

## RESPONSE RATES AND NON-RESPONSE ADJUSTMENT IN A NATIONAL SURVEY

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### INTRODUCTION

The National Survey of Family Growth, or NSFG, is a periodic survey conducted by the National Center for Health Statistics (NCHS). The survey is designed to provide national estimates of factors associated with fertility, contraception, and reproductive health among women 15-44 years of age in the United States. NCHS has conducted the survey in 1973, 1976, 1982, and most recently in 1988.

In 1973, 1976, and 1982, the survey was based on a complex, multistage area probability sample design. (Bachrach et al, 1985) Black women were sampled at higher rates than other women. The first stage of the sample design consisted of drawing a sample of primary sampling units (PSU's). A PSU consisted of a county, a group of contiguous counties, or a Standard Metropolitan Statistical Area (SMSA) as defined in 1970. The second and third stages of sampling were used to select segments (clusters of 15 to about 60 dwelling units) within each PSU. A systematic sample of dwelling units was then selected from each segment. Each sample dwelling unit was visited by an interviewer who listed all household members. If the household had one or more women 15-44 years of age, the interviewer then consulted a computer-generated sampling table to determine which woman, if any, should be interviewed. Thus, in the 1973-82 surveys, there was no prior list of eligible households or women.

For the 1988 NSFG, the sample was drawn from households who had participated in a larger NCHS survey, the National Health Interview Survey, or NHIS, between October of 1985 and March of 1987. Women were defined as eligible for the 1988 NSFG if they would be in the civilian noninstitutionalized population 15-44 years of age on March 15, 1988, the anticipated midpoint of interviewing. Thus, most women born between March 16, 1943 and March 15, 1973 would be eligible for the NSFG. Interviewing was conducted between January and August of 1988.

The age, sex, race and other characteristics of all persons participating in the 1986 NHIS were put on computer tape, and from that tape, the necessary number of black and non-black women 15-44 years of age were selected for the 1988 NSFG sample. Therefore, for the first time, the names, addresses, and characteristics of the women eligible for the survey were known in advance. This connection, or linkage, between the two surveys has many implications--for example, it requires that women who moved after the first survey (NHIS) and before the second (NSFG) must be tracked, or located, in order to be interviewed at their new addresses; it means that appointments can be made by phone with sampled women; and it means that all fieldwork materials, training, and fieldwork procedures for the survey had to be revised extensively. (See Botman et al, for further discussion of the linkage between the two surveys.)

For the present paper, however, the most important implication of this linkage is that we know the characteristics of all women in the NSFG sample regardless of whether they responded to the survey or not. And this permits us to study the characteristics

of eligible women in the NSFG sample who did and did not respond to the survey. The results of our analysis of nonresponse were used to construct weights for each interviewed woman, in an attempt to reduce nonresponse bias (Little, 1986). These weights can be used to estimate the number of women in the population represented by each woman in the sample. Using these weights, we can estimate such statistics as the number of women using oral contraceptive pills, the number who have ever used an IUD, the number of women who are infertile, or the number who used family planning services in the last year.

### NON-RESPONSE ADJUSTMENT

Response rates were calculated for the 10,566 women selected from the NHIS as eligible for the NSFG sample. Completed interviews were obtained with 8450 women, for a response rate of 80 percent. (Nonresponse to the NHIS was only 4 percent.) The first stage of the analysis of nonresponse was a series of crosstabulations. These revealed 10 small groups (less than 400 cases each, or less than 4 percent of eligible women each) that had bivariate response rates of under 70 percent. (Many of these characteristics were associated with each other, however, so that when these 10 groups were specified in a mutually exclusive way, some of the response rates exceeded 70 percent.) These 10 groups comprised the first 10 cells of the nonresponse adjustment matrix shown in table 1. These first 10 cells were defined hierarchically (with IF-THEN-ELSE statements), beginning with the lowest response rate (cell 1) to the highest (cell 10). Cases that fell into more than one group were classified into the first group they were qualified for. The tables were run first in more detail than shown in table 1; some smaller groups with similar response rates were combined. All response rates shown in table 1 are unweighted.

