

CALLBACK RESPONSE IN THE NATIONAL HEALTH INTERVIEW SURVEY

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1. INTRODUCTION

This paper provides an initial examination of callback nonresponse bias associated with retrospective truncation of interviewer callbacks in the National Health Interview Survey (NHIS). The analysis is intended to contribute to a better understanding of an ongoing project to study survey costs and related changes in mean square error.

2. STUDY METHODOLOGY

Mean square error (MSE) is the mathematical model used in this study. Estimates of the sampling variance and squared statistical bias of selected health measures (e.g., doctor visits and acute conditions) are derived where,

$$\text{Mean Square Error} = \text{MSE}(\bar{x}) = (\text{variance of } \hat{x}) + (\text{bias})^2$$
and perfect implementation of the sample frame and design are presumed.

The estimates of variance for physician visits and acute conditions were generated using the technique of Balanced Repeated Replication (BRR). This method allows the NHIS sample to be partitioned and estimates of error reflect the design effect of the survey's complex sample.

The BRR estimate of variance is calculated by first computing the statistic of interest for each replicate and applying standard variance calculation formulae using the number of replicates as the sample size and treating the replicate statistics as sample values. This estimate of variance is then adjusted to reflect the fact that it is based on an effective sample size approximately one-half as large as the original complex sample.

3. THE NATIONAL HEALTH INTERVIEW SURVEY

The NHIS is a health survey of the American people that has been conducted since July 1957 by the National Center for Health Statistics (NCHS). The NHIS is a continuous sampling and interviewing of the civilian noninstitutionalized population of the United States.

The NHIS provides information by which the health of the nation may be viewed including the social, demographic, and economic aspects of illness, disability, and use of medical services. Approximately 42,000 households including 110,000 persons are sampled for the survey each year.

3.1 NONINTERVIEW RATE

The total noninterview rate in the NHIS is less than 4 percent for any survey year. In 1979 it was 3.9 percent and in 1981 it was 3.0 percent. These figures include sample persons who refuse to respond and those eligible respondents who cannot be located at home after repeated calls by the interviewer. The effective sample for the 52 sample weeks in 1981 included 41,000 households or about 107,000 persons living at the time of interview.

In this paper the procedure for examining the NHIS sample retrospectively is to treat the total survey response of 97 percent as the effective sample or a universe from which expectations of various estimates are computed. The estimates are adjusted for nonresponse by a procedure that imputes to persons in a household who were not interviewed the characteristics of persons in households in the same segment who were interviewed.

3.2 INTERVIEWER CALLBACK PROCEDURES

Information from the NHIS is collected for the

NCHS by the Bureau of the Census. Personal interviews of adult civilian residents are conducted at the sample household address.

There are no prescribed number of callbacks (e.g., revisits to an address) to obtain an interview. All visits made to a sample household including visits when no one is at home are recorded. However, interviewers are instructed to reduce callbacks by planning initial visits at the most productive times and by scheduling callbacks with remaining initial visits to similar locations in the sample area. Interviewers are rated in part upon respondent refusal rates and are therefore assumed to be innovative and efficient in pursuing assignments.

3.3 DEFINITIONS

Physician visits are defined as consultation with a physician (e.g., doctors of medicine and osteopathy) in person or by telephone, for examination, diagnosis, treatment or advice. It may include service by a nurse or other person acting under a physician's supervision. Services provided by a physician on a mass basis (e.g., inoculation, screening) and physician visits to hospital inpatients are not included.

Acute conditions are defined as those illnesses and injuries lasting less than 3 months and involving medical attention or 1 day or more of restricted activity. In order to calculate the annual incidence of acute conditions only those conditions having their onset during the two weeks prior to the interview are used as a basis for computation.

4. ALTERATIONS IN MEAN SQUARE ERROR

The mean square error (MSE) relative to the nationally estimated number of physician visits (e.g., squared root MSE as a proportion of \bar{x}) for 1981 is shown in Table 1. MSE for the effective sample is equivalent to the sampling variance for total estimated physician visits with a value of about 1.2 percent of the estimate. As expected from the MSE model the squared bias relative to MSE (e.g., squared bias as a proportion of MSE) for the effective sample is zero. MSE values are smaller for females than for males and smaller for whites than for blacks in the effective sample.

