2005 NATIONAL SURVEY ON DRUG USE AND HEALTH

STATISTICAL INFERENCE REPORT

Prepared for the 2005 Methodological Resource Book

Contract No. 283–2004–00022
RTI Project No. 0209009.181.002
Deliverable No. 39

Authors:

Jeremy Aldworth
James R. Chromy
Andrew Clarke
Teresa R. Davis
Steven L. Emrich
David Heller
Erica Hirsch
Breda Munoz
Lisa E. Packer
Jill Ruppenkamp

Project Director: Thomas G. Virag

Prepared for:

Substance Abuse and Mental Health Services Administration
Rockville, Maryland 20857

Prepared by:

RTI International
Research Triangle Park, North Carolina 27709

December 2006

2005 NATIONAL SURVEY ON DRUG USE AND HEALTH

STATISTICAL INFERENCE REPORT

Contract No. 283–2004–00022
RTI Project No. 0209009.181.002
Deliverable No. 39

Authors:

Jeremy Aldworth
James R. Chromy
Andrew Clarke
Teresa R. Davis
Steven L. Emrich
David Heller
Erica Hirsch
Breda Munoz
Lisa E. Packer
Jill Ruppenkamp

Project Director:

Thomas G. Virag

Prepared for:

Substance Abuse and Mental Health Services Administration
Rockville, Maryland 20857

Prepared by:

RTI International
Research Triangle Park, North Carolina 27709

December 2006

Acknowledgments

This publication was developed for the Substance Abuse and Mental Health Services Administration (SAMHSA), Office of Applied Studies (OAS), by RTI International (a trade name of Research Triangle Institute), Research Triangle Park, North Carolina, under Contract No. 283-2004-00022. Significant contributors at RTI include Jeremy Aldworth, James R. Chromy, Andrew Clarke, Teresa R. Davis, Steven L. Emrich, David Heller, Erica Hirsch, Breda Munoz, Lisa E. Packer, and Jill Ruppenkamp. Joyce Clay-Brooks word processed and formatted the report, Richard S. Straw copyedited the report, and Thomas G. Virag is the RTI Project Director.

Table of Contents

Section **Page**

1. Introduction

Statistical inference occurs whenever data obtained from sample observations belonging to and considered representative of a larger target population are used to make generalizations concerning the larger population. The target population for the 2005 National Survey on Drug Use and Health (NSDUH)[1] was the U.S. civilian, noninstitutionalized population aged 12 or older (at the time of their interview) in 2005. Measurements for this target population were the responses to the survey questions provided by persons participating in the 2005 survey.

Statistical inferences concerning characteristics of interest for this population and various subpopulations are presented in the form of estimates derived from the sample data collected. Examples of the inferences made from the 2005 NSDUH data include estimates of the number of persons who were substance users during the past month, past year, and their lifetime, as well as the associated percentages (prevalence rates) of substance use for these reference periods. Inferences also were made for such categories as substance initiation; risk and protective factors; substance dependence, dependence or abuse, and treatment; and measures related to mental health problems. Among some populations of interest, sample sizes were not adequate to support inferences; in these cases, estimates were produced from annual averages based on combined data.

This report is organized as follows: Section 2 provides background information concerning the 2005 NSDUH; Section 3 discusses the prevalence rates and how they were calculated; Section 4 briefly discusses how missing item responses of variables that are not imputed may lead to biased estimates; Section 5 discusses sampling errors and how they were calculated; Section 6 describes the degrees of freedom that were used when comparing estimates; and Section 7 discusses how the statistical significance of differences between estimates was determined. Section 8 discusses confidence interval estimation, and Section 9 describes how past year incidence of drug use was computed. Finally, Section 10 discusses the conditions under which estimates with low precision were suppressed.

[1] Prior to 2002, the survey was called the National Household Survey on Drug Abuse (NHSDA).

2. Background

The 2005 National Survey on Drug Use and Health (NSDUH)[2] is the first survey in a coordinated 5-year sample design providing estimates for all 50 States plus the District of Columbia for the years 2005 through 2009. The survey is conducted using computer-assisted interviewing (CAI) methods for the screening and interviewing of selected respondents. The respondent universe is the civilian, noninstitutionalized population aged 12 years old or older residing within the United States and the District of Columbia. Persons excluded from the universe include active-duty military personnel, persons with no fixed household address (e.g., homeless and/or transient persons not in shelters), and residents of institutional group quarters, such as jails and hospitals.

Although there is no planned overlap with the 1999 through 2004 samples, a coordinated design for 2005 through 2009 facilitates 50 percent overlap in second-stage units (area segments) within each successive 2-year period from 2005 through 2009. Because the 2005 design enables estimates to be developed by State in all 50 States plus the District of Columbia, States may be viewed as the first level of stratification as well as a reporting variable.

For the 50-State design, 8 States were designated as large sample States (California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas) with samples large enough to support direct State estimates. In 2005, sample sizes in these States ranged from 3,562 to 3,699. For the remaining 42 States and the District of Columbia, smaller, but adequate, samples were selected to support State estimates using small area estimation (SAE).[3] Sample sizes in these States ranged from 840 to 978 in 2005.

