AN ASSESSMENT OF NONRESPONSE BIAS[1]

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Nonresponse is recognized as a major source of bias in sample surveys. Few surveys involving personal interviews, however, have focused on this source of bias. In view of the declining rates of response in household surveys involving personal interviews, the problem of nonresponse bias merits more attention. Moreover, when rates of nonresponse in particular segments of the population are known to be high, as for example among the elderly, the assessment of this source of bias becomes imperative.

This paper examines the extent and nature of nonresponse bias in a national survey of elderly women, personally interviewed in the Spring of 1978, and reports on a followup of nonrespondents through the use of a mail questionnaire. The survey was designed for purposes of gaining a better understanding of the low fertility achieved by women born in the first decade of the 20th Century. Henceforth, this survey is referred to as the Low Fertility Cohort Study.

THE SAMPLE[2]

Personal interviews were completed with a national sample of 1,049 white, ever married women belonging to the birth cohorts of 1901-1910 (i.e., born between July 1, 1900 and June 30, 1910). Excluded from the sample were women residing in institutions (less than 5 percent), women marrying for the first time after age 45 and foreign born women who migrated to the United States after attaining age 30. At the time of the interview the women were 67-77 years of age.

Utilizing a multistage probability sample design, 27,579 housing units were assigned to interviewers for household screening. Table 1 shows the final disposition of these housing units. Slightly more than 3,300 were found to be vacant, not a housing unit or outside the sampling unit boundaries. Screening interviews were attempted with the remaining 24,193 housing units for purposes of identifying women meeting the sample criteria. The screening response rate was 98.6.

Since the screening interview was conducted with any household member aged 14 or over, or with a neighbor after two unsuccessful visits to the sample household, a rather broad definition of a potentially eligible woman was adopted. Any white, ever married woman reported as being aged 62 to 82 was considered potentially eligible for an interview. If such a woman was identified in the screening, interviewers made unlimited calls until the termination of the fieldwork to ascertain whether she met all eligibility requirements. Of the women identified as eligible for an interview, interviews were successfully carried out with 1,049 women.[3] The final interview response rate was 71.6, and the completion rate was 70.6.

NONRESPONDENT STUDY

On the basis of our experience with the pretest for this study, carried out in four major metropolitan areas (Koo et al., 1976), and the reported experience of other surveys in interviewing older persons (Atchley, 1969; Benus and Ackerman, 1971; Kish, 1965), a relatively high rate of nonresponse was expected. Therefore, a followup of all nonrespondents was planned to occur shortly after the completion of the fieldwork. In September, 1978, a short mail-back questionnaire was sent to each woman identified as potentially eligible during the screening interview who was not interviewed because she refused, was not at home, was ill or had communication problems. On the basis of the screening interviews, 420 nonrespondents were identified as eligible to receive a mail questionnaire. The final disposition of the 420 questionnaires mailed out is shown below:[4]

Total questionnaires mailed	420
Returned	180
Ineligible	12
Discarded	3
Eligible nonrespondents returning questionnaire	165

One hundred and eighty questionnaires were returned, resulting in a response rate of 42.9. Three of the questionnaires were discarded because information in the questionnaires indicated that they were obviously filled out by someone other than the potentially eligible women. Twelve of the women were subsequently reclassified as ineligible on the basis of information contained in the mail-back questionnaire. This reclassification had the effect, incidentally, of slightly raising the final response rate. The nonrespondent study thus resulted in data for 165 nonrespondents.

THE DATA

To assess the bias resulting from nonresponse in our sample, we employ three sources of data. First, we have virtually complete data for the respondents. Second, for all nonrespondents we have data from the household screening interviews and third, we have data from the followup study for those nonrespondents who returned the mail-back questionnaire. Each of these sources of data, of course, contains some item nonresponse. The household screening interview provides data on residential characteristics (e.g., region, size of place and household size) as well as birth date, place of birth and age at marriage. The mail-back questionnaire includes data on number of live births, residence while growing up,

educational attainment and religion. Questions on date of birth and age at first marriage were repeated in the mail-back questionnaire to verify the data previously collected in the screening interview.

RESULTS

One method commonly used to assess non-response is to compare response rates among subgroups of the sample. If response rates do not vary for a number of characteristics of the sample, the sample is generally considered not biased as a result of nonresponse. Yet, this type of comparison can be made for only the limited number of characteristics for which data are available for both respondents and nonrespondents. Accordingly, there may still be serious bias resulting from nonresponse even when the response rates for these selected characteristics do not vary.

