

Studies of Nonresponse and Measurement Error in the National Household Survey on Drug Abuse

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ABSTRACT

A summary of the results of a series of studies of nonresponse and measurement error in the National Household Survey on Drug Abuse (NHSDA) is given in this chapter. Two studies not previously reported, the Skip Pattern Experiment and the Census Match Study, are the primary focus of the chapter. The Skip Pattern Experiment involved a test of a modified NHSDA questionnaire that made extensive use of skip patterns in drug use questions. Compared to the standard NHSDA method, which avoids skip patterns, the modified questionnaire tended to produce lower rates of reported drug use. The Census Match Study involved linking 1990 NHSDA nonrespondent cases with data from the 1990 Decennial Census. Household and individual data for NHSDA nonrespondents were obtained from the Census and used to characterize NHSDA nonresponse patterns in detail. A multilevel logistic model of response propensity identified the important predictors of nonresponse, including characteristics of the sampled person, the selected household, the neighborhood, and the interviewer.

INTRODUCTION

This chapter reports on a series of methodological studies conducted in conjunction with the NHSDA. These studies, sponsored primarily by the National Institute on Drug Abuse (NIDA) (sponsorship of the NHSDA and related methodological studies was given to the Substance Abuse and Mental Health Services Administration (SAMHSA) in 1992), were intended to evaluate NHSDA methodologies and test new ones; their focus was primarily on survey errors resulting from nonresponse and measurement error. Many of the results of these studies can be found elsewhere (Turner et al. 1992). This chapter briefly summarizes the results of the previously published studies and focuses on two more recent studies, which are described in more detail in unpublished reports (Gfroerer, unpublished data). The first study,

the Skip Pattern Experiment, assessed the potential measurement error that would result by introducing skip patterns into the NHSDA self-administered answer sheets (Lessler and Durante 1992). The second study, the Census Match Study, involved an analysis of nonresponse in the NHSDA and its potential for causing errors in estimation (Parsley 1993).

SOURCES OF ERROR IN SURVEYS

To put these studies in context, it is useful to summarize all the sources of error that occur in the NHSDA and surveys in general. Efforts to improve the quality of survey estimates should always focus on total survey error. Such a discussion may also serve to clarify terminology and, it is hoped, contribute to an improvement in communication between survey researchers, drug abuse researchers, and drug abuse policymakers. A commonly used term such as "nonresponse," for example, could easily be misinterpreted by some to mean the denial of drug use by survey participants who have used drugs (i.e., incorrect response), when in fact it refers to the failure to obtain data from some sampled units (i.e., no response).

Survey errors can be classified into four types: coverage, sampling, nonresponse, and measurement (Groves 1987). Coverage error results from using a sampling frame that does not include all of the target population. In establishment surveys (surveys of schools or businesses, for example), coverage error often results when eligible units are not included in lists of establishments from which the sample is drawn. In household surveys, undercoverage primarily occurs because members of the target population are not reported during screening as being members of any household.

Sampling error results when data are intentionally collected from only a portion of the sample frame. Methods of estimating the magnitude of sampling error are available when probability-based sampling is used.

Nonresponse errors result from the failure to obtain data from units that are selected to be in the sample. This can occur because potential respondents cannot be located or because they refuse to participate in the survey. The magnitude of this error depends on both the response rate (the percent of the sample from which data are obtained) and the difference between respondents and nonrespondents in the attribute (e.g., use of drugs) being measured. In household

surveys, nonresponse can occur at the household level, person level, and questionnaire item level.

Finally, the most often studied type of error is measurement error, which can be defined as the discrepancy between respondents' true attributes and the data obtained in the survey about their attributes. Response error has many sources, including the mode of interview, wording of questions, interviewer behavior, sensitivity of information requested, respondents' recall, and coding errors.

All four types of error are of concern in estimating drug use with household surveys. In measuring hardcore drug use, coverage error could be significant because many drug users may be transient or not permanently attached to one particular household. Sampling error is a problem in household surveys of drug use because many behaviors being measured have very low prevalence in the general population. Many users of NHSDA data, when told that the data are from a survey asking people to report on their drug use, assume that most drug users refuse to participate in such a survey (i.e., nonresponse error) or, if they do participate, they will lie about their drug use (i.e., measurement error). While all of these types of errors are undoubtedly present in NHSDA data, no study has comprehensively evaluated the relative contribution of each type.

