

SURVEY DESIGN FEATURES CORRELATES OF NONRESPONSE

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Introduction and Objectives

This paper discusses how the choice of, or changes in, survey design parameters may adversely affect unit nonresponse rates. Illustrations are taken from the National Health Interview Survey (NHIS). Analyses of these types may provide useful insights.

These kinds of analyses also identify the potential tension among survey data quality (where the survey nonresponse rate is only one measure), time availability, and survey cost. For example, in a one-time survey, designers typically schedule data collection to avoid the Thanksgiving-Christmas period. Using the NHIS, which is in the field each week, we provide evidence of the increased level of effort required in this period.

The NHIS is a large, continuous face-to-face household survey conducted by the National Center for Health Statistics (NCHS). While the NHIS sampling plan implemented in 1985 will be used through 1994, during each survey year the NHIS data collection plans change.

The NHIS has always attained high response and completion rates. In the 1989 NHIS, the NCHS obtained for 95.3 percent of the eligible sample households a completed basic NHIS health and demographic questionnaire (the "core"). Table 1 shows the response rates for the NHIS basic health and demographic questionnaire, by year, from 1985-1989. We look for some clues to explain both increasing survey costs and this apparent decline in NHIS response rates, and identify some factors potentially attenuating this trend.

We also illustrate design correlates of unit nonresponse where in each NHIS sample household a sample adult from each family is randomly selected for more extensive data collection. Examined are correlates of unit nonresponse to the 1989 NHIS Orofacial Pain (OP) supplement. For this supplement, a completed interview¹ was obtained for 95 percent of the sample adults in households where the core interview was completed.

Background: The National Health Interview Survey

Since the National Health Interview Survey has special features, some background information is necessary. This multipurpose national survey is the principal source of information on the health of the civilian, noninstitutionalized population of the United States.

The NHIS was mandated by Congress in the U.S. National Health Survey Act of 1956 which provided for a continuing survey and special studies to secure accurate and current statistical information on the amount, distribution, and effects of illness and disability in the United States and the services required for or because of such conditions. Initiated in 1957, the NHIS has been conducted continuously since then. The survey objective has evolved to one of collecting data to address major current health issues, as well as, the collection of baseline health data.

The NHIS is a cross sectional household interview survey based on a multistage area probability sample. With the exception of the first week in each survey year, sampling and interviewing are continuous throughout the year and the sample assigned to each week is representative of the target population. Interviews are conducted in person in approximately 50,000 households including about 120,000 persons each year.

While data collection for the NHIS is normally in the field 52 weeks in each survey year, the current practice is not to attempt data collection on the households assigned to first week of the NHIS survey year. Since 1988, the NHIS has used this first week to conduct interviewer training. This training focuses on supplementary topics to be introduced in that survey year. The NHIS interviewing is performed for NCHS by the U.S. Bureau of the Census with a permanent staff of about 230 interviewers in 12 regional offices.

There are two components of the NHIS data collection instrument: a basic health and demographic questionnaire and one or more supplemental questionnaires that address current health topics of special public health interest.

The basic health and demographic questionnaire consists of a fixed set of health and sociodemographic questions - "fixed" in the sense that this questionnaire usually remains unchanged for about 10 years. This portion of the survey is used, for example, for developing annual estimates of acute and chronic conditions, hospital stays, medical visits, and limitations of activities. Data are collected family style on all members of the household. There is self-response for all adults at home at the time of the interview and proxy response for children and for adults not available or unable to respond for themselves. This survey component averages about 30 minutes.

The NHIS supplemental questionnaires address health issues or topics identified as of particular interest within the U. S. Public Health Service. These topics are usually included in the NHIS for an entire survey year.

