy findings for the sociodemographic measures emerged for employment status and veteran status. Consistent with the discretionary time hypothesis, non-working sample adults had greater odds of participation (AOR=1.26, CI=1.12-1.41) than adults working 35 hours or more a week. And consistent with authority perspectives, sample adults who were veterans had greater odds of participation (AOR=1.31, CI=1.11-1.55) than non-veterans.

Fewer effects than anticipated emerged for the sample adult health measures. Nonetheless, and consistent with a topic saliency approach, sample adults who delayed or did not receive care in the past 12 months (AOR=1.29, CI=1.11-1.50) and sample adults

who had an injury or poisoning episode in the past three months (AOR=1.33, CI=1.09-1.63) had increased odds of participation. Additionally, sample adults whose health was "very good" (AOR=1.22, CI=1.09-1.36) or "excellent" (AOR=1.13, CI=1.02-1.26) had greater odds of participation than those whose health was "good."

3.2 Using Response Propensities to Assess Nonresponse Bias

Next, we output the predicted values or response propensities from the logistic regression analysis (model 2) and grouped our responding sample adults into response propensity quintiles. We then examined estimates for 10 key sample adult health measures[10] in two ways. First, we observed the health estimates for each of the response propensity groups (quintiles). And second, we observed the estimate cumulatively moving from the high response propensity group (quintile) to the low response propensity group (quintile). Comparisons of estimates by quintile, as well as systematic changes in the cumulative estimate as adults with lower response propensities are added to the sample, provide clues as to possible nonresponse bias with these key health measures. The approach is akin to level-of-effort (LOE) analyses (see Curtin, Presser, and Singer, 2000), where change in a statistic over increased levels of effort, or in this case over response propensity quintiles, is indicative of the risk of nonresponse bias. Conversely, little to no change in the statistic is suggestive of the absence of nonresponse bias (Olson, 2006).

What follows is a discussion of the results for three of the 10 indicators: the percentage of adults aged 18 or older who received an influenza vaccination in the past 12 months (a health care access/utilization measure); the prevalence of diagnosed diabetes among adults aged 18 or older (a diagnosed condition); and the percentage of adults aged 18 or older who engaged in regular leisure-time physical activity (a health behavior).

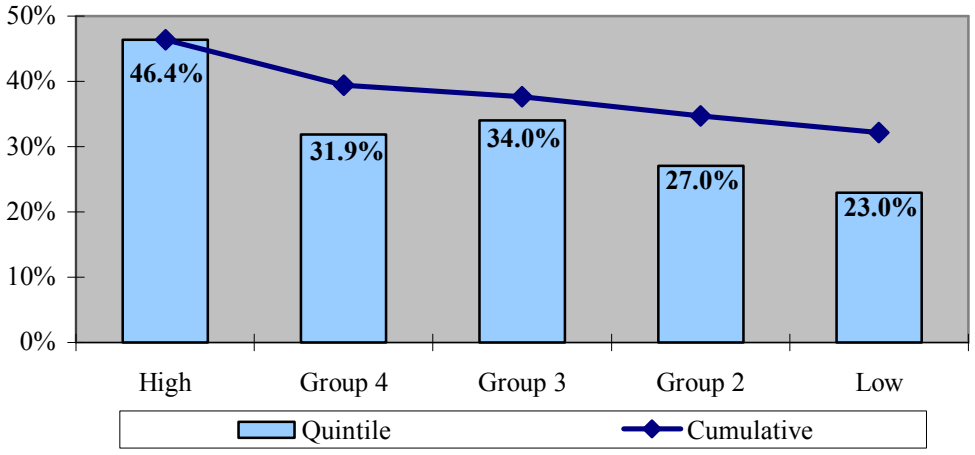

Figure 2. Percentage of Adults (18 +) Who Had Received an Influenza Vaccination During the Past 12 Months, By and Cumulatively Over Response Propensity Quintiles: NHIS, 2007

Figure 2 presents the percentage of adults who received an influenza vaccination in the past 12 months by and cumulatively over the response propensity quintiles. Focusing on the bars, we can consider the sample adults in the "high" response propensity quintile to

[10] These 10 measures are included in the NHIS Early Release Program. Due to their policy significance, Early Release health estimates are released on a quarterly basis (via the Internet).