DESIGN OF THE NHSDA

A description of the NHSDA sample design and estimation methodology can be found in published reports from the survey (SAMHSA 1993, 1994). For this chapter, a summary of the NHSDA data-collection method is given.

In-person interviews were conducted with sample persons, incorporating procedures that would be likely to enhance respondents' cooperation and willingness to report honestly about their illicit drug use behavior. Introductory letters were sent to sampled addresses, followed by an interviewer visit. A 5-minute screening procedure involved listing all household members along with their basic demographic data and a selection of sample person(s) based on the household composition. Zero, 1, or 2 persons could be selected. Interviewers attempted to conduct interviews in a private place, away from other household members. The interview averaged about an hour, and included a combination of interviewer-administered and self-administered questions. With this procedure, the answers to sensitive

questions (such as those on illicit drug use) were recorded by the respondent and not seen or reviewed by the interviewer. After these answer sheets were completed, they were placed by the respondent in an envelope, which was sealed and mailed back to the contractor. The self-administered answer sheets are also designed to conceal responses from interviewers by avoiding the use of skip patterns that could allow nondrug users to skip questions on drug use that did not pertain to them, thus identifying drug users as those who take longer to complete the answers. Skip patterns might also induce some drug users to deny their use as a way of avoiding answering more detailed questions that might follow a positive response.

MEASUREMENT ERROR IN THE NHSDA

Studies of measurement error in the NHSDA have focused on errors resulting from the questionnaire design and the mode of data collection. The basic issues of interest are how questions should be asked to maximize validity and reliability, and under what survey conditions are respondents most likely to provide accurate data. Results of some of this research can be found elsewhere (Turner et al. 1992); a few highlights are described below.

- Cognitive evaluations and analyses of inconsistent reporting patterns identified questionnaire items that needed revision to reduce response error (Cox et al. 1992; Forsyth et al. 1992).
- A comparison of NHSDA data to a national telephone survey found that respondents are less likely to report drug use by telephone than in person (Gfroerer and Hughes 1992).
- A methodological field test found that respondents are more likely to report drug use using self-administered answer sheets than with interviewer-administered questionnaires (Turner et al. 1992).

- Underreporting of drug use was found to be significant among a sample of former treatment clients who were selected to participate in the NHSDA at home (Harrell et al. 1986; Harrell, this volume).
- An analysis of NHSDA data found that youth were more likely to report drug use when interviews were conducted in private (Gfroerer 1985).
- A comparisons of NHSDA and Monitoring the Future data found that among young teenagers, reporting of drug use was more likely in a school setting than at home (Gfroerer 1992).

SKIP PATTERN EXPERIMENT

Design

Throughout its history the NHSDA has generally avoided the use of skip patterns because of the fear that respondents will realize that their use or nonuse of a drug will be revealed to interviewers (and others present during the interview) based on the length of time needed to complete answer sheets, thus diminishing confidentiality. Also, drug users may deny their use if they realize that a "never used" response will allow them to avoid answering a series of questions, thus saving time. Another concern is that respondents may not be able to follow skip patterns correctly in a self-administered answer sheet.

However, substantial benefits in terms of reduced respondent burden and expanded questionnaire content would occur with the introduction of skip patterns into the NHSDA questionnaire. Therefore it is important to know whether skip patterns can be implemented without seriously affecting data quality. Furthermore, if data quality is affected, it is also important to understand the mechanisms involved if there is to be a successful movement toward computer-assisted data collection.

In 1990, NIDA conducted a large methodological field test, primarily to evaluate the effect of using interviewer-administered versus self-administered questionnaires. In this study, some questionnaire answer sheets incorporated skip patterns. It was found that, in general, respondents were able to follow skip patterns that were not too complex, particularly if skips were always to the top of a page. Generally, when errors occurred, they resulted in respondents

answering additional questions unnecessarily, so there was no loss of data. However, the design of the field test did not allow a determination of the effect of skip patterns on reporting of drug use. In an attempt to address this, NIDA conducted an experiment during the first 3 months of 1992 to test a new questionnaire that incorporated skip patterns into the drug use answer sheets.