Except for extremely sensitive topics (e.g., drug use, youth risk behaviors), NCHS permits the use of the telephone to interview difficult-to-reach NHIS respondents for supplement questionnaires. The number of special topics questionnaires fielded varies from one to as many as ten and the average total amount of time required for the interview(s) is around 60 minutes. In 1989, data collection for the core and supplement questionnaires together required about 90 minutes for data collection. Table 1 also shows the average total household NHIS data collection burden, by year, from 1985-1989. From 1985-1989, the average NHIS household data collection burden has substantially increased.

The 1989 NHIS included for a randomly selected sample adult, by family, in each sample NHIS household, data collection for three current health topics. This paper focuses on data collection for the 1989 NHIS core and one such health topic, the Orofacial Pain (OP) supplement.

Design Features Impacting on Nonresponse Rates, with NHIS Illustration

The following are selected survey design parameter choices for face-to-face household surveys that could be expected to affect completion rates (and costs). It, however, is usually difficult to isolate the effect on nonresponse of a particular design feature.

Callback strategy. A callback strategy governs the minimum, maximum, and possibly the scheduling of calls to a sample unit before the unit is classified as a noninterview due to no one at home. The larger the maximum number of callbacks and the longer the time duration for these callbacks available to interviewers usually correspond to higher completion rates.

In the NHIS, interviews are not limited on the number of call attempts in order to obtain a survey interview. While 95 percent of the household interviews are completed within 5 call attempts, interviewers obtain nearly all remaining cases by 10 call attempts.

In 1985, the average number of calls to obtain a final NHIS household survey disposition was 2.56; Table 1 shows the average number of calls by year from 1986-1989.² In 1985, for completed household interviews the average number of required calls was 2.69; in 1986, 2.79; in 1987, 3.09; in 1988, 3.20; and 1989, 3.19. Thus, for the entire NHIS sample from 1985-1989, the average number of call attempts increased by 15 percent and for completed interviews the average number of call attempts increases by 19 percent.

Over this period the NHIS clearly has devoted additional fiscal and other resources in order to obtain NHIS survey response. Even in a clustered design, funding high-order interviewer call attempts is expensive.

Note that NCHS has investigated the cost and error effects of implementing a truncated NHIS callback strategy.³ **Interview length.** Obtaining a completed survey interview may be more difficult with a longer questionnaire than a shorter one. For example, with a longer questionnaire, an interviewer can complete few interviews in a single evening, which is rapidly becoming the most productive time for interviewing. Moreover, with a longer questionnaire, because of conflicting respondent obligations, respondents may be less willing to participate in a survey.

In the NHIS, with a lengthy interview, interviewers report that they are now less likely to approach a household in the late evening, because approaching a household at 9 pm means starting an interview even later and likely not ending the interview until 11 pm. The National Center for Health Statistics, however, has not conducted an statistical experiment to isolate the effect of interview length on completion rates.

This increased interview length may in fact be a primary contributor to the increased number of NHIS call attempts. With more time needed per interview, and the evening being the most productive interviewing time, interviewers are approaching households more often, since their attempts are more often in less productive times for survey interviewing. Analogously, Table 1 also shows the average total interviewer data collection time per case has increased

in 1985-1989 by 14 percent. This also reflects the increase in fiscal and other resources being devoted to the survey, in part to offset unit nonresponse.

Multiple questionnaires/respondents. Some household surveys attempt data collection on several different topics each with a different respondent. This can adversely affect survey completion rates. Each transition provides the respondent(s) with an additional opportunity to refuse to continue the interview and additional information on the survey data collection burden.

Since 1985 the NHIS has consisted of numerous separate questionnaire topics, sometimes with the requirement of multiple respondents (e.g., household respondent for core questionnaire; sample adult; biological mother for child; household member identified as having a particular condition).

Procedures for releasing and closing sample cases for data collection. A design parameter for household surveys is how cases are to be released and closed for data collection. In general, the more time an interviewer has to work a case the more likely the interviewer can make a contact and then potentially obtain an interview.

For surveys employing reference periods in questionnaires, data quality, however, drops as the time increases between the reference period and the survey interview.⁴ Other factors, such as cost, may enter on the design of these procedures.