Changes in MSE values may be observed for interviewer callbacks 3 through the effective sample. All values are cumulative across callbacks and include data collected by interview at the initial visit as well as at the second visit to sample households. For example MSE values for callback 3 are cumulative over calls 1 through 3 and MSE values for the effective sample represent 1 through 9 or more calls. All values reflect physician visit estimates that have been nonresponse and poststratified adjusted similar to that for the effective sample.

Examination of these values shows that in large part as callbacks are truncated retrospectively both MSE and squared bias increase. Of particular interest is the somewhat geometric increase in the bias as callbacks decrease. For total physician visits at callback 3 bias accounts for nearly 60 percent of MSE. For total physician visit estimates at all callbacks there is a quantum increase between callbacks 6 and 5 where MSE changes respectively from 1.25 to 1.40 percent and bias nearly triples from 13 to 38 percent of MSE.

Excluding what appears to be several random departures from this trend for sex and race the bias for

physician visits appears systematic in the sample. Conversely sampling variability remains relatively stationary across callbacks.

4.1 RESPONDENT CHARACTERISTICS IN THE SAMPLE

The distribution of respondents in the NHIS sample is shown by age in Table 2 in order to begin to examine potential causes of the callback nonresponse bias evidenced in MSE values. Excluding persons under age 17 who are not respondents the response in the sample clearly increases with advancing age after age 44. The younger and more mobile of the respondents, those ages 17-44, are less represented through the first 7 callbacks than all other responding age groups.

Differences by sex for the total sample do not appear to be appreciably different for any one age group. Females respond higher at the outset at ages 25-64, where there is a large concentration of the sample, and males respond higher for the first few calls at ages 17-24 and 75 years or above.

The distribution of respondents is shown by age and sex for white and black persons in Tables 3 and 4, respectively. Whites account for approximately 87 percent of the sample and blacks account for about 11. All "other" races (not shown) account for about 2 percent of the sample.

For both white males and females the most noticeable lag in response occurs among the younger respondents as noted in the total sample. For both black males and females the lag in response is fairly uniform at all ages compared to whites and excluding the very elderly. With several exceptions black females tend to respond higher at the outset of the interview process than black males.

In general the earliest respondents in the NHIS sample tend to be older persons, white and female. The fact that the number of physician visits per person advances with age and is differentially higher for female than for male respondents at all ages adds to the greater possibility of overrepresentation by these groups at earlier callback levels.

NUMBER OF PHYSICIAN VISITS PER PERSON: NHIS 1981

	All ages	Under 17 yrs	17-24 years	25-44 years	45-64 years	65-74 years	75 Yrs. & over
Both Sexes	4.6	4.1	4.0	4.4	5.1	6.3	6.4
Male	4.0	4.3	2.6	3.2	4.7	5.9	6.1
Female	5.2	4.0	5.4	5.5	5.4	6.6	6.6

PHYSICIAN VISIT ESTIMATES

The estimated number of physician visits for interviewer callbacks 3 through 9+ is shown in Table 5 by respondent age and sex. These estimates have been adjusted to reflect total visits for the U.S. population at each callback and are the basis from which the bias portion of MSE is derived.

The dominant pattern of physician visits shows the estimates as overstated compared to the effective sample. The estimates can also be seen to decrease as callbacks increase. For example total physician visits are estimated at 1.057 billion at the third callback and subsequently decline to the national estimate of 1.039 billion after 9+ callbacks.

For the total population, all ages, visits are overestimated between callback 3 and the effective sample by 3, 9 and 5 million for ages 17-24, 25-44 and 45-64, respectively. Females account for nearly two-thirds of the overestimated visits.

The magnitude of difference in the estimates both in size and spread reflects the influence of white females shown in Table 6. They account for more than one-half billion physician visits and decline in visits by approximately 10 million from callback 3 through the

effective sample. In truncating back from the effective sample the first noticeable change in magnitude for this group occurs between callbacks 6 and 5. As noted earlier this was accompanied by a near tripling in the estimated bias of MSE. The underestimation of all males in the ages 17-24 reflects in large part the influence of white males where an estimated increase of about 2 million physician visits occurs across callbacks.