An experimental questionnaire was developed that included a number of skip patterns that allowed respondents to skip out of entire sections of questions if they responded "no" to an initial question on whether they had used a drug. This questionnaire was called the skip version. The regular NHSDA questionnaire was called the nonskip version. Differences between the two questionnaires varied by section in the questionnaire. The main differences between the two versions are summarized below.

- Cigarettes—Questions are identical. Both use interviewer- administered mode with skip patterns.
- Alcohol—In the skip version, respondents are told, "If you've never had an alcohol drink, just circle the 991 in the box after A-1 and tell me that you are finished with this answer sheet." In the nonskip version, respondents are told to answer all questions.
- Sedatives, tranquilizers, stimulants, analgesics—Questions are identical. Both use answer sheets with a skip pattern.
- Marijuana, inhalants, cocaine, crack, hallucinogens, heroin—In the skip version, respondents were told after an early question that if they never used the drug, they could skip the remainder of this answer sheet. In the nonskip version, all questions had to be answered.

Another difference between the two versions that could potentially affect the reporting of drug use was the technique used by interviewers to administer the answer sheets. For certain answer sheets, interviewers were instructed to read the questions aloud to respondents while respondents filled in the answers. This procedure is used in the NHSDA for the first several answer sheets to help respondents understand the questions. In the nonskip version, interviewers read the alcohol, marijuana, inhalants (for 12- to 17-year-olds only), cocaine, and crack answer sheets. In the skip version, reading

questions aloud would have made it obvious to interviewers what the responses were to initial drug use questions. Thus, to enhance respondent privacy, only the questions on the first answer sheet (alcohol) were read aloud to respondents.

The Skip Pattern Experiment was embedded in the first quarter 1992 NHSDA sample. One-eighth of the first quarter sample was randomly assigned to receive the skip questionnaire, while the other seven-eighths received the nonskip version. Assignment of questionnaire versions to sampled dwelling units was done in advance of any contact by field staff. Allocation of the skip version was done within sample segments to maximize the power of statistical comparisons between the two groups. Interviewers were trained to administer both versions of the questionnaire. Overall, the nonskip version was administered to 7,149 respondents and the skip version was administered to 974 respondents.

Results

In the first stage of analysis, unweighted, unedited estimates of lifetime prevalence from the two questionnaires were compared to determine whether there were any indications that the skip questionnaire resulted in lower prevalence rates. A one-sided test of the hypothesis that the nonskip version produced lower prevalence was employed, using Fisher's exact test, assuming a simple random sample, and with a level of significance of 0.15. If this hypothesis could not be rejected (for answer sheets that had skips in the skip version and no skips in the nonskip version), it would suggest that using skips was a viable option for the NHSDA. The results of this analysis are shown in table 1. Of the six illicit drug categories that had different questionnaire versions, the hypothesis was rejected in three cases. For marijuana, cocaine, and hallucinogens, rates were significantly lower with the skip version. For legal drugs and for drugs that used skip patterns in both questionnaires, the hypothesis could not be rejected in any case.

To evaluate the impact of using skips on actual NHSDA prevalence estimates, a comparison was done of prevalence rates in the two versions based on weighted and edited data. This analysis revealed that, due to variations across subgroups in how the skip questionnaire affected response, weighted comparisons showed larger differences than unweighted comparisons. Analysis of these differences showed that this was primarily because the lower reports with the skip questionnaire tended to be concentrated among more educated

groups, which are generally sampled at lower rates in the NHSDA. For example, the skip questionnaire produced a weighted estimate of lifetime marijuana use that was 11 percent lower

TABLE 1. *Lifetime prevalence of drug use in two questionnaire versions used in first quarter 1992 NHSDA skip pattern experiment; unweighted and unedited, all ages 12+.*

Drug type	Nonskip (N = 7,149) %	Skip (N = 974) %	P- value ¹
Identical questions in two versions			
Cigarettes	58.9	59.0	NA
Sedatives	3.5	3.9	0.681
Tranquilizers	5.1	5.9	0.836
Stimulants	6.4	6.9	0.733
Analgesics	6.6	6.6	0.497
Different questions in two versions			
Alcohol	74.4	77.7	0.988
Marijuana	35.2	33.3	0.107
Inhalants	6.8	6.1	0.200
Cocaine	13.2	11.1	0.025
Hallucinogens	8.8	7.0	0.020
Heroin	2.2	2.1	0.394