With only one exception (cell 2), the first ten groups have between 39 and 359 cases. The lowest response rate (33 percent) is in group 1--women whose education is unknown or who did not complete any years of school. Cell 2 taps a transient, marginal population which may not be covered well by most surveys. (These are small groups, however, and it is debatable whether so much weight should be given to such small groups.) Information was missing in the NHIS for certain variables for women in cells 3, 4, and 5. This is probably a measure of reluctance to cooperate, as is group 7. Rates were also relatively low for Asian and Cuban women (8 and 9), and for those who were unemployed or worked without pay (10).

The results of the second and largest part of the analysis of nonresponse are shown in the rest of table 1 (cells 11-51). For this part of the analysis, tables of response rates were run by about 30 characteristics of women as measured in the NHIS. Chi-square values were computed for each table. Variables were included in the model in order by their Chi-Square per degrees of freedom. This approach was used at each stage of the analysis to identify a classification of the NSFG sample by response rates that would be least likely to result from chance. We stopped when we ran out of cases or when further tabulations found no more

significant variables.

The variable showing the highest Chi-Square per degrees of freedom was whether the NHIS respondent provided, or refused to provide, a telephone number for a contact person (a person who would know where the NHIS respondent could be reached) in case the NHIS respondent moved. NHIS respondents who refused to give this telephone number had a response rate of only 74 percent in the NSFG, while women who did give this number had a response rate of 84 percent in the NSFG. Clearly, this variable measures the tendency to cooperate. This variable was used, then, as the major divider, and is listed first in part II of table 1. For ease of expression, the following discussion will say that each NSFG sampled woman responded for herself to the NHIS. However in about 20 percent of the cases, someone else in the household (a "proxy respondent") responded to the NHIS for her. Thus, when we say "women" in this paper, we actually mean "women or their proxy respondents from their own household."

Cells 11-16 show women who refused to provide the NHIS contact person's telephone number, and refused to provide their own social security number. Among women who refused to provide the telephone number of a contact person, the highest chi-square per degrees of freedom was obtained for the variable of whether she provided, or refused to provide, her social security number (to facilitate tracking her if she moved, and identifying her if other information is inaccurate or missing). Among women who refused to give their social security number to the NHIS interviewer, the highest chi-square per degrees of freedom was obtained for class of worker, a variable that measures occupation, industry, and labor force status (employed by government, not in labor force, or other). Among government workers, the strongest variable was whether the woman had any children of her own living with her; if she did not have any children in the household, her response rate was only 61 percent (cell 11); if she had children in the household, her response rate was 85 percent (cell 12). Number of own children in the household is an important variable substantively for the NSFG, because it is highly correlated with parity, the number of births the woman has had. Thus, the ability to adjust for nonresponse by this indicator of parity is an advantage of the linkage to NHIS. (The same kind of effect could be obtained by post-stratification by parity, but that could not take into account the higher-order interactions that this procedure can account for.)

Among women age 18 or older who refused the NHIS contact person's phone number, and refused to give her own social security number, and who were not in the labor force (II A 1 b in table 1), women living in the central cities of large metropolitan areas had response rates of only 63 percent (cell 13); those living in suburbs or in smaller MSA's had a rate of 74 percent (cell 14); and those in non-metropolitan or rural areas had a rate of 91 percent (cell 15). Many survey researchers have obtained the lowest response rates in big cities and the highest rates in rural areas (Smith, 1983). Women who were under 18 or were employed in the private sector (cell 16) had the lowest response rates (59 percent).