Estimated physician visits for the black population are shown in Table 7. Compared to whites the magnitude of difference in estimated visits reflects smaller numerical changes but higher percentages of decline for males across all callbacks and females following the third callback.

5. DISCUSSION

This initial investigation of callback nonresponse bias in the NHIS suggests that the potential for truncating interviewer callbacks needs to be considered carefully if correlating health variables to age, sex and race. In the case of physician visits the demographic biases decrease as callbacks increase.

Physician visits by older persons, females and whites appear to be overrepresented in the sample particularly at early callback levels. Physician visits by younger persons and blacks are underrepresented at early callback levels and are not representative until late in the callback process.

A summary of MSE values and the bias component of MSE for physician visits and acute conditions is shown in Table 8. The pattern of bias associated with MSE for acute conditions, which occur inversely with respondent age, is of less magnitude than for physician visits but similar in its systematic contribution to MSE.

Several limitations to this study are recognized. Aside from imputing respondent characteristics to nonrespondents at the segment level the demographic and health characteristics of the 3 percent nonrespondents in the sample are unknown. This small population represents a potential source of bias which has of yet to be accounted for and could impact on subgroups where nonresponse rates are higher than the overall rate.

In truncating callbacks retrospectively the variance increases at callback 8 but then remains relatively stationary and at lower expected values as sample size decreases to callback 3. This phenomenon occurs in the variance estimates contained in MSE for both the physician visit and acute condition variables. It appears that the poststratification process may very efficiently adjust the variation in outcome measures which correlate with age-race-sex and region thus eliminating the sensitivity to alterations in variance occasioned by sample loss.

Two additional steps are in progress to expand the study of callback nonresponse bias. One, other health variables are being examined for changes in MSE in order to develop a more complete understanding of the survey error consequences associated with callback truncation. Two, an important missing dimension is the cost of callbacks in terms of field data collection so that benefit/cost decisions may be considered. To this end the NCHS and Bureau of the Census are preparing a special survey of the time and costs of data collection for all callback levels.

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Table 1
REL-MSE of total estimated physician visits
for the sample at callbacks 3-9+ by race and sex: NHIS 1981

	Number of callbacks													
	3		4		5		6		7		8		9+	
	B ²	MSE	B ²	MSE	B ²	MSE	B ²	MSE	B ²	MSE	B ²	MSE	B ²	MSE
Total	.59	.0222	.54	.0190	.38	.0140	.13	.0125	.08	.0127	.02	.0123	-	.0117
Males	.35	.0246	.39	.0235	.17	.0188	.09	.0183	.06	.0183	.02	.0178	-	.0172
Females	.55	.0255	.42	.0207	.29	.0170	.07	.0153	.04	.0154	.01	.0152	-	.0147
White	.54	.0219	.47	.0185	.31	.0143	.09	.0131	.04	.0126	.01	.0130	-	.0125
Males	.21	.0238	.36	.0244	.18	.0203	.08	.0195	.04	.0192	.02	.0190	-	.0184
Females	.54	.0268	.31	.0202	.18	.0172	.03	.0162	.01	.0163	*	.0162	-	.0158
Black	.37	.0437	.32	.0396	.25	.0366	.06	.0332	.13	.0341	.02	.0322	-	.0314
Males	.53	.0777	.20	.0567	.07	.0523	.02	.0511	.07	.0517	*	.0499	-	.0492
Females	.01	.0452	.20	.0466	.20	.0460	.05	.0424	.07	.0424	.02	.0412	-	.0403

*Less than .005

SOURCE: National Center for Health Statistics

Table 2
Callback response in the NHIS sample: 1981
(cumulative percent)

	Number of calls									Percent of sample
	1	2	3	4	5	6	7	8	9+	
All ages										
Under 17 years	45	72	86	93	96	98	99	99	100	26.7
17-24 years	40	67	82	90	94	97	98	99	100	14.2
25-44 years	38	66	82	90	94	97	98	99	100	28.1
45-64 years	47	73	86	93	96	98	99	99	100	20.3
65-74 years	60	82	92	96	98	99	99	99	100	6.7
75 and over	63	85	94	97	99	99	99	99	100	4.0
Total	44	71	85	92	96	98	99	99	100	100.0¹
Sample in '000	47.8	28.7	14.7	7.7	3.8	2.3	1.0	.6	.8	