States were first stratified into a total of 900 State sampling (SS) regions (48 regions in each large sample State and 12 regions in each small sample State). Unlike the 1999 through 2001 NHSDAs and the 2002 through 2004 NSDUHs in which the first-stage sampling units were clusters of census blocks called area segments, the first stage of selection for the 2005 through 2009 NSDUHs was census tracts.[4]

A total of 48 census tracts per SS region were selected, and within these sampled census tracts, adjacent census blocks were combined to form the second-stage sampling units or area segments. Eight sample segments per SS region were fielded during the 2005 survey year. These sampled segments were allocated equally into four separate samples, one for each 3-month period (calendar quarter) during the year, so that the survey was essentially continuous in the field.

The overall design remained the same beginning with the 2002 NSDUH and continuing through the 2005 NSDUH. Survey respondents were given a $30 incentive payment for

[2] Prior to 2002, the survey was called the National Household Survey on Drug Abuse (NHSDA).

[3] SAE is a hierarchical Bayes modeling technique used to make State-level estimates for approximately 20 substance-use-related measures. See the *State Estimates of Substance Use from the 2003-2004 National Surveys on Drug Use and Health* (Wright & Sathe, 2006) for more details.

[4] Census tracts are relatively permanent statistical subdivisions of counties and provide a stable set of geographic units across decennial census periods.

participation, which increased response rates, thereby requiring fewer selected households than in previous surveys. A new pair-sampling strategy was implemented that increased the number of pairs selected in dwelling units (DUs) with older persons on the roster (Chromy & Penne, 2002).

Several design changes were implemented in the 2005 NSDUH. One design change was a special Reliability Study Pretest sample that was fielded during quarters 1 and 2 of the 2005 NSDUH. Reliability Study Pretest[5] respondents were administered the survey instrument on two occasions. The purpose of the pretest was to test field procedures, materials, and instrumentation for the planned 2006 Reliability Study. Additionally, the pretest provided an idea of respondents' reactions to the interview and expected response rates. A second design change was the removal of the split-sample[6] algorithm that was added into the computer-assisted interviewing (CAI) in 2004 so that for 2005 all respondents aged 18 or older received the stand-alone K6 serious psychological distress (SPD)[7] module and the adult depression module.

The final respondent sample of 68,308 persons for the 2005 NSDUH provides a sufficient sample to create domain estimates for a broad range of ages and other demographic categories. Individual observations are weighted in a manner such that the weighted sample is representative of the civilian, noninstitutionalized population aged 12 or older for both the general U.S. population as well as for each of the individual States.[8]

[5] For more details on the 2005 NSDUH Reliability Study Pretest, see the Sample Design Report in the *2005 National Survey on Drug Use and Health: Methodological Resource Book* (Morton, Chromy, Hunter, & Martin, 2006).

[6] For more information on the split sample, see Sections B.4.4 on SPD and B.4.5 on major depressive episode in Appendix B from the *Results from the 2005 National Survey on Drug Use and Health: National Findings* (OAS, 2006).

[7] The 2005 CAI originally referred to the SPD module as serious mental illness (SMI).

[8] For more information on the sampling weight calibration in the 2005 NSDUH, see the Person-Level Sampling Weight Calibration report in the *2005 National Survey on Drug Use and Health: Methodological Resource Book* (Chen et al., 2007).

3. Prevalence Rates

The national prevalence rates were computed using a multiprocedure package called SUrvey DAta ANalysis (SUDAAN®) Software for Statistical Analysis of Correlated Data (RTI International, 2004b). The final, nonresponse-adjusted, and poststratified analysis weights were used in SUDAAN to compute unbiased design-based drug use estimates.

Prevalence rates are the proportions of the population who exhibit characteristics of interest (such as substance use). Let $\hat{p}_d$ represent the prevalence rate of interest for domain *d.* Then $\hat{p}_d$ would be defined as the ratio

$$\hat{p}_d = \frac{\hat{Y}_d}{\hat{N}_d},$$

where $\hat{Y}_d$ = estimated number of persons exhibiting the characteristic of interest in domain *d,* and $\hat{N}_d$ = estimated population total for domain *d*.

$\hat{N}_d$ is estimated as $\sum w_i \delta_i$, where w_i represents the analysis weight and δ_i represents an indicator variable, which is defined as

$\delta_i\ (d) =$ 1 if the i^{th} sample unit is in subgroup *d,*
0 otherwise.

For certain populations of interest, the data were combined for 2002-2003, 2003-2004, or 2004-2005 to obtain annual averages, and then the prevalence rates were computed in SUDAAN as described above. The annual averages were derived by concatenating the 2002-2003, 2003-2004, and 2004-2005 datasets and then dividing the analysis weights by a factor of 2.

4. Missingness

In the 2005 National Survey on Drug Use and Health (NSDUH), many variables, including core drug and demographic variables, had missing item response values imputed. See the 2005 NSDUH imputation report (Aldworth et al., 2007) for further details. However, the missing item responses of many other variables were not imputed, and these missing responses may lead to biased estimates in the 2005 Detailed Tables (available at http://oas.samhsa.gov/WebOnly.htm#NHSDAtabs). In addition, another source of potential uncertainty about some estimates in the 2005 Detailed Tables may occur due to the way unknown item responses (e.g., blank, "don't know," "refused") were actually coded for different variables. For example, some recoded variables (i.e., variables created from one or more source variables) classified unknown item responses in the source variable(s) as missing values, whereas others did not. See Ruppenkamp, Emrich, Aldworth, Hirsch, and Foster (2006) for further details.