Cells 17-22 show women aged 18 or older who refused to give a telephone number for the NHIS contact person, but gave their own social security number. Among women who refused the contact person's phone number, but gave their own social security number (IIB), and completed the NHIS interview after only 1 or 2 visits by the NHIS interviewer, response

rates were lower in the Northeast and West (77 percent, cell 17) than in the Midwest or South (87 percent, cell 18). The number of visits to complete the interview may be a measure of how much the woman is home (availability), or how much resistance she makes to being interviewed (cooperation), or both. The Northeast and West contain such large metropolitan areas as New York, Boston, Los Angeles, and San Francisco, which are often difficult places in which to do interviewing. Cells 19 and 20 show that less educated women had lower response rates, and cells 21 and 22 show that married women in this subgroup had higher rates than unmarried women. Cells 23 and 24 show that among women under 18 years of age, 17 year olds had higher rates than 15-16 year olds. Part III of table I shows women who provided (did not refuse) the NHIS contact person's phone number. The table shows that there were 8233 of these women, and their response rate was 83 percent. Among those who provided the contact person's phone number, the highest Chi-square per degrees of freedom was for age-over or under 18. There were 6396 women 18 or over, with a response rate of 85 percent.

Among women 18 or over, the highest chi-square per degrees of freedom was found by whether she had children in the household. Thus, cells 25-34 of table 1 are for women who gave a phone number for the NHIS contact person, who were 18 years or older, and had no children in the household at the time of the NHIS interview. For women without children in the household, education and region were found to affect response rates. Among women 18 and older who had no children, had a high school education or less, and lived in the Northeast, response rates to the NSFG were much higher for women who had completed the NHIS in 1 or 2 interviewer visits (74 percent, cell 25) than for those who required 3 visits or more (54 percent, cell 26). As noted above, the number of visits to complete the NHIS interview appears to be a measure of how much the respondent is home and how willing she is to be interviewed. Among women living in the South, response rates were higher for non-working women (87 percent, cell 27) than for working women (80 percent, cell 28). For women in the Midwest, those who responded to the NHIS themselves (cell 29) had a higher response rate to the NSFG (83 percent, cell 29) than those whose NHIS data were provided by another household member (64 percent, cell 30). This self vs proxy variable may be an indicator of availability, or propensity to cooperate, or both. Among women 18 and older with no children in the household who were college graduates, 88 percent completed the NSFG interview (cell 34).

Cells 25-34 illustrate one important feature of this adjustment procedure: its ability to take advantage of higher order interactions in the pattern of nonresponse. In the previous cycles of the survey, we could only take marital status, race, and age into account. This procedure allows us to examine a wide range of variables, about 30 of which are used in the nonresponse adjustment matrix in table 1. Interestingly, race (black vs white) was not found to be a significant predictor of response rates. Age was also not significant, except for the variable over or under 18, which is partly an artifact, because some variables were only asked for women 18 or older. Marital status was significant only in some higher order interactions in certain subgroups. So the variables used in the nonresponse adjustment in Cycles I-III of the NSFG were not the most important determinants of response rates in Cycle IV.

Cells 35-43 of table 1 show response rates for women who provided the NHIS contact person's phone number, who were 18 or over when the NHIS was conducted, and had 1 or more children in the household when the NHIS was conducted(IIIA2b). Within this group, women living in central cities of large metropolitan areas had a response rate of 82 percent. For these central city residents, response rates varied by education, from 79 percent in the lowest group (cell 35) to 88 percent among college graduates(cell 37). Among suburban residents who responded to the NHIS themselves, response rates were 81 percent for Hispanics(cell 38) and 88 percent for non-Hispanics. Among the non-Hispanics, response rates were somewhat higher for women not in the labor force or who were government workers(90 percent, cell 39) than for others(86 percent, cell 40). For women who lived outside of large metropolitan areas, those who refused to give their own social security number to the NHIS interviewer had lower response rates on the NSFG(83 percent, cell 42) than those who provided their social security number(92 percent, cell 43).

Cells 44-51 are for women who provided the NHIS contact person's telephone number, and who were under 18 years of age at the NHIS interview(III B in table 1). There were 1041 of these 15-17 year olds in the NHIS, and their response rate to the NSFG was 81 percent. For these teenagers, Hispanics had a higher response rate (91 percent, cell 44) than non-Hispanics(80 percent). This is the opposite of the pattern in cell 38, for women 18 and older, and is a good illustration of the need to account for interactions when designing non-response cells. Among non-Hispanic teenagers, response rates to the NSFG varied sharply by number of visits needed to complete the NHIS, and by whether the teenager herself (cells 45 and 47) or someone else(cell 46) was the NHIS respondent. Cells 48-50 show that, even among relatively hard-to-find teenagers(3-5 visits to complete NHIS), response rates varied from 68 percent in central cities of large metropolitan areas, to 86 percent in non-metropolitan and rural areas.