¹Sample size 107,480 persons
 SOURCE: National Center for Health Statistics

Table 3
Callback response in the NHIS sample: Whites, 1981
(cumulative percent)

	Number of calls									Percent of sample whites
	1	2	3	4	5	6	7	8	9+	
Males										
Under 17 years	45	73	87	94	97	99	99	99	100	13.1
17-24 years	40	67	82	90	95	97	98	99	100	6.8
25-44 years	39	66	82	90	95	97	98	99	100	13.8
45-64 years	48	73	86	93	97	98	99	99	100	9.9
65-74 years	61	83	92	96	98	99	99	99	100	3.1
75 and over	64	88	94	97	99	99	99	99	100	1.6
Females										
Under 17 years	45	73	86	93	97	98	99	99	100	12.5
17-24 years	39	67	82	90	94	97	98	99	100	7.2
25-44 years	39	67	83	91	95	98	99	99	100	14.5
45-64 years	48	74	87	93	96	98	99	99	100	11.0
65-74 years	60	83	92	96	98	99	99	99	100	3.8
75 and over	62	84	93	97	99	99	99	99	100	2.8
Total	45	72	85	92	96	98	99	99	100	100.0¹

¹White sample size 93,701 persons
 SOURCE: National Center for Health Statistics

Table 4
Callback response in the NHIS sample: Blacks, 1981
(cumulative percent)

	Number of calls									Percent of sample blacks
	1	2	3	4	5	6	7	8	9+	
Males										
Under 17 years	43	69	84	91	94	96	98	99	100	17.5
17-24 years	45	70	82	90	93	96	98	99	100	6.8
25-44 years	36	60	76	85	90	94	96	98	100	10.9
45-64 years	45	72	84	89	93	96	97	98	100	7.0
65-74 years	56	81	92	95	97	98	98	98	100	2.0
75 and over	65	89	96	97	98	98	98	99	100	0.9
Females										
Under 17 years	42	65	80	89	92	95	97	98	100	17.7
17-24 years	46	70	82	90	92	95	97	98	100	9.0
25-44 years	37	61	78	87	91	94	96	98	100	14.7
45-64 years	46	73	85	90	94	96	97	98	100	9.0
65-74 years	59	82	91	95	97	99	99	99	100	3.0
75 and over	65	83	92	94	97	99	99	99	100	1.5
Total	43	68	82	89	93	96	97	98	100	100.0¹

¹Black sample size 11,605 persons
 SOURCE: National Center for Health Statistics

Table 5
Total estimated physician visits for
callbacks 3-9+ : NHIS, 1981
(in billions)

Sex and age	Number of callbacks						
	3	4	5	6	7	8	9+
All ages	1.057	1.053	1.048	1.043	1.042	1.041	1.039
Under 17 years	.245	.248	.246	.244	.245	.244	.244
17-24 years	.136	.134	.133	.133	.133	.133	.132
25-44 years	.289	.285	.283	.282	.281	.280	.280
45-64 years	.230	.229	.227	.236	.226	.225	.225
65-74 years	.097	.098	.098	.099	.099	.099	.098
75 and over	.060	.060	.060	.060	.060	.059	.059
Male							
All ages	.436	.436	.433	.432	.431	.430	.429
Under 17 years	.129	.131	.130	.129	.129	.128	.128
17-24 years	.041	.042	.042	.042	.042	.042	.042
25-44 years	.103	.101	.101	.100	.100	.100	.099
45-64 years	.102	.101	.100	.100	.100	.099	.099
65-74 years	.039	.040	.040	.040	.040	.040	.040
75 and over	.021	.021	.021	.021	.021	.021	.021
Female							
All ages	.621	.617	.615	.612	.611	.610	.609
Under 17 years	.116	.117	.117	.115	.116	.116	.116
17-24 years	.094	.092	.092	.092	.091	.091	.090
25-44 years	.186	.183	.182	.181	.181	.126	.181
45-64 years	.129	.128	.127	.127	.126	.181	.125
65-74 years	.058	.059	.058	.058	.058	.058	.058
75 and over	.039	.039	.039	.039	.039	.039	.039