KEY: 1 = Based on a one-sided test of the hypothesis that the nonskip version produced a lower prevalence, using Fisher's exact test. NA = not available.

than the nonskip questionnaire among respondents with less than a high school education. Among respondents with a college degree, the skip estimate was 27 percent lower than the nonskip estimate. Table 2 shows the comparison of weighted, edited prevalence rates for the two questionnaires. The nonskip version produced higher rates of lifetime drug use prevalence for all five illicit drugs that did not have skip patterns. Estimates of past month use indicate an even larger effect of using skip patterns for marijuana and cocaine.

Overall, this methodological study indicates that using skip patterns tends to reduce the prevalence of illicit drug use. There is also an indication that the bias due to using skips would not be uniform across different

TABLE 2. *Lifetime and past month prevalence of drug use in two questionnaire versions used in first quarter 1992 NHSDA skip pattern experiment; weighted and edited, all ages 12+.*

Drug type	Nonskip (N = 7,149) %	Skip (N = 974) %	Relative difference %
Lifetime prevalence			
Identical questions in two versions			
Cigarettes	70.9	67.7	4
Sedatives	4.2	4.8	-14
Tranquilizers	5.6	5.0	11
Stimulants	6.8	6.7	1
Analgesics	6.1	6.0	2
Different questions in two versions			
Alcohol	82.1	80.6	2
Marijuana	32.8	27.9	15
Inhalants	5.1	4.5	11
Cocaine	12.0	7.5	38
Hallucinogens	8.0	6.1	24
Heroin	0.9	0.7	16
Past month prevalence			
Identical questions in two versions			
Cigarettes	27.7	26.3	5
Difference questions in two versions			
Alcohol	49.3	51.5	-4
Marijuana	5.0	2.9	42
Cocaine	0.8	0.3	56

populations, as it seemed to be more pronounced among respondents with more education. It was not possible to conclude whether the lack of privacy or the desire to avoid additional questions was operating. However, it is interesting to note that the skip in the alcohol questions had no apparent impact. This would suggest that it is the sensitivity of the illicit drug questions and the loss of privacy in the skip version that is most important.

NONRESPONSE ERROR IN THE NHSDA

Nonresponse error in the NHSDA is of particular concern because of a recent decrease in response rates. In the 1992 NHSDA, the screening and interview response rates were 95.0 percent and 82.5 percent, respectively. In 1993, the respective rates had dropped to 93.9

percent and 79.2 percent. While data are available on the demographic characteristics of NHSDA nonrespondents that allow inferences of whether nonresponse bias is likely, there is very little information on the drug use patterns of nonrespondents. In the only study to attempt to determine the drug use of NHSDA nonrespondents, a followup of 1990 NHSDA nonrespondents in the Washington, DC, area resulted in completed interviews with 38 percent with a shortened questionnaire and monetary incentives (Caspar 1992). This study found that nonrespondents did have higher rates of cocaine use than respondents. Because of the difficulties involved in obtaining data on nonrespondents' drug use, studies of nonresponse bias often rely on obtaining measurements of known correlates of drug use. This was the intent of the Census Match Study conducted in 1991.

CENSUS MATCH STUDY

Design

In 1991, NIDA and the Research Triangle Institute cooperated with the U.S. Bureau of the Census on a study of nonresponse in surveys. This effort was part of the multiagency work conducted by Groves and Couper at the Census Bureau to study nonresponse in seven major Federal Government surveys, including the NHSDA. The study involved linking data from a sample of respondents and nonrespondents to the 1990 NHSDA with their 1990 Decennial Census data to provide descriptive information about NHSDA nonrespondents. NHSDA and census records were linked by Census Bureau clerks using primarily address and other location information.

A total of 5,030 NHSDA households were selected to be matched to 1990 census records. All 860 screener nonresponse households were selected. In addition, all 1,821 households with at least one interview nonrespondent were selected for matching. To allow comparisons between respondents and nonrespondents on the census items, a random systematic sample of 1,938 households was selected in which all sample persons completed the interview. Finally, to assess the accuracy of interviewers' classifications, a sample of 411 cases classified as vacant, temporary dwellings, or nonhousing units by the NHSDA interviewer was selected.