Recall from Section 3 that prevalence rates are defined as the proportions of the population who exhibit characteristics of interest. Let $\hat{p}_d$ represent the prevalence rate of interest for domain *d*. Then $\hat{p}_d$ would be defined as the ratio

$$\hat{p}_d = \frac{\hat{Y}_d}{\hat{N}_d},$$

where $\hat{Y}_d$ = estimated number of persons exhibiting the characteristic of interest in domain *d*, and $\hat{N}_d$ = estimated population total for domain *d*.

The variable defining the characteristic of interest (e.g., illicit drug use) is referred to as the *analysis* variable, and the variable defining the domain of interest (e.g., receipt of past year mental health treatment/counseling) is referred to as the *domain* variable. Suppose that the analysis variable has all its missing values imputed, but the domain variable does not employ the imputation of missing values. In such cases, the estimates $\hat{N}_d$ and $\hat{Y}_d$ may be negatively biased, and the $\hat{p}_d$ estimates may also be biased. To see this, suppose that the domain variable has D levels, and define

$$\hat{N} = \sum_{d=1}^{D} \hat{N}_d + \hat{N}_m,$$

where $\hat{N}$ = estimated population total, $\hat{N}_d$ = estimated population total for domain *d*, $d = 1,2,...D$, and $\hat{N}_m$ = estimated population total corresponding to the missing values of the domain variable. Thus, if $\hat{N}_m$ is positive (i.e., there exist missing domain-variable responses),

then at least one of the $\hat{N}_d$ estimates will be negatively biased. The presence of negative bias in at least one of the $\hat{Y}_d$ estimates can be similarly demonstrated if $\hat{Y}_m$ is positive, where $\hat{Y}_m$ = the estimated number of persons exhibiting the characteristic of interest and corresponding to the missing values of the domain variable. If either of $\hat{N}_m$ and $\hat{Y}_m$ is positive, then $\hat{p}_d$ may be biased by some unknown amount.

In the 2005 Detailed Tables, potential bias in the $\hat{N}_d$, $\hat{Y}_d$, or $\hat{p}_d$ estimates was not treated, although footnotes included on the tables provide detailed information about which estimates were based on missing values.

This problem may be illustrated by the following example, which corresponds to information presented in Tables 6.24A and 6.24B of the 2005 Detailed Tables (available at http://oas.samhsa.gov/WebOnly.htm#NHSDAtabs).

Table 6.24A presents population estimates of the past year use of several types of illicit drugs among persons aged 18 or older for 2004 and 2005. These analysis variables are grouped into a two-level domain variable that is categorized according to whether mental health treatment or counseling was received. In 2005, the population estimate of persons aged 18 or older was approximately 217,865,000. However, the subdomain population estimates summed to approximately 217,250,000, resulting in an estimate for $\hat{N}_m$ = 615,000 (approximately 0.3 percent of the total population). This number represents the estimated population not assigned to either domain. This negative bias can extend to various analysis variables, such as "Illicit Drugs." In 2005, the population estimate of persons aged 18 or older who used illicit drugs was approximately 29,999,000. However the subdomain estimates summed to 29,874,000, giving an estimate of $\hat{Y}_m$ = 125,000 (approximately 0.4 percent of the total population).

Table 6.24B presents prevalence estimates of the past year use of several types of illicit drugs among persons aged 18 or older for 2004 and 2005. Because $\hat{N}_m$ is positive and $\hat{Y}_m$ is positive for the analysis variable, "Illicit Drugs," the prevalence estimates for this variable may be biased by some unknown amount across the two domains. The prevalence estimates reported in Table 6.24B are 19.8 and 12.9 percent, respectively. It can be shown that the approximate range of possible bias values for each of these estimates is as follows: between –0.34 and 0.35 percent and between –0.03 and 0.06 percent, respectively.

5. Sampling Error

As were the prevalence rates, all of the variance estimates (including those for prevalence based on annual averages from combined data) were calculated using a method in SUDAAN[9] that is unbiased for linear statistics. This method is based on multistage clustered sample designs where the first-stage (primary) sampling units are drawn with replacement.

Due to the complex nature of the sampling design for the National Survey on Drug Use and Health (NSDUH) (specifically the use of stratified-clustering sampling), key nesting variables were created for use in SUDAAN to capture explicit stratification and to identify clustering. Starting with the 2005 NSDUH, there was a change made in the way the key nesting variables were defined. Each State sampling (SS) region appears in a different variance estimation stratum every quarter. This method had the effect of assigning the regions to strata in a pseudo-random fashion while ensuring that each stratum consists of four SS regions from four different States.

Two replicates per year were defined within each variance stratum. Each variance replicate consists of four segments, one for each quarter of data collection. The first replicate consists of those segments that are "phasing out" or will not be used in the next survey year. The second replicate consists of those segments that are "phasing in" or will be fielded again the following year, thus constituting the 50 percent overlap between survey years.

Although the standard errors (SEs) of estimates of means and proportions can be calculated appropriately in SUDAAN using a Taylor series linearization approach, SEs of estimates of totals may be underestimated in situations where the domain size is poststratified to data from the U.S. Census Bureau. Because of this underestimation, alternatives for estimating SEs of totals were implemented in all of the 2005 Detailed Tables (available at http://oas.samhsa.gov/WebOnly.htm#NHSDAtabs), where appropriate.