The response rates shown in Table 2 indicate an underrepresentation of women living in the West and in metropolitan areas, particularly central cities. Additionally, respondents living in two person households or in multiple dwelling housing units are somewhat underrepresented. Women in the younger birth cohorts of 1906-1910 are also slightly underrepresented, as are women marrying at age 20 or older. These differences are, however, quite minimal.

The response rates presented in Table 2, calculated on the basis of household screening data, do not permit an assessment of nonresponse bias in terms of the variables most important to our planned analysis, namely number of live births and other fertility related characteristics. To evaluate nonresponse with respect to these variables, we must rely on the followup study of nonrespondents.

The data collected in the nonrespondent study permit us to estimate the effects of nonresponse on a number of demographic characteristics. The accuracy of these estimates, however, depends on the extent to which the followup nonrespondents can be considered representative of all nonrespondents. Table 3 presents a detailed comparison of respondents, total nonrespondents and followup nonrespondents. In general, the differences observed between the total and followup nonrespondents are small. The differences observed between these two groups tend to be largest for those variables where nonrespondents differed most markedly from respondents. Thus the followup nonrespondents contain greater proportions of residents in the West and metropolitan residents than observed for all nonrespondents. These data suggest that some of the deficiences of the sample could be overcome if the nonrespondent data obtained in the mail-back questionnaire were incorporated into the analysis.

In interpreting Table 3, a data problem should be noted. Twelve of the women returning the nonrespondent followup questionnaire were reclassified as ineligible and removed from the sample of followup nonrespondents. The sample of total nonrespondents contains these twelve women since they could not be matched with the screening data. In addition, there may be other ineligibles among the nonrespondents who did not return the followup questionnaire. Accordingly, the results presented in Table 3 must be interpreted with caution.

Table 4 compares respondents and followup nonrespondents in terms of age at marriage, education, number of live births and religion. As previously noted, the data indicate that the respondents are underrepresented at the younger ages at marriage. High school graduates and women attending college are also underrepresented, as are women with fewer than two live births. Roman Catholic and Jewish women are also somewhat underrepresented. In the case of number of live births, the degree of underrepresentation was found to be statistically significant.

The data contained in Table 4 permit an assessment of the response bias for the relationships we are concerened with in our analysis (Ellis et al., 1970; Platek et al., 1978). Since the focus of the analysis of the Low Fertility Cohort Study is on variables related to fertility, Tables 5, 6 and 7 were prepared. These tables present the percentage distributions and the means and standard deviations for number of live births by age at marriage, educational attainment and religion. The top panel of each table presents data for the sample of respondents, while the lower panel presents data for the combined sample of respondents and the followup nonrespondents.

As indicated in Tables 5, 6 and 7, the inclusion of the followup nonrespondents does not markedly change the effects of age at marriage, educational attainment or religion on fertility. Since numerous studies of fertility have documented that these three variables have the strongest relationship to fertility, this finding is most reassuring and indicates that little would be gained in our analysis if we weighted for nonresponse bias.

CONCLUSIONS

The analysis of the data available for all nonrespondents and for the followup nonrespondents who returned the mail-back questionnaires indicates several types of bias resulting from nonresponse in the sample of respondents of the Low Fertility Cohort Study. First, there is a bias by place of residence. Respondents generally underrepresent residents of the West and of central cities of metropolitan areas. Also, the sample of respondents underrepresents two person households. In this study, the nonresponse biases

identified regarding residence or household size are not of primary importance, since these are not major independent variables.

The analysis also indicates a bias in terms of age at marriage, educational attainment and number of live births. These latter biases are of special concern to us since an analysis of the reproductive behavior of the 1901-1910 birth cohorts is the primary objective of the Low Fertility Cohort Study. Fortunately, the additional data for the followup nonrespondents do not indicate any serious bias regarding the relationships between age at marriage, educational attainment, religion and fertility.

In most studies of nonresponse bias, the available data do not permit any assessment regarding relationships of substantive interest. For such an evaluation, a followup of nonrespondents is not only useful but a virtual necessity. Furthermore, relative to the costs of conducting surveys that involve personal interviews, a mailback followup study is extremely inexpensive. The data presented in this paper support both the feasibility of conducting such a study and its value in the assessment of nonresponse bias.

In this paper we have focused exclusively on nonresponse bias, and ignored any bias which may have resulted from lack of representativeness due to inadequacy in the sample design. In order to assess the representativeness of the sample, data for all eligibles must be compared to an independent source of data for a comparable population. We have begun such an analysis using data from the March, 1978 and June, 1978 Current Population Surveys, but are hampered by lack of comparability on a number of residential measures and the fact that few demographic measures were included in the CPS. This and other sources of bias will be explored in greater depth in future work.