In the NHIS, in part to permit measuring of spreading epidemics or other rapidly changing health conditions, the survey is designed so that each weekly sample is representative of the target population and the weekly samples are additive over time. Also many core questionnaire data items have reference periods directly or indirectly linked to the assignment week.

Because of these features, NHIS interviewers are "encouraged" to complete data collection in one week for all households in their weekly assignment. Further, each weekly assignment generally must be closed slightly more than one week after the assigned week.

Table 2 shows by week for the 1989 NHIS the proportion of the basic health and demographic questionnaires completed "on time" (i.e., in the assigned week). Overall 65 percent of the interviews are completed on time; however, in weeks corresponding to certain holidays this figure drops, with an annual low of 56 percent corresponding to Thanksgiving week. Because of the number of the holidays in the latter part of the year, the proportion of interviews completed on time during this period is lower than that for the rest of the year.

This certainly provides evidence of the additional difficulties resulting from year-round interviewing. For a one-time survey, additional efforts would be required to secure survey response for this period as opposed to survey response during other parts of the year.

Table 3 shows for the 1989 NHIS the completion rates by week for the basic health and demographic questionnaire. Over the year, response rates are virtually constant. In week 7 of the first quarter, the lower response rate is attributable to questionnaires being lost in transit to

the NCHS data processing center. We do not show similar data for the Orofacial Pain Supplement, since the range of completion rates is similar.¹

The adverse effect on completion rates of a large number of late interviews and interviewer stress may be magnified if the interviewer's assignment in the next week falls in a different primary sampling unit (PSU) or if the interviewer has multiple assignments for the next week. In the former case, the interview may no longer be in the same area. In the latter case, the interviewer must borrow time from that allocated to the next week's assignment.

Moreover, such back-to-back interviewer assignments are not unusual. For the NHIS, most interviewers work no fewer than 240 hours per quarter, which is required in order to qualify for certain Census employee benefits such as health insurance. Interviewer assignments are not currently designed to reduce the frequency of such back-to-back assignments.

With respect to traveling interviewers, about one third of the NHIS interviewers are not resident in the assigned PSU's and often must travel large distances to be in the PSU in which their assignment is located. For these interviewers there may be little additional time to work on late cases in subsequent weeks.

Respondent rule. In some survey situations, a proxy respondent rule is feasible. Permitting proxy reporting will obviously increase the level of response over that attained with a self response.

In the NHIS, proxy reporting is permitted for the core questionnaire, but proxy reporting is not permitted for the supplemental questionnaires administered to an adult randomly selected by family in the sample household. The completion rate for the core questionnaire is generally 5-10 percentage points higher than for supplemental questionnaire administered to a randomly selected adult (e.g., 95 percent vs. 85-90 percent). The sample persons supplements generally collect information on knowledge, attitudes, or behaviors for which a proxy respondent rule may not be appropriate.

Generally, data are not available on the characteristics of eligible persons in a sample for whom an interview is not obtained; i.e., survey nonrespondents. However, with the NHIS, sociodemographic and health-related data are available for all eligible persons in households where the core questionnaire was completed. Additional household information and "bookkeeping" information is also available, including whether or not the sample person was at home at the time of the core interview and the week in which the core interview was completed. The analysis which follows is based on such information for eligible sample persons.¹

Table 4 provides by age, sex, and race completion rates for the 1989 NHIS supplement on Orofacial Pain in which one adult was sampled per household. Table 4 also shows the completion rates by whether or not the sample person was present at the time of the initial (core) NHIS interview. In the 1989 Orofacial Pain supplement sample, about 36,000 sample persons were present at the interview for the NHIS basic health and demographic questionnaire, about

10,000 were not present, and about 500 persons are not classifiable by this criteria. Virtually all persons (96 percent) in the Orofacial Pain supplement sample present at the basic NHIS health and demographic interview provided data for this supplement. 74 percent (22 percentage points lower) in the Orofacial Pain Supplement sample, not present at the basic NHIS health and demographic interview, provided data for this supplement. The overall completion rate for eligible sample persons at home at the time of the core interview was around 30 percent higher than for those not at home. Table 5 shows the clear interplay on Orofacial Pain Supplement completion rates between presence or absence of the sample persons and timing of the initial interview relative to the assigned week.