Estimates of means or proportions, $\hat{p}_d$, such as drug use prevalence rates for a domain *d*, can be expressed as a ratio estimate:

$$\hat{p}_d = \frac{\hat{Y}_d}{\hat{N}_d},$$

where $\hat{Y}_d$ is a linear statistic estimating the number of substance users in the domain *d* and $\hat{N}_d$ is a linear statistic estimating the total number of persons in domain *d* (both users and nonusers). The SUDAAN software package is used to calculate direct estimates of $\hat{Y}_d$ and $\hat{N}_d$ and also can be used to estimate their respective SEs. A Taylor series approximation method implemented in SUDAAN provides estimates for $\hat{p}_d$ and its SE.

[9] SUrvey DAta ANalysis (SUDAAN®) Software for Statistical Analysis of Correlated Data (RTI International, 2004b).

When the domain size, $\hat{N}_d$, is free of sampling error, an appropriate estimate of the SE for the total number of substance users is

$$\mathrm{SE}(\hat{Y}_d) = \hat{N}_d \mathrm{SE}(\hat{p}_d) .$$

This approach is theoretically correct when the domain size estimates, $\hat{N}_d$, are among those forced to match their respective U.S. Census Bureau population estimates through the weight calibration process.[10] In these cases, $\hat{N}_d$ is not subject to a sampling error induced by the NSDUH design.

For estimated domain totals, $\hat{Y}_d$, where $\hat{N}_d$ is not fixed (i.e., where domain size estimates are not forced to match the U.S. Census Bureau population estimates), this formulation still may provide a good approximation if it can be assumed that the sampling variation in $\hat{N}_d$ is negligible relative to the sampling variation in $\hat{p}_d$. This is a reasonable assumption for most cases in this study.

For various subsets of estimates, the above approach yielded an underestimate of the variance of a total because $\hat{N}_d$ was subject to considerable variation. In 2000, an approach was implemented to reflect more accurately the effects of the weighting process on the variance of total estimates. This approach consisted of calculating SEs of totals for all estimates in a particular detailed table using the formula above when a majority of estimates in a table were among domains in which $\hat{N}_d$ was fixed during weighting or if it could be assumed that the sampling variation in $\hat{N}_d$ was negligible. Detailed tables in which the majority of estimates were among domains where $\hat{N}_d$ was subject to considerable variability were calculated directly in SUDAAN.

Starting with the 2005 NSDUH, a "mixed" method approach was implemented for all the 2005 Detailed Tables to improve on the accuracy of SEs. This method had been applied to selected tables in the 2004 NSDUH, but it was implemented across all tables for the 2005 NSDUH. This approach assigns the method of SE calculation to domains within tables so that all estimates among a select set of domains with fixed $\hat{N}_d$ were calculated using the formula above, and all other estimates were calculated directly in SUDAAN, regardless of other estimates within the same table. The set of domains considered controlled (i.e., those with a fixed $\hat{N}_d$) was restricted to main effects and two-way interactions in order to maintain continuity between years. Domains consisting of three-way interactions may be controlled in 1 year but not necessarily in preceding or subsequent years. The use of such SEs did not affect the SE estimates for the corresponding proportions presented in the same sets of tables because all SEs for means and proportions are calculated directly in SUDAAN. As a result of the use of this mixed-method

[10] For more information on the sampling weight calibration in the 2005 NSDUH, see the Person-Level Sampling Weight Calibration report in the *2005 National Survey on Drug Use and Health: Methodological Resource Book* (Chen et al., 2007).

approach, the SEs for the total estimates within many detailed tables were calculated differently from those in prior NSDUH reports.

Table 1 contains a list of domains with a fixed $\hat{N}_d$. This table includes both the main effects and two-way interactions and may be used to identify the method of SE calculation employed for estimates of totals in the 2005 Detailed Tables. For example, Table 1.32 presents estimates of illicit drug use among persons aged 18 or older within the domains of gender, Hispanic origin and race, education, and current employment. Estimates among the total population (age main effect), males and females (age by gender interaction), and Hispanics and non-Hispanics (age by Hispanic origin interaction) were treated as controlled in this table, and the formula above was used to calculate the SEs. The SEs for all other estimates, including white and black or African American (age by Hispanic origin by race interaction), were calculated directly from SUDAAN. It is important to note that estimates presented in the 2005 Detailed Tables for racial groups are among non-Hispanics, unless noted otherwise. For instance, the domain for whites is actually non-Hispanic whites and is therefore a two-way interaction.

Table 1 Demographic and Geographic Domains Forced to Match Their Respective U.S. Census Bureau Population Estimates through the Weight Calibration Process, 2005

MAIN EFFECTS	TWO-WAY INTERACTIONS
Age Group	
12-17	
18-25	
26-34	**Age Group x Gender**
35-49	(e.g., Males Aged 12 to 17)
50-64	
65 or Older	
All Combinations of Groups Listed Above[1]	**Age Group x Hispanic Origin**
Gender	(e.g., Hispanics or Latinos Aged 18 to 25)
Male	
Female	
Hispanic Origin	**Age Group x Race**
Hispanic or Latino	(e.g., White Aged 26 or Older)
Not Hispanic or Latino	
Race	
White	**Age Group x Geographic Region**
Black or African American	(e.g., Persons Aged 12 to 25 in the Northeast)
Geographic Region	
Northeast	
Midwest	**Age Group x Geographic Division**
South	(e.g., Persons Aged 65 or Older in New England)
West	
Geographic Division	
New England	**Gender x Hispanic Origin**
Middle Atlantic	(e.g., Not Hispanic or Latino Males)
East North Central	
West North Central	
South Atlantic	**Hispanic Origin x Race**
East South Central	(e.g., Not Hispanic or Latino Whites)
West South Central	
Mountain	
Pacific	

[1] Combinations of the age groups (including but not limited to 12 or older, 18 or older, 26 or older, 35 or older, and 50 or older) also were forced to match their respective U.S. Census Bureau population estimates through the weight calibration process.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2005.