#### WEIGHTING IN PREVIOUS CYCLES

The ability to study the characteristics of nonrespondents to the survey is useful for insight into the determinants of response. But it is also useful for adjusting for nonresponse in an attempt to reduce nonresponse bias. Because the survey is intended to produce national estimates, each case has a weight, which is the number of women in the population represented by that woman in the sample.

In the 1973, 1976, and 1982 surveys, the weights were constructed using 3 basic steps(Pamuk and Mosher, 1988):

1) The weight was inflated by the reciprocal of the probability of selection; the latter is the product of the probabilities of selection of the PSU, segment, household, and sample person within the household. For example, if the product of these probabilities was 1 in 6000, the woman's weight at this stage would be 6000.

2) Nonresponse adjustment was a multiplication of two factors in the 1973, 1976, and 1982 surveys. Nonresponse to the screener(household roster) was adjusted for by imputing the characteristics of responding women to nonresponding women in the same PSU and stratum. The second factor adjusted for nonresponse to the interview by imputing the characteristics of responding women to nonresponding women in the same age-race-marital status category and PSU. For example, if nonresponse in such a category

was 20 percent, the weight of 6000 would be divided by 0.80, for a non-response-adjusted weight of 7500. (Note that adjusting for PSU may have captured some of the effects of region and size of place, which were used in this article.) The new data on the characteristics of nonrespondents in the 1988 NSFG allowed us to alter the details of this nonresponse adjustment. The procedure will be outlined below.

3) Post-stratification: In the 1973, 1976, and 1982 surveys, the non-response-adjusted estimates were ratio adjusted to independent control totals by age, race, and marital status(ever married vs never married) used by the U. S. Bureau of the Census for the Current Population Survey. In the 1988 survey, the control totals used for post-stratification included parity(number of children born to the woman) as well as age, race, and marital status.

#### WEIGHTING IN THE 1988 NSFG

Here we will describe the weighting procedure in the 1988 NSFG. The NSFG estimation procedures will be shown in detail in a forthcoming report (Judkins et al, forthcoming). The steps in constructing the weights for the 1988 NSFG were as follows:

1) inflation by the reciprocal of the probability of selection: this is done as in previous surveys. This weight is called the baseweight, or W0.

2) Trimming: about 100 cases had extremely large baseweights(W0) in the 1988 NSFG. In previous cycles, these large weights were left alone, but they could have adverse effects on results, especially in small categories. To reduce this problem, these large weights were trimmed, or reduced to a maximum value of 8000 for black women(about 4 times the average W0 weight for blacks) and 19000 for non-black women(over 3 times the average W0 weight for nonblacks). This trimmed weight is called W1. The trimming of course reduced the total weighted numbers to less than the 57.9 million women that we knew were 15-44 in the US in 1988. So the reduction in the weighted numbers was redistributed, within each of 16 cells, to form a new weight, called W2. This weight was trimmed again, when it exceeded the maximum value. The resulting weight was called W3.

3) Nonresponse adjustment: For each of the 51 cells defined in Table 1, the ratio of the weighted sum of all cases to the weighted sum of complete cases was applied to W3 by cell. The new weight was called the non-response adjusted weight, or W4.

4) Post-stratification: We defined a 72-cell matrix of categories of age by race(black vs. non-black) by marital status(ever-married vs never married) by parity. (The categories of the matrix are shown in Judkins et al, forthcoming.) The control totals for these cells were obtained from the June 1988 Current Population Survey, conducted by the US Bureau of the Census. The non-response adjusted weight, W4, was forced to be equal (to the nearest thousand) to the CPS control total by raking parity against marital status within age by race categories. The resulting weight is called the final post-stratified weight, or W5.