These differences are large and reflect the facts that: (1) very high completion rates are obtained if the eligible sample person is home at the time of the core interview, regardless of contact status relative to assigned week; and (2) for persons not at home at the time of the core interview, completion rates are significantly related to contact status relative to assigned week, reflecting the importance of the time available for call back by the interviewer.

These large differences by presence or absence are likely due to interactions between the weekly sample design feature, statistical design of the weekly assignments, interview length, and other design features. We do not know specifically whether such differences results from a "respondent" problem, "interviewer" problem, or "length of interview" problem, or "assignment design problem" or something else. Some clues can be found in this paper. Interviewer performance measures. In household surveys an interviewer's completion rate is usually one component of how that interviewer's performance is measured. In surveys with one data collection component, setting levels of performance is straightforward. In surveys with several components and with annually changing components, it becomes more difficult to set performance levels covering all aspects of survey data collection.

In the NHIS, because of the variability in the number and features of the supplement questionnaires, evaluation of interviewer performance is weighted heavily toward completion of the core questionnaire, rather than supplement questionnaires. Consequently, when faced with insufficient time, interviewers would be expected to favor data collection for the core, at the expense of data collection for completing the supplements. Prior to 1987, on the average, NHIS interviewers completed weekly assignments in about 35 hours; in 1987, interviewers required more than 50 hours.

Clearly, the probability that interviewers will have insufficient time to complete weekly assignments has increased over time. The problems resulting from this are aggravated by interviewers frequently having assignments covering consecutive weeks. Also, while additional interviewers have been hired for the survey, this may not completely offset such interviewer workload problems. Residency rules. Most surveys employ residency rules to determine how the target population is linked to sampling

units. This can cause problems.

In the NHIS, persons are generally linked to their usual residence. This means that individuals who are temporarily absent from their household are eligible for the survey, but difficult to contact and thus survey. This, combined with the effects of the weekly sample design, adversely affect survey completion rates with a designated respondent for a special health topic, since interviewers have only about two weeks to locate, contact and then interview a respondent who may be travelling.

Data collection modes. Limitations on the data collection modes may adversely affect survey completion rates. The ability to use several data collection modes can enhance survey participating but can adversely affect survey data quality (e.g., because of mode effects and inability in telephone data collection to use visual aids). Some respondents may be difficult to reach during normal hours; however, they may be willing to participate in a telephone interview at their convenience.

In the NHIS, face-to-face data collection is usually required for the core questionnaire, largely because the survey employs a number of visual aids for the interview. As noted, telephone data collection is permitted with supplement questionnaires. This strategy, in part, recognizes that interviewers may have more difficulty locating, contacting, and interviewing the designated sample person for the supplemental topics, than a knowledgeable respondent for the core.

Sample size stability In ongoing surveys, variability in funding sometimes requires changes in the sample size. In 1985--the first year of the current NHIS sample design--NCHS could support the fielding of 3/4 of the full sample. In 1986--the second year of the current NHIS sample design--NCHS could support the fielding of the 1/2 of the full sample. In 1987--the third year of the current NHIS sample design--NCHS could support the fielding of the full sample. Because in a survey as demanding as the NHIS, for maximum effectiveness interviewers need both substantial training and field experiences, a decrease in response rates could be related to rapidly increasing the field work for interviewers.

Implications

Completion rates in sample surveys are often taken as proxy measures of data quality and attaining high survey completion rates is becoming more costly. With lower completion rates the corresponding survey data may be more prone to nonresponse bias. In this case, survey nonresponse adjustments become more important, since they have a larger effect on survey results.