6. Degrees of Freedom

To determine whether the observed difference between estimates is statistically significant, the degrees of freedom (*df*) are needed to locate the corresponding probability level (*p* value) of the test statistic. The test statistic is computed from the sample data and represents a numerical summary of the difference between the estimates under consideration; it is a random variable that has a predetermined distribution (such as Student's *t*, chi-square, or *F*). The degrees of freedom characterize the amount of variation expected in the estimation of sampling error and are used in conjunction with the test statistic to determine probabilities and evaluate statistical significance.

Due to a change in the way the variance estimation strata were defined for the 2005 National Survey on Drug Use and Health (NSDUH), the 2005 definition has the effect of increasing the number of degrees of freedom for State-level estimates while preserving the number of degrees of freedom for national estimates (900). The degrees of freedom are calculated as the number of primary sampling units (variance replicates) minus the number of strata for the data being analyzed. Because the 5-year NSDUH design provides for estimates by State in all 50 States plus the District of Columbia, States may be viewed as the first level of stratification. When producing NSDUH estimates on the national level, including estimates based on annual averages from combined data, there are 900 degrees of freedom. If an analysis only involves certain States, the degrees of freedom change depending on whether the State is a large sample or small sample State. The large sample States (i.e., California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas) each have 192 degrees of freedom because each large State is in 192 strata. All of the other States (i.e., the small sample States, which include the District of Columbia) have 48 degrees of freedom because each small State is in 48 different strata. Note that the 2005 Detailed Tables (available at http://oas.samhsa.gov/WebOnly.htm#NHSDAtabs) use 900 degrees of freedom for all estimates, including those for geographic regions and divisions.

For an analysis of a group of States, the degrees of freedom would be less than or equal to the sum of the degrees of freedom for each individual State due to overlap of strata. The specific number of degrees of freedom can be computed by counting the unique values of VESTR for the particular geographic area of interest. For these type of specific State analyses (or other subpopulations of interest), the degrees of freedom can be specifically indicated in SUDAAN[11]; otherwise, the degrees of freedom are computed using the entire dataset.

[11] SUrvey DAta ANalysis (SUDAAN®) Software for Statistical Analysis of Correlated Data (RTI International, 2004b).

7. Statistical Significance of Differences

Once the degrees of freedom have been determined, various methods used to compare prevalence estimates may be employed. This section describes some of these methods. Customarily, the observed difference between estimates is evaluated in terms of its statistical significance. Statistical significance is based on the *p* value of the test statistic and refers to the probability that a difference as large as that observed would occur due to random variability in the estimates if there were no difference in the prevalence rates being compared. The significance of observed differences is generally reported at the .05 and .01 levels.

Significance tests were conducted on differences between prevalence estimates from the 2005 National Survey on Drug Use and Health (NSDUH) and previous years of NSDUH back to 2002. Due to survey design changes implemented in 2002, data from the 2002 through 2005 NSDUHs should not be compared with data from earlier survey years. Significance tests also were conducted on differences of prevalence estimates between combined 2002-2003 data and either combined 2003-2004 data or combined 2004-2005 survey data. Within-year tests were conducted on differences between prevalence estimates for various populations (or subgroups) of interest using data from the 2005 survey.

When comparing prevalence estimates, one can test the null hypothesis (no difference between rates) against the alternative hypothesis (there is a difference in prevalence rates) using the standard *t* test (with the appropriate degrees of freedom) for the difference in proportions test, expressed as

$$t_{df} = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\text{var}(\hat{p}_1) + \text{var}(\hat{p}_2) - 2\,\text{cov}(\hat{p}_1, \hat{p}_2)}},$$

where *df* = the appropriate degrees of freedom, $\hat{p}_1$ = first prevalence estimate, $\hat{p}_2$ = second prevalence estimate, $\text{var}(\hat{p}_1)$ = variance of first prevalence estimate, $\text{var}(\hat{p}_2)$ = variance of second prevalence estimate, and $\text{cov}(\hat{p}_1, \hat{p}_2)$ = covariance between $\hat{p}_1$ and $\hat{p}_2$. Note that the first and second prevalence estimates may take the form of prevalence estimates from two different survey years (e.g., 2004 and 2005, respectively), prevalence estimates from sets of combined survey data (e.g., 2002-2003 annual averages and 2004-2005 annual averages, respectively), or prevalence estimates for populations of interest within a single survey year.

Under the null hypothesis, *t* is distributed as a random variable from the *t*-distribution. Therefore, calculated values of *t*, along with the appropriate degrees of freedom, can be used to determine the corresponding probability level (i.e., *p* value). Whether testing for differences between years or from different populations within the same year, the covariance term in the formula for *t* will, in general, not be equal to zero. SUDAAN[12] is used to compute estimates of *t*

[12] SUrvey DAta ANalysis (SUDAAN®) Software for Statistical Analysis of Correlated Data (RTI International, 2004b).

along with the associated *p* values such that the covariance term is calculated by taking the sample design into account. A similar procedure and formula for *t* are used for estimated totals; however, it should be noted that because it was necessary to calculate the standard error (SE) outside SUDAAN for domains forced by the weighting process to match their respective U.S. Census Bureau population estimates, the corresponding test statistics also were computed outside SUDAAN.