SOURCE: National Center for Health Statistics

Table 6
Total estimated physician visits for
callbacks 3-9+ : NHIS 1981
White (in billions)

Sex and age	Number of callbacks						
	3	4	5	6	7	8	9+
All ages	.908	.905	.900	.897	.896	.895	.893
Under 17 years	.207	.210	.209	.207	.208	.207	.207
17-24 years	.116	.115	.114	.114	.114	.114	.113
25-44 years	.246	.242	.241	.240	.239	.239	.239
45-64 years	.199	.198	.196	.195	.194	.194	.193
65-74 years	.087	.087	.087	.088	.088	.088	.087
75 and over	.054	.054	.054	.053	.053	.053	.053
Male							
All ages	.375	.376	.374	.373	.372	.371	.371
Under 17 years	.109	.112	.110	.110	.110	.109	.109
17-24 years	.034	.036	.036	.035	.036	.036	.036
25-44 years	.088	.086	.086	.085	.085	.085	.085
45-64 years	.088	.088	.087	.087	.086	.086	.086
65-74 years	.036	.036	.036	.036	.036	.036	.036
75 and over	.019	.019	.019	.019	.019	.019	.019
Female							
All ages	.533	.529	.527	.524	.524	.523	.523
Under 17 years	.097	.098	.098	.097	.098	.098	.098
17-24 years	.081	.079	.079	.079	.078	.078	.078
25-44 years	.158	.155	.155	.155	.154	.154	.154
45-64 years	.110	.110	.109	.109	.108	.108	.108
65-74 years	.052	.051	.051	.051	.051	.051	.051
75 and over	.035	.034	.034	.034	.034	.034	.034

SOURCE: National Center for Health Statistics

Table 7
Total estimated physician visits for
callbacks 3-9+ : NHIS 1981
Black (in billions)

Sex and age	Number of callbacks						
	3	4	5	6	7	8	9+
All ages	.125	.124	.124	.123	.123	.122	.122
Under 17 years	.032	.031	.031	.030	.031	.031	.030
17-24 years	.017	.017	.017	.018	.017	.017	.017
25-44 years	.036	.035	.034	.034	.034	.034	.033
45-64 years	.027	.027	.027	.026	.027	.027	.027
65-74 years	.009	.009	.009	.009	.009	.009	.009
75 and over	.005	.005	.005	.005	.005	.005	.005
Male							
All ages	.052	.050	.049	.049	.049	.049	.049
Under 17 years	.016	.016	.016	.016	.016	.016	.016
17-24 years	.006	.005	.005	.006	.006	.006	.006
25-44 years	.013	.012	.012	.012	.012	.012	.012
45-64 years	.012	.012	.011	.011	.012	.011	.011
65-74 years	.003	.003	.003	.003	.003	.003	.003
75 and over	.002	.002	.002	.002	.002	.002	.002
Female							
All ages	.073	.075	.075	.074	.074	.073	.073
Under 17 years	.015	.015	.015	.015	.015	.015	.015
17-24 years	.011	.012	.012	.012	.012	.012	.012
25-44 years	.023	.023	.022	.022	.022	.015	.022
45-64 years	.015	.015	.015	.015	.015	.022	.015
65-74 years	.006	.006	.007	.007	.007	.006	.006
75 and over	.003	.003	.003	.003	.003	.003	.003

SOURCE: National Center for Health Statistics

Table 8
Planning components for NHIS design strategies

	Number of callbacks						
	3	4	5	6	7	8	9+
Physician visits							
Mean square error	.0222	.0190	.0140	.0125	.0127	.0123	.0117
B²	.59	.54	.38	.13	.08	.02	-
Acute conditions							
Mean square error	.0208	.0168	.0151	.0138	.0138	.0138	.0138
B²	.33	.27	.08	.05	.03	.01	-
Field survey costs	-	-	-	-	-	-	\$5 million

SOURCE: National Center for Health Statistics