While the NHIS response rates are high, the nonresponse does seem related to certain design parameters. There are several objectives of this analysis of design features related to NHIS survey nonresponse. A first objective is to

identify the correlates of nonresponse, using univariate and bivariate approaches. Identification of these correlates may potentially lead to modifying survey procedures resulting in reduction in nonresponse and/or costs. A long range objective is to improve estimation procedures designed to compensate for nonresponse.

The practical implications of these findings are that interviewers often do not have sufficient time to complete their assignments and may be handicapped from attaining higher response by survey design features. This results largely from the combined impact of the increasing length and complexity of the NHIS and the structure of interviewer assignments; i.e., the requirement that weekly assignments be closed out in just over two weeks and that interviewers often have consecutive weekly assignments. As noted previously, in 1987 on the average more than 50 hours were required for an interviewer to complete an assignment (as contrasted to 35 hours in earlier years). It is not surprising that a significant number of households are not contacted during the assigned week and that even with the use of the telephone, the time available for followup is very limited and often insufficient for the desired number of callback/conversion attempts.

The actions that should be taken to address this problem are not as simple as might appear. Some actions are underway to reduce the length and complexity of the NHIS. However, current demands and federal requirements of the NHIS have limited the success (at least in the short term) of these efforts. Extending the time available for completion of weekly assignments is not desirable given the fixed reference periods in the NHIS core questionnaire and that new assignments can be made each week. Simply employing a very large number of interviewers is not a solution, given the structure of interviewer assignments throughout the U.S. and related evidence that very few interviewers are willing to work on an intermittent or less than "near full time" basis.

For the 1991 NHIS, a number of changes were made with the objective of improving supplement completion rates. The Bureau of the Census made a careful assessment in each of its 12 regions of interviewer staffing patterns and the structure of interviewer assignments and then assigned additional interviewers to reduce interviewer assignments where needed while maintaining a satisfactory work load for all interviewers. This is of course costly. More long term strategies are being developed. In addition, a complete redesign of the NHIS sample and the core questionnaire will be implemented in 1995, at which time the weekly interviewer assignment concept may be dropped.

Summary

Numerous survey design parameters do affect survey response rates and potentially should be addressed in survey planning and design.

Notes and References

- ¹ These completion rates should be regarded as approximations rather than exact figures, since there may be minor errors in the data base on the identification of Individuals targeted for the OP supplement.
- ² Memorandum for the record, Michael P. Zukauskas, Demographic Survey Division, Bureau of the Census, dated July 18, 1991.

- ³ Cost Efficiency and the Number of Allowable Call Backs, by William Kalsbeek, Steven L. Botman, and James Massey, 1989 Proceedings of the Section on Survey Research Methods, American Statistical Association (Pages 434-439, 1990).
- ⁴ Charles Cannel: A Summary of a studies of interviewing methodology, 1959-1970 Vital and Health Statistics: Series 2, Data Evaluation and Methods Research, No. 69) (DHEW publication; no. (HRA) 77-1343).

Table 1

Design Parameter or Measure	Year				
	1985	1986	1987	1988	1989
Core response rate (%)	95.7	96.5	95.4	94.9	95.3
Average number of calls	2.56	2.62	2.88	2.98	2.95
Interviewer total minutes per case	152	167	156	179	173
% Full sample fielded	75	50	100	100	100
Total average household data collection burden (minutes)	46	50	55	80	66
% core interviewers completed on time	78	80	73	70	68

Table 2:

Quarter	Week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Percent 1989 Core Interviews completed on time</u>													
1	-	69	72	69	67	70	67	71	69	71	65	65	74
2	73	68	73	69	73	68	74	69	73	67	69	69	63
3	69	69	62	71	69	69	66	72	70	61	68	68	65
4	62	65	65	68	70	70	56	68	73	62	60	60	66

Table 3:

Quarter	Week												
	1	2	3	4	5	6	7	8	9	10	11	12	13
<u>Response Rate (%) for 1989 NHIS Basic Health and Demographic Questionnaire</u>													
1	-	95	95	94	95	95	84	95	95	96	95	94	96
2	97	96	95	96	95	96	96	97	96	96	95	95	95
3	95	95	95	95	95	95	96	95	95	96	96	95	96
4	95	96	96	96	95	95	96	95	95	95	95	96	95

Table 4

Race	Sex	Age	All	OP	
				Present	SP Not Present
				<u>Completion Rate (%)</u>	
			91	96	74
	MALE		88	95	74
	FEMALE		93	96	74
BLACK			90	94	72
NONBLACK			91	96	74
BLACK	MALE		86	93	69
BLACK	FEMALE		92	95	75
NONBLACK	MALE		88	95	75
NONBLACK	FEMALE		93	96	74
BLACK	MALE	18<=AGE<=19	84	91	79
BLACK	MALE	20<=AGE<=24	82	91	69
BLACK	MALE	25<=AGE<=29	85	95	61
BLACK	MALE	30<=AGE<=34	86	92	72
BLACK	MALE	35<=AGE<=44	84	93	68
BLACK	MALE	45<=AGE<=49	88	96	71
BLACK	MALE	50<=AGE<=54	85	92	65
BLACK	MALE	55<=AGE<=64	88	94	72
BLACK	MALE	65<=AGE<=74	94	97	74
BLACK	MALE	75<=AGE	86	90	68
BLACK	FEMALE	18<=AGE<=19	92	96	82
BLACK	FEMALE	20<=AGE<=24	92	95	80
BLACK	FEMALE	25<=AGE<=29	91	95	72
BLACK	FEMALE	30<=AGE<=34	93	97	66
BLACK	FEMALE	35<=AGE<=44	93	96	78
BLACK	FEMALE	45<=AGE<=49	94	97	79
BLACK	FEMALE	50<=AGE<=54	94	94	96
BLACK	FEMALE	55<=AGE<=64	92	95	69
BLACK	FEMALE	65<=AGE<=74	93	94	82
BLACK	FEMALE	75<=AGE	85	88	45
NONBLACK	MALE	18<=AGE<=19	83	95	68
NONBLACK	MALE	20<=AGE<=24	87	95	69
NONBLACK	MALE	25<=AGE<=29	89	95	74
NONBLACK	MALE	30<=AGE<=34	89	95	79
NONBLACK	MALE	35<=AGE<=44	88	95	77
NONBLACK	MALE	45<=AGE<=49	89	97	75
NONBLACK	MALE	50<=AGE<=54	87	97	71
NONBLACK	MALE	55<=AGE<=64	88	95	75
NONBLACK	MALE	65<=AGE<=74	91	95	76
NONBLACK	MALE	75<=AGE	89	95	57
NONBLACK	FEMALE	18<=AGE<=19	91	97	77
NONBLACK	FEMALE	20<=AGE<=24	93	97	75
NONBLACK	FEMALE	25<=AGE<=29	93	96	79
NONBLACK	FEMALE	30<=AGE<=34	93	97	75
NONBLACK	FEMALE	35<=AGE<=44	93	96	76
NONBLACK	FEMALE	45<=AGE<=49	93	96	75
NONBLACK	FEMALE	50<=AGE<=54	91	96	69
NONBLACK	FEMALE	55<=AGE<=64	93	96	78
NONBLACK	FEMALE	65<=AGE<=74	94	96	67
NONBLACK	FEMALE	75<=AGE	91	95	46

See note 1.

Table 5

Presence of OP sample person at Basic Health and Demographic Interview	Timing of NHIS Basic Health and Demographic Interview		
	In Assigned Week	1 Week Late	2 Weeks Late
	<u>OP Completion Rate</u>		
OP sample person present	97	94	85
OP sample person not present	79	66	40

See note 1.