be the easiest to recruit. The estimate for this group is 46.4%. This is roughly double the estimate for our "low" response propensity quintile (23.0%), or the sample adults least likely to participate. The line graph presents the cumulative estimate moving from the high response propensity quintile to the low response propensity quintile. As we recruit sample adults with lower and lower response propensities, the estimate declines from 46.4% to 32.1%. Furthermore, we can treat our low response propensity adults as proxies for nonrespondents, and then compare the estimate for this group (23.0%) to the estimate for the remainder of the sample (34.7%). The difference between the two estimates is statistically significant (two-tailed t-test conducted at the .05 level). Together, the quintile-specific and cumulative estimates suggest that nonresponding sample adults may have a low rate of influenza vaccination. Therefore, we may be overestimating the percentage of adults who received an influenza vaccination.

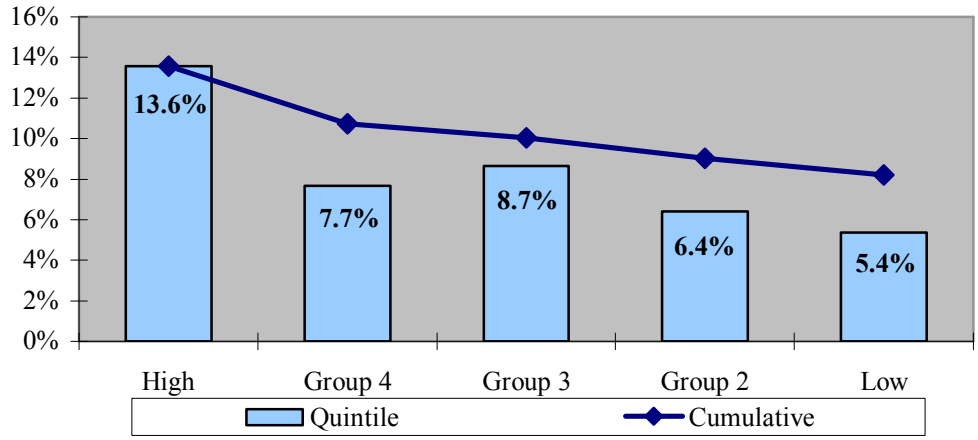

Figure 3. Prevalence of Diagnosed Diabetes Among Adults (18 +), By and Cumulatively Over Response Propensity Quintiles: NHIS, 2007

Figure 3 presents the prevalence of diagnosed diabetes among adults age 18 or older, by and cumulatively over the response propensity quintiles. We observe a similar trend to that observed for receipt of an influenza vaccination. The estimate for the high response propensity quintile is more than double that for the low response propensity quintile (13.6% versus 5.4%), and the cumulative estimate (line graph) declines (from 13.6% to 8.2%) as lower response propensity adults are included in the sample. In other words, adults who were fairly easy to recruit have a higher prevalence of diabetes compared to adults who were more difficult to recruit. And if we treat the adults in the "low" response propensity quintile as proxies for nonrespondents, their estimate of 5.4% is significantly different from the estimate of 9.0% for the remainder of the sample (two-tailed t-test conducted at the .05 level). Here the results suggest that we may be overestimating the prevalence of diagnosed diabetes.

Finally, figure 4 presents the percentage of adults age 18 or older who engaged in regular leisure-time physical activity, by and cumulatively over the response propensity quintiles. The results for this measure provide a nice contrast to the previous two measures. First, there are very small differences in the quintile-specific estimates, ranging from a low of 29.0% ("low" response propensity quintile) to a high of 32.5% ("Group 2"). Furthermore, there is no consistent movement of the cumulative estimate when lower response propensity adults are included in the sample, with a slight, overall increase in the estimate from 29.1% to 30.5%. And finally, comparing the "low" response

propensity quintile to the remainder of the sample produces no significant difference in estimates (29.0% versus 30.9%). Again, using this information to make assumptions about the composition of the nonresponders, it would appear that this measure is subject to little or no nonresponse bias.