Excluding the 411 noneligible cases, the NHSDA sample had a very high matching success rate of 97.2 percent, compared with rates

ranging from 93.4 percent to 97.5 percent in the other Government surveys in the study (Groves and Couper 1992). It should be noted that this matching was based primarily on address information, and that in some cases the household members were different in the NHSDA and census data for matched addresses.

In households with completed NHSDA screeners, a second match procedure was performed to identify the individuals selected for the survey interview. This person match used the gender, race, Hispanic origin, and age information from the NHSDA screener to match with the census data on household residents. Criteria were set up to define what was considered a successful match. Person-level matching was attempted for 3,793 persons for whom census data were available. Of these, 3,392 (89.4 percent) were successfully matched. Matching success rates were generally higher for persons in households in which the date of NHSDA screening was close to April 1, the census date. Matching rates were lowest in large apartment buildings and highest in single-family units. These patterns suggest that the nonmatches are largely due to true changes in the household composition at the address over time rather than to errors in matching at the household level.

Special weights appropriate for this analysis were created, taking into account the probabilities of selection for households in the NHSDA and the subselection of cases to be matched.

Another component of this study was a questionnaire completed by NHSDA interviewers before and after NHSDA data collection. These questionnaires obtained information about expectations before data collection and reports of behaviors during data collection. Interviewer characteristics, including their expectations, behaviors, demographics, and experience, may affect the success rate in obtaining completed interviews.

Results

Survey response rates (both screening and interview) by type of non-response were tabulated by variables characterizing the location of the interview, the interviewer characteristics, the respondents' characteristics, and the household characteristics. The two types of nonresponse were noncontacts and refusals. Noncontacts at the screening level are cases where the interviewer was never able to contact anyone in the household, could not find an eligible screening respondent, or was denied access to the entire structure. Noncontacts at the interview level are cases where the interviewer was never able to reach the individual once he/she was selected for interview. It should be mentioned that these noncontacts at the screening and interview level may sometimes actually be passive refusals in which potential respondents are available but deliberately avoid interviewers because they do not want to participate.

These detailed tabulations, including standard errors, can be found elsewhere (Parsely 1993). Some examples are shown in tables 3 to 5. For each variable, these tables show the p value for a chi-square test of the significance of the relationship between the components of the response rate and the variable.

Households in structures containing 50 or more units (i.e., large apartment buildings or condominiums) had the highest screening noncontact rates. This reflects the commonly encountered high-security or controlled-access buildings where guards or lock systems prevent interviewers from accessing whole segments of housing units. Other household types with high screening noncontact rates were single adult households with children under 18 and households with never-married heads. The screening refusal rate in general is more constant across all groups than the noncontact rate. This is perhaps because the screening task requires minimal time and effort from households once contacted. Overall, the high screening response rate and the small differences among demographic groups suggest that screening nonresponse is not likely to result in biased drug use estimates in the NHSDA.

Because it is more frequent than screening nonresponse, interview nonresponse has greater potential for causing bias. Tables 4 and 5 show interview noncontact and refusal rates for selected household and person-level characteristics. Age was related to interview nonresponse, with refusal rates increasing as age increased. An exception to this trend was the higher rate among 12- to 17-year-olds, reflecting the fact that parents

TABLE 3. *Screening completion, noncontact, and refusal rates in 1990 NHSDA from Census Match Study.*

	N	% comple te	% noncontac t	% refusal
Number of units in structure ($O^2 = 35.05$, $P = 0.000$)				
Mobile home	169	99.31	0.32	0.29
Single family	2,914	95.46	0.53	0.93
2 - 9 apartments	553	97.56	1.24	0.81
10 - 49 apartments	400	95.62	2.43	1.41
50+ apartments	339	93.93	4.98	0.87
Tenure ($O^2 = 29.15$, $P = 0.000$)				
Owner	2,586	98.53	0.54	0.86
Renter	1,642	96.90	1.80	0.97
Urban/rural status ($O^2 = 38.84$, $P = 0.000$)				
Large urban, including suburbs, pop. > 50,000)	3,651	97.25	1.38	1.17
Small urban (pop. 2,500- 50,000)	268	99.14	0.16	0.54
Rural (pop. < 2,500)	555	99.26	0.27	0.43
HH composition ($O^2 = 76.51$, $P = 0.000$)				
Single person	726	97.19	1.77	0.77
Single adult, child under 18	259	95.94	2.78	1.17
Couple, child under 18	1,062	98.63	0.35	0.90
Couple, no children	526	98.23	0.80	0.90
Couple or single, child over 18	489	98.84	0.22	0.94
At least one non-nuclear	502	98.74	0.46	0.62
At least one non-relative	502	97.84	0.92	1.09
Race/ethnicity of HH head ($O^2 = 10.47$, $P = 0.334$)				
Hispanic	488	97.66	1.18	0.97
Non-Hispanic, white	2,583	98.25	0.78	0.88
Non-Hispanic, black	956	97.22	1.70	0.97
Non-Hispanic, other	307	97.52	0.82	0.46