FOOTNOTES

[1]This research was supported in part by the National Institute of Child Health and Human Development, Contract N01-HD-62818.

[2]The sampling and fieldwork were carried out by the Institute for Survey Research (ISR) of Temple University.

[3]Eight women terminated the interview before completion. These partial interviews were retained for data analysis, however, since most of the major topics being studied had been completed by the time the interview was terminated.

[4]This figure includes three women erroneously classified as nonrespondents at the time of mailing who were actually ineligible on the basis of screening data.

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Table 1. Final Disposition of Sample for Low
Fertility Cohort Study

Disposition of Sample	Number	Percent
Total housing units	27,579	
Vacant, not a housing unit, etc.	3,386	
Housing units eligible for screening interview	24,193	
Housing units not screened	347	
Not at home	61	
Refusal	275	
Language barrier	11	
Housing units screened	23,846	Percent
No eligible women	22,380	
Eligible women	1,466	100.0
Respondents	1,049	71.6
Nonrespondents	417	28.4
Not at home	39	(2.6)
Refusal	313	(21.4)
Sick, senile	56	(3.8)
Hearing, speech impairment	9	(0.6)

Table 2. Interview Response Rates by Selected
Characteristics

Characteristic	Interview Response Rate	Number of Eligible Women
Region		
Northeast	77.2	281
North Central	72.4	500
South	72.6	427
West	62.0	258
Residence[a]		
SMSA		
Central City	59.3	302
Outside Central City	67.5	682
Non SMSA	85.1	482
Household Size		
One	73.4	587
Two	69.8	725
Three or more	78.2	142
NA	—	12
Type of Housing Unit		
Single detached	72.7	1,014
Other	70.1	435
NA	—	17
Birth Cohort		
1901-1905	74.2	616
1906-1910	72.5	817
NA[b]	—	33
Age at First Marriage[c]		
Less than 20	84.5	472
20-24	81.8	505
25 or more	79.3	299
NA	—	190

[a]Differences in response rate by residence are significant at the p < .01 level ($\chi^2 = 20.191$, df = 2).

[b]Month of birth was not ascertained on screening form, but year of birth indicated eligibility.

[c]Differences in response rate by age at first marriage are significant at the p < .01 level ($\chi^2 = 20.971$, df = 2).

Table 3. Comparison of Respondents, Total Nonrespondents and
Followup Nonrespondents in Low Fertility Cohort Study

Characteristic	Respondents	Nonrespondents	
		Total[a]	Followup
Region[b]			
Northeast	20.7	15.3	11.5
North Central	34.5	33.1	38.2
South	29.5	28.1	24.2
West	15.3	23.5	26.1
Total	100.0	100.0	100.0
Residence[c]			
SMSA			
Central City	17.1	29.5	32.1
Outside Central			
City	43.8	53.2	52.7
Non SMSA	39.1	17.3	15.2
Total	100.0	100.0	100.0
Household Size			
One	41.1	37.4	35.8
Two	48.3	52.3	53.9
Three or more	10.6	7.4	9.7
NA	0.0	2.9	0.6
Total	100.0	100.0	100.0
Type of Housing Unit			
Single detached	70.2	66.4	61.2
Other	29.1	31.3	36.4
NA	0.7	2.3	2.4
Total	100.0	100.0	100.0
Birth Cohort			
1901-1905	43.6	38.1	39.4
1906-1910	56.4	54.0	60.6
NA[d]	0.0	7.9	0.0
Total	100.0	100.0	100.0
Age at First Marriage			
Less than 20	38.0	17.5	30.3
20-24	39.4	22.1	47.3
25 or more	22.6	14.9	22.4
NA	0.0	45.5	0.0
Total	100.0	100.0	100.0
Number of women	1,049	417	165

[a]Includes twelve cases later determined to be ineligible
based on followup nonrespondent return, as well as unknown
number of other ineligibles that may exist among those not
returning the followup questionnaire.

[b]Differences between respondents and total nonrespondents are
significant at the $p < .01$ level ($\chi^2 = 16.34$, df = 3).

[c]Differences between respondents and total nonrespondents are
significant at the $p < .01$ level ($\chi^2 = 71.34$, df = 2).

[d]Month of birth was not ascertained on screening form, but
year of birth indicated eligibility.