#### COMPARISONS WITH OTHER DATA

How well did this procedure work? Did it produce more accurate weighted numbers than the less elaborate procedure used in the 1982 NSFG? A full answer to these questions is beyond the scope of any paper of this length, but one key comparison can be discussed here. Table 2 shows the number of births in the United States in thousands, as estimated in the 1982 and 1988 NSFG (in column 1), and as recorded in the birth registration system by NCHS. We have shown the

data for the last 5 full calendar years before each survey (interviewing began in each survey in January): 1977-81 for the 1982 survey, and 1983-87 for the 1988 survey.

In the 1982 survey, the estimated number of births was higher than the actual number in every year, and the average for the 5-year period 1977-81 was 4 percent higher than in the vital statistics. In the 1988 survey, the estimated number of births in 1983-87 was higher in two of the 5 years and lower in 3. But the average for the 5-year period was only 1 percent higher than the actual number of registered births. The average percent difference between the vital statistics and the NSFG was 4.2 percent in the 1982 survey, and 4.8 percent in the 1988 survey. This result suggests that the 1988 adjustment procedure may have produced less bias in estimates of births, but perhaps at the cost of slightly more variance than the 1982 procedure. If similar results were obtained with other comparisons, we might conclude that the reduced nonresponse bias is worth the cost of the more elaborate adjustment procedure. If so, the results would suggest that it may be worthwhile to continue this more elaborate weighting procedure in future cycles of the survey.

#### SUMMARY

In previous cycles of the National Survey of Family Growth, the samples were drawn independently, and nonresponse adjustments were made with the very few data items available--Primary sampling unit, stratum, age, and race. However, in the 1988 NSFG, the sample for the 1988 NSFG was drawn from the National Health Interview Survey, which means that the characteristics of all women chosen for the sample were known. This made it possible to identify a number of characteristics of nonrespondents. This, in turn, meant that the nonresponse adjustment procedure could take into account these characteristics, in an attempt to reduce nonresponse bias. This paper describes the

details of that procedure, as well as how the nonresponse adjustment was used in the weighting of the sample results. It is too early to reach any firm conclusions about the costs and benefits of this procedure, but one key comparison suggests that the new procedure may have reduced nonresponse bias.

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Table 1: Nonresponse Adjustment Cells Used in the 1988 National Survey of Family Growth (Characteristics of sampled women were obtained from the National Health Interview Survey)

#### I. Initial nonresponse cells

	<u>N</u>	<u>Response Rate</u>
1. Education is unknown or never attended	91	33%
2. else: housing unit type is motel, hotel or rooming house	21	48%
3. else: refusal on height, weight, education, health status or major activity; or racial background is unknown	148	70%
4. else: Has telephone but no phone number is given	333	61%
5. else: Marital status, income or class of worker is unknown	359	72%
6. else: NHIS Interview length 15 minutes or less	103	76%
7. else: Interview is 2+ weeks late	202	68%
8. else: Asian/Pacific islander	182	72%
9. else: Cuban	39	74%
10. else: Never worked but in labor force; or worked without pay	64	73%