TABLE 3. *Screening completion, noncontact, and refusal rates in 1990 NHSDA from Census Match Study (continued).*

	N	% comple te	% noncontac t	% refusal
Education of HH head ($\chi^2 = 27.38$, $P = 0.004$)				
Less than high school	142	98.72	0.69	0.28
High school graduate	159	98.54	0.46	0.93
Some college	133	98.85	0.48	0.67
College degree and higher	175	97.61	1.35	1.05
Marital status of HH head ($\chi^2 = 22.95$, $P = 0.003$)				
Married	2,446	98.52	0.47	0.91
Widowed/divorced/separated	1,037	97.98	1.01	0.83
Never married	772	96.50	2.50	0.75

KEY: HH = household.

sometimes refuse to allow their teenager to participate. The lowest refusal rate was among 18- to 24-year-olds, who generally have the highest rates of drug use. Refusal rates varied by race, with whites being the most likely to refuse. There was little variation in noncontact rates among racial groups. Divorced/separated people had the lowest response rate. There was no significant relationship between education and interview response rates.

Nonresponse rates were significantly related with housing value and rents, with noncontact rates generally increasing with higher values and rents. Noncontact and refusal rates were highest in large urban areas (including suburbs).

By linking all of the data from the various components of the Census Match Study, it was possible to describe the characteristics of sampled persons, households, neighborhoods, and interviewers for NHSDA cases, including both nonrespondents and respondents. This provided the opportunity to develop an overall model of nonresponse that could take into account all of these factors. The final logistic regression model, including only significant (at the 0.1 level) predictors of propensity of a sampled person to participate in the NHSDA, is shown in table 6. The

TABLE 4. *Interview completion, noncontact, and refusal rates in 1990 NHSDA from Census Match Study: person-level variables.*

	N	% complete	% noncontact	% refusal
Age ($\chi^2 = 81.60$, $P = 0.000$)				
12 - 17	579	88.24	2.24	7.96
18 - 24	594	88.64	4.89	4.87
25 - 34	903	86.15	3.81	8.03
35 - 50	609	83.59	4.91	10.16
Over 50	536	84.15	2.17	9.77
Sex ($\chi^2 = 7.95$, $P = 0.056$)				
Male	1,573	83.44	4.75	9.84
Female	1,774	86.38	3.11	8.00
Race ($\chi^2 = 20.92$, $P = 0.005$)				
White	2,427	84.69	3.94	9.35
Black	684	87.36	3.49	6.68
Other	139	83.78	3.84	3.69
Hispanic origin ($\chi^2 = 5.27$, $P = 0.164$)				
No	2,526	85.25	3.52	9.23
Yes	546	86.21	4.16	6.57
Marital status ($\chi^2 = 28.31$, $P = 0.003$)				
Married	1,180	85.67	3.24	9.66
Widowed	150	83.98	2.59	5.84
Divorced/separated	327	82.54	5.43	10.08
Never married	1,649	85.10	4.49	7.84
Education ($\chi^2 = 12.45$, $P = 0.427$)				
8th grade or less	82	89.87	1.45	7.07
9th - 12th grade, no diploma	106	86.05	3.64	6.80
High school graduate	118	89.96	0.24	8.70
Some college	99	89.26	2.26	6.75
College degree and higher	66	90.69	2.14	6.28

TABLE 4. Interview completion, noncontact, and refusal rates in 1990 NHSDA from Census Match Study: person-level variables (continued).