Table 4. Comparison of Respondents and Followup Nonrespondents
in Low Fertility Cohort Study

Characteristic	Respondents	Followup Nonrespondents
Age at First Marriage		
Less than 20	38.0	30.3
20-24	39.4	47.3
25 or more	22.6	22.4
Total	100.0	100.0
Education		
0-8 years	40.6	33.9
9-11 years	25.7	25.5
12 years	16.5	17.6
13+ years	17.2	23.0
Total	100.0	100.0
Number of Live Births[a]		
0	14.4	21.2
1	19.8	27.9
2	24.3	20.0
3	15.7	16.3
4+	25.8	14.6
Total	100.0	100.0
Religion		
Protestant	70.0	66.1
Roman Catholic	21.4	26.7
Jewish	3.2	3.6
Other	5.3	3.0
NA	0.1	0.6
Total	100.0	100.0
Number of Women	1,049	165

[a]Difference in distributions of respondents and followup
nonrespondents is significant at $p < .01$ level ($\chi^2 = 17.38$,
df = 4).

Table 5. Percentage Distributions, Means and Standard Deviations of Number of Live Births by Age at First Marriage for Respondents and Followup Nonrespondents in Low Fertility Cohort Study

Age at First Marriage	Number of Live Births					Total	$\bar{X}$	s.d.	N
	0	1	2	3	4+				
				Respondents					
Under 20 years	3.5	17.3	23.8	18.1	37.3	100.0	3.5	±2.7	399
20-24 years	11.4	20.3	26.4	17.7	24.2	100.0	2.5	±2.0	413
25 years or more	38.0	23.2	21.5	8.4	8.9	100.0	1.3	±1.5	237
Total	14.4	19.8	24.3	15.7	25.8	100.0	2.6	±2.2	1049
		Respondents and Followup Nonrespondents							
Under 20 years	4.9	18.3	22.9	17.6	36.3	100.0	3.4	±2.7	449
20-24 years	12.2	21.0	26.5	18.3	22.0	100.0	2.4	±1.9	491
25 years or more	37.9	25.2	20.1	8.4	8.4	100.0	1.3	±1.4	274
Total	15.3	21.0	23.7	15.8	24.2	100.0	2.5	±2.3	1214

Table 6. Percentage Distributions, Means and Standard Deviations of Number of Live Births by Education for Respondents and Followup Nonrespondents in Low Fertility Cohort Study

Education	Number of Live Births					Total	$\bar{X}$	s.d.	N
	0	1	2	3	4+				
				Respondents					
8 years or less	10.1	15.3	21.1	17.4	36.1	100.0	3.3	±2.7	426
9-11 years	13.0	20.4	25.9	15.2	25.5	100.0	2.6	±2.1	270
12 or more years	20.7	24.9	26.9	14.2	13.3	100.0	1.9	±1.7	353
Total	14.4	19.8	24.3	15.7	25.8	100.0	2.6	±2.2	1049
		Respondents and Followup Nonrespondents							
8 years or less	10.8	15.8	20.7	16.8	35.9	100.0	3.2	±2.7	482
9-11 years	15.7	21.2	24.7	16.0	22.4	100.0	2.4	±2.1	312
12 or more years	20.2	26.8	26.4	14.5	12.1	100.0	1.8	±1.6	420
Total	15.3	21.0	23.7	15.8	24.2	100.0	2.5	±2.3	1214

Table 7. Percentage Distributions, Means and Standard Deviations of Number of Live Births by Religion for Respondents and Nonrespondents in Low Fertility Cohort Study

Religion	Number of Live Births					Total	$\bar{X}$	s.d.	N
	0	1	2	3	4+				
				Respondents					
Protestant	15.3	19.1	24.9	15.4	25.3	100.0	2.6	±2.2	734
Roman Catholic	11.6	20.1	21.9	19.2	27.2	100.0	2.8	±2.5	224
Jewish	11.8	32.3	35.3	11.8	8.8	100.0	1.8	±1.2	34
Other	16.1	21.4	17.9	8.9	35.7	100.0	3.3	±3.2	56
Total[a]	14.4	19.8	24.3	15.7	25.8	100.0	2.6	±2.2	1049
		Respondents and Followup Nonrespondents							
Protestant	16.5	20.7	23.8	15.3	23.7	100.0	2.5	±2.2	843
Roman Catholic	11.9	19.8	22.4	19.8	26.1	100.0	2.8	±2.4	268
Jewish	12.5	30.0	40.0	10.0	7.5	100.0	1.7	±1.1	40
Other	16.4	23.0	16.4	9.8	34.4	100.0	3.2	±3.1	61
Total[a]	15.3	21.0	23.7	15.8	24.2	100.0	2.5	±2.3	1214

[a] Includes women unknown as to religion