As the degrees of freedom approach infinity, the *t* distribution approaches the standard normal (*Z*) distribution. That is, because most of the statistical tests performed have 900 degrees of freedom, the *t* tests performed produce approximately the same numerical results as if a *Z* test had been performed.

When comparing population subgroups defined by three or more levels of a categorical variable, log-linear chi-square tests of independence of the subgroup and the prevalence variables were conducted first to control the error level for multiple comparisons. If a chi-square test indicated overall significant differences, the significance of each particular pairwise comparison of interest was tested using SUDAAN analytic procedures to properly account for the sample design. A detailed description of the test statistic, which is based on the Wald statistic, can be found in the SUDAAN language manual (RTI International, 2004a, p. 177).

If SUDAAN is not available to compute the significance testing, using the published estimates and SEs to perform independent *t* tests for the difference of proportions usually will provide the same results as tests performed in SUDAAN. However, where the *p* value is close to the predetermined level of significance, results may differ for two reasons: (1) the covariance term is included in the SUDAAN tests, whereas it is not included in independent *t* tests; and (2) the reduced number of significant digits shown in the published estimates may cause rounding errors in the independent *t* tests.

8. Confidence Intervals

In some National Survey on Drug Use and Health (NSDUH) publications, sampling error has been quantified using 95 percent confidence intervals (CIs). Because NSDUH estimates are frequently small percentages, the CIs are based on logit transformations. Logit transformations yield asymmetric interval boundaries that are more balanced with respect to the probability that the true value falls below or above the interval boundaries than is the case for standard symmetric CIs for small proportions.

To illustrate the method, let the proportion P_d represent the true prevalence rate for a particular analysis domain d. Then the logit transformation of P_d, commonly referred to as the "log odds," is defined as

$$L = \ln[P_d / (1 - P_d)],$$

where "1n" denotes the natural logarithm.

Letting $\hat{p}_d$ be the estimate of the domain proportion, the log odds estimate becomes

$$\hat{L} = \ln[\hat{p}_d / (1 - \hat{p}_d)].$$

The lower and upper confidence limits of L are formed as

$$A = \hat{L} - K\left[\frac{\sqrt{\text{var}(\hat{p}_d)}}{\hat{p}_d(1-\hat{p}_d)}\right],$$
$$B = \hat{L} + K\left[\frac{\sqrt{\text{var}(\hat{p}_d)}}{\hat{p}_d(1-\hat{p}_d)}\right],$$

where $\text{var}(\hat{p}_d)$ is the variance estimate of $\hat{p}_d$, the quantity in brackets is a first-order Taylor series approximation of the standard error (SE) of $\hat{L}$, and K is the constant chosen to yield a level of confidence based on the degrees of freedom (*df*) (e.g., $K = 1.96$ for 95 percent confidence limits for national estimates with 900 degrees of freedom).

Applying the inverse logit transformation to A and B above yields a confidence interval for $\hat{p}_d$ as follows:

$$\hat{p}_{d,lower} = \frac{1}{1+\exp(-A)},$$
$$\hat{p}_{d,upper} = \frac{1}{1+\exp(-B)},$$

where "exp" denotes the inverse log transformation. The lower and upper CI endpoints for percentage estimates are obtained by multiplying the lower and upper endpoints of $\hat{p}_d$ by 100.

The CI for the estimated domain total, $\hat{Y}_d$, as estimated by

$$\hat{Y}_d = \hat{N}_d \cdot \hat{p}_d,$$

is obtained by multiplying the lower and upper limits of the proportion CI by $\hat{N}_d$. For domain totals $\hat{Y}_d$, where $\hat{N}_d$ is not fixed, the CI approximation assumes that the sampling variation in $\hat{N}_d$ is negligible relative to the sampling variation in $\hat{p}_d$.

9. Incidence Estimates

In epidemiological studies, incidence is defined as the number of new cases of a disease occurring within a specific period of time. Similarly, in substance use studies, incidence refers to the first use of a particular substance.

To assist in the evaluation of trends in the initiation of drug use, National Survey on Drug Use and Health (NSDUH) data also were used to generate estimates of drug use incidence or initiation (i.e., the number of users whose first use was within the 12 months prior to their interview date). This incidence measure, termed "past year initiation," is determined by self-reported past year use, age at first use, year and month of most recent new use, and the interview date.

Prior NSDUH reports have included long-term trends in incidence by calendar year based on these self-reports. Calendar year initiates refer to the number of new substance users reporting first use within a calendar year (between January 1 and December 31 of a specific prior year of a respondent's life) and are determined by the respondents' information on age and month at first use, interview date, and date of birth, as well as date of entry to the United States if respondents indicated they were not born in the United States (for more information on calendar year estimates, see Section B.4.1 in Appendix B of OAS, 2005). Although calendar year estimates can provide useful indicators of long-term trends, they may be subject to substantial bias, as discussed later in this section.

Beginning in 1999, the NSDUH questionnaire allowed for the collection of year and month of first use for recent initiates. The month, day, and year of birth for the initiates also were obtained directly or imputed during the processing of the data. In addition, the questionnaire call record provided the date of the interview. By imputing a day of first use within the year and month of first use, a specific date of first use, $t_{fu,d,i}$, can be used for estimation purposes.