	N	% complete	% noncontact	% refusal
Worked last week ($O^2 = 7.06$, $P = 0.080$)				
Yes	236	87.92	2.03	9.04
No	178	90.16	1.39	5.56

TABLE 5. Interview completion, noncontact, and refusal rates in 1990 NHSDA from Census Match Study: household-level variables.

	N	% complete	% noncontact	% refusal
House value (owners) ($O^2 = 100.24$, $P = 0.000$)				
Less than \$20,000	120	90.72	1.70	6.35
\$20,000 - 39,999	179	86.21	3.37	8.55
\$40,000 - 59,999	272	87.56	2.50	8.09
\$60,000 - 79,999	265	84.95	2.16	11.57
\$80,000 - 99,999	239	82.77	3.29	11.73
\$100,000 - 149,999	497	84.26	3.67	9.20
House value (owners)				
\$150,000 - 199,999	306	81.17	6.03	9.31
\$200,000 - 299,999	243	77.56	8.18	12.02
\$300,000+	132	80.57	7.88	10.88
Monthly rent (renters) ($O^2 = 47.61$, $P = 0.002$)				
Less than \$200	138	87.23	2.80	6.87
\$200 - 299	163	88.36	2.98	6.12
\$300 - 399	225	87.84	2.01	6.41
\$400 - 499	205	86.20	3.77	7.23
\$500 - 599	185	87.43	2.47	7.04
\$600 - 699	141	80.14	10.61	5.67
\$700+	268	76.77	6.50	10.92

TABLE 5. *Interview completion, noncontact, and refusal rates in 1990 NHSDA from Census Match Study: household-level variables (continued).*

	N	% complete	% noncontact	% refusal
Urban/rural status ($O^2 = 50.29$, $P = 0.000$)				
Large urban, including suburbs (pop. > 50,000)	3,103	80.28	5.41	10.79
Small urban (pop. 2,500-50,000)	158	88.60	1.51	7.76
Rural (pop. < 2,500)	346	90.32	2.86	5.89

person-level factors indicate that males are less likely to participate, while Hispanics are more likely to participate in the NHSDA. Owner-occupied households, homes with greater value or rent, and households consisting of single persons over age 65 were less likely to participate. Households with children under 5 years of age were more likely to participate. Block-level characteristics associated with response propensity were urbanicity (persons living in urban areas were less likely to participate) and the percent of housing units boarded up (lower response rate when more units were boarded up). Several of these person-, household-, and block-level factors are included in statistical models used to adjust for nonresponse in NHSDA analysis weights. Because these factors are significantly associated with nonresponse, they are likely to be effective in reducing nonresponse bias in NHSDA estimates.

Several interviewer characteristics were significantly associated with interview completion rates. Hispanic interviewers and interviewers with a household income of less than \$30,000 were less likely to obtain completed interviews. (The positive effect of Hispanic respondents and negative effect of Hispanic interviewers reflects the poor completion rates by Hispanic interviewers at non-Hispanic households.) Interviewers who had worked on any household surveys in the past 3 years were more likely to obtain completed interviews. Interviewers' attitudes and behavior were found to be associated with success in the field as well. Interviewers who always left a copy of the NHSDA advance letter when visiting a household and finding no one at home were more likely to complete interviews. Interviewers who felt that "with enough effort, I can convince even the most reluctant respondent to participate" were more

TABLE 6. *Final multilevel logistic model of response propensity in 1990 NHSDA from Census Match Study (N = 3,201).*

Variable	Coefficient	Std. error	P	Adjusted odds ratio
Intercept	2.653271	0.275089	0.000	---
Person level				
Male	-0.317930	0.124322	0.013	0.7277
Hispanic	0.622700	0.221535	0.007	1.8640
Household level				
Owner	-0.531859	0.197145	0.009	0.5875
House value ¹	-0.000001	0.000001	0.035	0.9900
Monthly rent ²	-0.001001	0.000333	0.004	0.9512
Children under 5 years	0.394853	0.163665	0.019	1.4842
Single person over 65	-0.771967	0.309151	0.015	0.4621
Block level				
Urban	-0.819406	0.176381	0.000	0.4407
Percent boarded up ⁴	-0.062186	0.033672	0.069	0.9876
Interviewer level				
Hispanic	-0.746810	0.282162	0.010	0.4739
Recent experience ⁵	0.323332	0.110695	0.005	1.3817
Advance letter ⁶	0.348507	0.122957	0.006	1.4170
Income < \$30,000 ⁷	0.298085	0.113771	0.011	0.7422
Can convince anyone ⁸	0.242386	0.117690	0.044	1.2743
Personally affect ⁹	0.449398	0.163389	0.008	1.5674