II.	NHIS Contact person's telephone number <u>refused</u> :	1587	74%
A.	AND Refused own Social Security Number	475	65%
(1)	AND Class of worker=Employed by Government	62	74%
11.	AND Number of own children in household=0	28	61%
12.	AND Number of own children in household=1+	34	85%
(b)	AND Class of worker=Not in labor force	138	74%
13.	AND Type of place=Central City of an MSA* of 1 million+	48	63%
14.	AND Type of place=Central City of an MSA of less than 1 million, or in the suburban area of an MSA	58	74%
15.	AND Type of place=Non-Metropolitan or rural	32	91%
(c)	16. AND woman is employed in private sector or is under 18	275	59%
B.	AND Gave own Social Security number:	873	79%
(a)	AND Number of visits to complete NHIS interview=1 or 2	484	83%
17.	AND Region=Northeast or West	207	77%
18.	AND Region=Midwest or South	277	87%
(b)	AND Number of visits to complete NHIS interview=3-5	299	78%
19.	AND sampled women completed 1-12 years of school	174	72%
20.	AND woman completed 13+ years of school	125	85%
(c)	AND Number of visits to complete NHIS interview=6 or more	90	63%
21.	AND Marital Status=Married	37	76%
22.	AND Marital Status=Not married	53	55%
C.	AND Social Security number Not asked because woman is under 18 years of age	239	
23.	AND Respondent=17 years of age	47	87%
24.	AND Respondent is 15 or 16 years of age	192	68%
III.	NHIS Contact person's phone number <u>answered</u> (NOT refused):	7437	84%
A.	AND sampled women is 18 or older	6396	85%
(1)	AND Number of children in the household=0	2271	80%
(aa)	AND Education=1-12 years	1148	76%
	AND Region=Northeast	234	66%
25.	AND Number of calls to complete NHIS=1 or 2	143	74%
26.	AND Number of calls=3 or more	91	54%
	AND Region=South	467	82%
27.	AND Keeping house or attending school	150	87%
28.	AND Working	317	80%
	AND Region=Midwest	298	77%
29.	AND NHIS Respondent=Self	196	83%
30.	AND NHIS Respondent=Proxy	102	64%
31.	AND Region=West	149	72%
(bb)	AND Education=13-15 years	662	82%
32.	AND Refused to give Social Security Number	74	72%
33.	AND woman did NOT refuse Social Security Number	588	83%
(cc)	34. AND Education=16 years or more	461	88%
III			
(A2)	AND Number of own children in household=1 or more	4125	87%

(aa)	AND Type of Place=Central City of MSA of 1 million+	841	82%
	35. AND Education=1-12 years	571	79%
	36. AND Education=13-15 years	177	85%
	37. AND Education=16 years or more	93	88%
(bb)	AND Type of Place=Suburb of large MSA or CC of smaller MSA	1810	86%
	AND Respondent=Self	1555	87%
	38. AND woman is Hispanic	93	81%
	AND woman is not Hispanic	1462	88%
	39. AND woman is not in labor force or works for government	703	90%
	40. AND sampled women works in private sector or is under 18	759	86%
	41. AND Respondent for NHIS=Proxy	255	82%
(cc)	AND Type of Place=Rural parts of MSA or Non-metro	1474	91%
	AND Respondent=Self	1271	92%
	42. AND woman refused SS Number	240	83%
	43. AND woman did <u>not</u> refuse SS Number	1234	92%
B.	AND woman is under 18 years of age	1041	81%
(1)	44. AND woman is Hispanic	66	91%
(2)	AND woman is not Hispanic	975	80%
(a)	AND Number of calls to complete NHIS=1 or 2	627	82%
	45. AND NHIS Respondent=self	44	86%
	46. AND NHIS Respondent=Proxy	85	72%
	47. AND woman is under 17	498	84%
(b)	AND Number of calls to complete NHIS=3-5	295	78%
	48. AND type of place=Central City of large MSA	60	68%
	49. AND type of place=Suburb, or CC of smaller MSA	130	75%
	50. AND type of place=Rural or Non-metro	105	86%
(c)	51. AND Number of calls to complete NHIS=6 or more	53	70%

Table 2: Number of live births in the U.S. (in thousands) as estimated in the 1982 and 1988 National Survey of Family Growth (NSFG), the actual number of registered births, and the ratio of NSFG to the actual number

<u>from 1982 NSFG:</u>	<u>NSFG</u>	<u>Actual</u>	<u>Ratio</u>
1977	3,334	3,327	1.01
1978	3,408	3,333	1.02
1979	3,859	3,494	1.10
1980	3,808	3,612	1.05
1981	3,795	3,681	1.03
1977-81	18,224	17,447	1.04
<u>from 1988 NSFG:</u>			
1983	3,584	3,649	0.98
1984	4,142	3,669	1.13
1985	3,855	3,761	1.02
1986	3,705	3,757	0.99
1987	3,564	3,809	0.94
1983-87	18,850	18,635	1.01