Past year initiation among persons using a substance in the past year can be viewed as an indicator variable defined as follows:

$$I_{(Past\ Year\ Initiate)}(i) = \begin{cases} 1 & \text{if } \left(DOI_i MOI_i YOI_i - t_{fu,d,i}\right) \le 365 \\ 0 & \text{otherwise} \end{cases},$$

where DOI_i, MOI_i, and YOI_i denote the day, month, and year of the interview for person *i*, respectively, and $t_{fu,d,i}$ denotes the date of first use associated to person *i*.

The calculation of past year initiation does not take into account whether the respondent initiated substance use while a resident of the United States. This method of calculation has little effect on past year estimates and provides direct comparability with other standard measures of substance use because the populations of interest for the measures will be the same (i.e., both measures examine all possible respondents and do not restrict to those only initiating substance use in the United States).

One important note for incidence estimates is the relationship between a main substance category and subcategories of substances (e.g., illicit drugs would be a main category and inhalants and marijuana would be examples of subcategories in relation to illicit drugs). Typically, any member of a subcategory is by necessity a member of the main category (e.g., if a respondent is a past month user of a particular drug, then he or she is also a past month user of illicit drugs in general). However, this is not the case with regard to incidence statistics. Because an individual can only be an initiate of a particular substance category (main or sub) a single time, a respondent with lifetime use of multiple substances may not, by necessity, be included as an initiate of a main category, even if he or she were an initiate for a particular subcategory because his or her first initiation of other substances could have occurred earlier.

Because the incidence estimates are based on retrospective reports of age at first drug use by survey respondents, the estimates may be subject to memory-related biases, such as recall decay and telescoping. Recall decay occurs when respondents who initiated many years ago fail to report this use and will tend to result in a downward bias in estimates for earlier years (i.e., 1960s and 1970s). Telescoping refers to misreporting of an event in time. An event can be dated too remote (backwards telescoping) or too recent (forward telescoping). Forward telescoping occurs, for example, when an 18-year-old respondent who first used at age 12 reports his or her age at first use as 14. Telescoping such as this will tend to result in an upward bias for estimates in more recent years. Backward telescoping occurs, for example, when an 18-year-old respondent who first used a substance at age 17 reports his or her age at first use as 16. This tendency will result in a downward bias for the estimate corresponding to the previous year and upward bias for the estimates corresponding to 2 years prior to the survey.

There is also likely to be some underreporting bias because of the social stigma of drug use behaviors and respondents' fears of disclosure. This bias is likely to have the greatest impact on recent estimates, which reflect more recent use and are based heavily on reporting by younger respondents for some substances, particularly alcohol, cigarettes, and inhalants. Finally, for drug use that is frequently initiated at age 10 or younger, estimates based on 1-year retrospective reports underestimate total incidence because children 11 years old or younger are not sampled by NSDUH. Prior analyses showed that incidence estimates for any alcohol use and any cigarette use could be affected significantly by this.

An evaluation of NSDUH retrospective estimates of incidence suggests that these types of bias are significant and differ by substance and length of recall (Gfroerer, Hughes, Chromy, Heller, & Packer, 2004). For very recent time periods (within the past 2 or 3 calendar years), bias in estimates of marijuana, cocaine, alcohol, and cigarette use appear to be small, but for all other types of substance use there is significant downward bias. Bias for all substance use increases the further back in time the estimates are made, suggesting a relationship with the length of recall.

Recent analysis on the recall period suggested the presence of both forward and backward telescoping effects when reporting first use of a substance. In particular, it appears that there was a tendency to report very recent events as if they had occurred further back in time, while more remote events may be reported to have occurred more recently. Because past year and calendar year initiation estimates are based on reports occurring in the first 12 months and the first 24 months prior to the interview date, respectively, both may be affected by these telescoping effects in different degrees. Because the past year reflects the most recent time

period, past year incidence estimates may be most affected by forward telescoping. This may explain why past year estimates tend to show lower incidence than do calendar year estimates. On the other hand, calendar year estimates from 2 or 3 years prior to the survey may be more affected by backward telescoping, resulting in upward biased estimates for those years. In the same study, it was observed that for a given survey year and for several substances the most recent calendar year incidence estimate is usually lower than the two previous calendar year estimates, and that calendar year estimates tend to diminish as length of recall increases, probably as a result of recall bias.

Although it is clear that both the calendar year and the past year incidence estimates are affected by a variety of types of bias, both can provide useful epidemiological information for researchers and policymakers. Calendar year estimates, used with caution, can be analyzed to understand historical shifts in substance use as far back as the 1960s, when marijuana use began to become widespread in the United States. To track very recent shifts and patterns in incidence, however, past year incidence estimates have several important advantages and since 2004 have been the primary focus of the NSDUH national results report. The main advantages are as follows:

- Past year incidence estimates reflect a more recent time period than calendar year incidence estimates, thus providing more timely data on emerging patterns of use.

- Past year incidence data can be combined with past year substance use data to provide a more complete and consistent picture of substance users.

In addition to estimates of the number of persons initiating use of a substance in the past year, estimates of the mean age of past year first-time users of these substances were computed. Starting with the 2005 NSDUH, estimates of the mean age at initiation in the past 12 months have been restricted to persons aged 12 to 49 so that the mean age estimates reported are not influenced by those few respondents who were past year initiates at age 50 or older. As a measure of central tendency, means are influenced heavily by the presence of extreme values in the data, and this constraint should increase the utility of these results to health researchers and analysts by providing a better picture of the substance use initiation behaviors among the civilian, noninstitutionalized population in the United States. This constraint was applied only to estimates of mean age at first use and does not affect estimates of incidence.