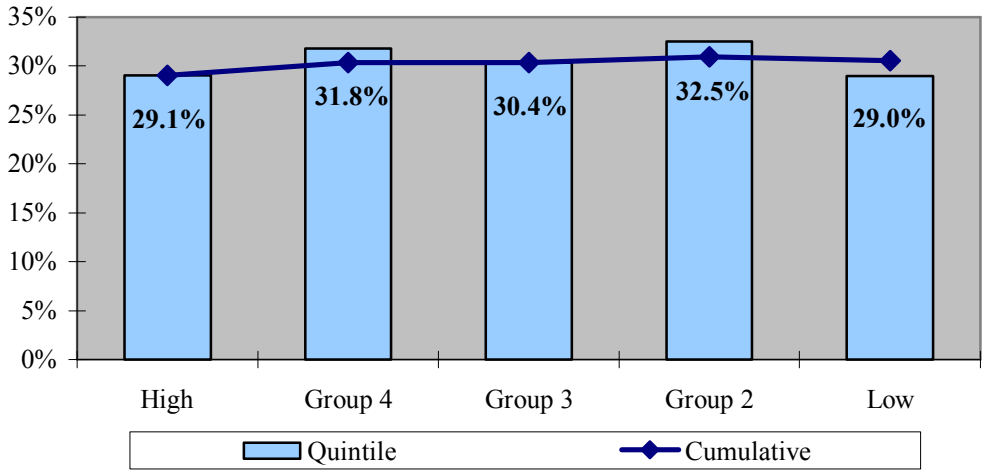

Figure 4. Percentage of Adults (18 +) Who Engaged in Regular Leisure-time Physical Activity, By and Cumulatively Over Response Propensity Quintiles: NHIS, 2007

4. Conclusions and Future Directions

Consistent with research on unit-level nonresponse with the NHIS (Bates, Dahlhamer, and Singer, 2008; Dahlhamer et al., 2006), paradata measures greatly improved the predictive power of the model and our understanding of subunit participation. Collectively, the paradata results have a number of implications. First, basic respondent rules such as the random selection of sample adults can have significant implications for participation. For roughly 35% of participating families, the family interview respondent is not the sample adult, and this proves to be highly problematic for securing sample adult interviews. Second, the 17-day interview period of the NHIS plays a potentially significant role in sample adult participation. We saw how difficulties making initial contact with a household reduced the odds of sample adult participation. We suspect extended efforts to negotiate initial cooperation reduce the time available to secure and/or complete sample adult interviews. And third, the results for the concerns/reluctance measures suggest that once initial entrée has been negotiated, there are no guarantees that any good will fostered during introductory conversations will carry over to later portions of the interview. The last two points may be especially magnified when the sample adult is not the family interview respondent, suggesting possible interactions in need of exploration.

In addition to the paradata measures, key sociodemographic and health-related measures influenced participation, including age, sex, education, employment status, delaying or not receiving care due to cost, injury or poisoning episodes in the past three months, and others. What measures can we take to ensure greater representation of younger, employed adults for example? Combinations of strategies such as the use of monetary incentives, switching to alternative modes of collection, and conducting interviews in non-traditional settings (e.g., places of employment) could be considered (Stussman,

Taylor, and Riddick, 2004). The use of varied recruitment protocols could be employed in phases consistent with responsive design (Groves and Heeringa, 2006).

From the perspective of estimate-specific bias, the results suggest that we may be overestimating the prevalence of certain diagnosed conditions and utilization of health care services. Concerns in this area must be tempered by the inability to truly assess the composition of our nonrespondents. Furthermore, since the bias analysis relied on predicted values from a model, the results are sensitive to model specification. Since the model explained just a quarter of the variation in sample adult participation, the inclusion of additional, important variables could substantially improve the explanatory power of the model and alter the conclusions we draw concerning bias. As a next step, we plan to explore all possible two-way interactions among existing measures. In addition, we would like to supplement the model with a set of ecological measures (e.g., percent of population below poverty level), whether measured at the Census tract/block group level, or at more aggregate levels such as ZIP codes.

And finally, we plan on using the response propensities to explore nonresponse adjustments to the sample adult weight, at least in the production of NHIS estimates. Currently, no explicit nonresponse adjustment is made. Instead, it is assumed that ratio adjustments to population control totals adjust for possible nonresponse error at the adult level. To an extent, this is likely true, as adjustments to population control totals are done on the basis of age, sex, and race and ethnicity. Age, for example, had a very strong effect on sample adult participation and is strongly related to many health outcomes of interest. Nonetheless, preliminary analysis reveals that the response propensity quintiles are significantly associated, net of age, sex, and race/ethnicity, with the three sample adult health measures presented in the bias analysis.

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