KEY: 1 = Based on the census question for owners, "What is the value of this property?" 2 = Based on the census question for renters, "What is the monthly rent?" 3 = Includes large or small urban. 4 = Percent of boarded up housing units in block. 5 = Worked on other household surveys in past 3 months. 6 = "Always" leave copy of advance letter at HH when no one is home. 7 = Family income. 8 = Agreed that "With enough effort, I can convince even the most reluctant respondent to participate." 9 = "Always" informed respondents how NHSDA results could affect them personally.

successful in completing interviews, as were interviewers who reported that they always informed the respondent of how the survey results could affect them personally. The significance of these interviewer-level variables in the model suggests potential areas for interviewer training that could lead to improved response rates in other surveys.

DISCUSSION

Drug abuse surveys are particularly vulnerable to nonresponse and measurement error because of the difficulties in accessing heavy drug users and the likelihood that the illegal and stigmatized nature of drug abuse may lead to underreporting. The Skip Pattern Experiment confirms once again that respondents' reporting of their drug use behavior is highly sensitive to the conditions under which they report. This conclusion makes clear the need to proceed with great caution in interpreting differences in drug use rates obtained in different surveys. It also suggests caution in the implementation of new technologies such as computer-assisted data collection that undoubtedly will have some as yet unknown effect on respondents' willingness to report their drug use. The Skip Pattern Experiment may have implications in the introduction of these new technologies, as one of the advantages of computer-assisted interviewing is the ease with which skips can be implemented.

The Skip Pattern Experiment and previous studies of measurement error are useful for indicating differences in measurement error caused by different data-collection methods. However, none of these studies provides what is most needed: a measure of the overall underreporting level. There is also a critical need for a well-designed study of the validity of self-reported drug use in the household population. New technologies for obtaining criterion measures of drug use, such as hair testing, may provide the means for conducting such a study.

The Census Match Study demonstrates that response rates are not constant across various interviewer, respondent, household, and neighborhood characteristics. To the extent that rates of drug use vary by these same characteristics, bias due to nonresponse may be a problem. However, it is not always the case that low response rates occur in conjunction with high drug use prevalence (table 7). Some populations with low response rates (e.g., older adults and high-income populations) tend to have low rates of drug use. On the other hand, some populations

TABLE 7. *Relationship between interview response rate and illicit drug use rate.*

		Interview response rate	
		High	Low
Illicit drug use rate	High	Age 18-34 Low income Black	Male Large metro
	Low	Female Married College degree Rural	Age 35+ High income White

(e.g., large metro residents and men) have low response rates and high drug use rates. In estimating overall prevalence, many of these potential sources of bias would be in opposite directions and would therefore tend to cancel each other.

The potential biases suggested by the Census Match analysis are also reduced somewhat by nonresponse adjustments built into drug use prevalence estimates. The extensive knowledge gained from studies of nonresponse patterns has led to improvements in these statistical adjustments. The NHSDA now utilizes a sophisticated propensity of response logistic regression model to adjust estimates (Folsom 1991). This model incorporates many of the variables found by the Census Match Study to be associated with survey participation, such as block-level rent and housing values. Since screening response rates in the NHSDA are high, the response propensity model can also take advantage of the screening data on the characteristics of most interview nonrespondents. This basic data collected on the 1995 NHSDA screening form includes age, gender, race/ethnicity, marital status, and current smoking status.

Nonresponse adjustments, however, are only a partial solution to the problem of reducing nonresponse bias. By taking advantage of available auxiliary data known to be related to drug use rates and to response propensity, statistical adjustments undoubtedly improve the accuracy of NHSDA drug use prevalence estimates. But auxiliary data and statistical correlations are only proxies for the true drug use data for nonrespondents. Achievement of a high response rate remains the most important goal and the most effective method of reducing nonresponse bias.

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