Because NSDUH is a survey of persons aged 12 years old or older at the time of the interview, younger individuals in the sample dwelling units are not eligible for selection into the NSDUH sample. Some of these younger persons may have initiated substance use during the past year. As a result, past year initiate estimates suffer from undercoverage when one can think of the estimates as reflecting all initial users regardless of current age. For earlier years, data can be obtained retrospectively based on the age at and date of first use. As an example, persons who were 12 years old on the date of their interview in the 2005 survey may report having initiated use of cigarettes between 1 and 2 years ago; these persons would have been past year initiates reported in the 2004 survey had persons who were 11 years old on the date of the 2004 interview been allowed to participate in the survey. Similarly, estimates of past year use by younger persons (age 10 or younger) can be derived from the current survey, but they apply to initiation in prior years.

To get an impression of the potential undercoverage in the current year, reports of substance use initiation reported in 2005 by persons aged 12 or older were estimated for the years in which these persons would have been 1 to 11 years younger. These estimates do not necessarily reflect behavior by persons 1 to 11 years younger in 2005. A rough adjustment to recognize likely 2005 behaviors was based on a ratio of lifetime users aged 12 to 17 in 2005 to the same estimate for the prior applicable survey year. To illustrate the calculation, consider past year use of alcohol. In the 2005 survey, 4,274,000 persons were estimated to have initiated use of alcohol in the past year based on reports by persons 12 year old or older. In addition, an estimate of 110,552 persons 12 years old in 2005 also reported having initiated use of alcohol between 1 and 2 years earlier. These persons would have been past year initiates in the 2004 survey conducted on the same dates had the 2004 survey covered younger persons. The estimated number of lifetime users currently aged 12 to 17 was 10,305,889 for 2005 and 10,595,539 for 2004, indicating fewer overall initiates of alcohol use among persons aged 17 or younger in 2005. An adjusted estimate of initiation of alcohol use by persons who were 11 years old in 2005 is given by

$$(Estimated\ Past\ Year\ Initiates\ Age\ 11)_{2004} * \frac{(Estimated\ Lifetime Users\ Age\ 12\ to\ 17)_{2005}}{(Estimated\ Lifetime\ Users\ Age\ 12\ to\ 17)_{2004}}.$$

Numerically, this yielded an adjusted estimate of 107,530 persons 11 years old on a 2005 survey date and initiating use of alcohol in the past year:

$$110{,}552 * \frac{10{,}305{,}889}{10{,}595{,}539} = 107{,}530.$$

A similar procedure was used to adjust the estimated number of past year initiates among persons who would have been 10 years old on the date of the interview in 2003 and for younger persons in earlier years. The overall adjusted estimate for past year initiates of alcohol use by persons 11 years of age or younger on the date of the interview was 268,249, or about 6 percent of the estimate based on past year initiation by persons 12 or older only (268,249/4,274,000 = 0.0628).

Based on similar analyses, the estimated undercoverage of past year initiates aged 11 or younger was about 6 percent for cigarettes, about 1.5 percent for marijuana, and about 26 percent for inhalants.

The undercoverage of past year initiates aged 11 or younger also affects the mean age at first use estimate. An adjusted estimate of the mean age at first use was calculated using a weighted estimate of the mean age at first use based on the current survey and the numbers of persons aged 11 or younger in the past year obtained in the aforementioned analysis for estimating undercoverage of past year initiates. A comparison of the reported mean age at first use estimate and the corresponding adjusted estimate resulted in a change from 16.8 to 16.3 (or a decrease of about 3 percent) for alcohol, from 17.3 to 16.8 (or a decrease of about 3 percent) for cigarettes, from 20.6 to 20.5 (or a decrease of about 0.5 percent) for marijuana, and from 16.1 to 14.6 (or a decrease of about 10.5 percent) for inhalants.

10. Suppression of Estimates with Low Precision

Direct survey estimates that were considered to be unreliable due to unacceptably large sampling errors were not reported, but rather were noted by an asterisk (*). The criterion used for suppressing all direct survey estimates was based on the relative standard error (RSE), which is defined as the ratio of the standard error (SE) over the estimate.

Proportion estimates $(\hat{p})$ within the range $0 < \hat{p} < 1,$ rates, and corresponding estimated numbers of users were suppressed if

$$\text{RSE}\,[-\ln(\hat{p})] > .175 \text{ when } \hat{p} \le .5,$$
$$\text{or}$$
$$\text{RSE}\,[-\ln(1-\hat{p})] > .175 \text{ when } \hat{p} > .5.$$

Based on a first-order Taylor series approximation of $\text{RSE}\,[-\ln(\hat{p})]$ and $\text{RSE}\,[-\ln(1-\hat{p})],$ the following suppression rule was used for computational purposes:

$$\frac{\text{SE}(\hat{p})/\hat{p}}{-\ln(\hat{p})} > .175 \text{ when } \hat{p} \le .5,$$
$$\text{or}$$
$$\frac{\text{SE}(\hat{p})/(1-\hat{p})}{-\ln(1-\hat{p})} > .175 \text{ when } \hat{p} > .5.$$

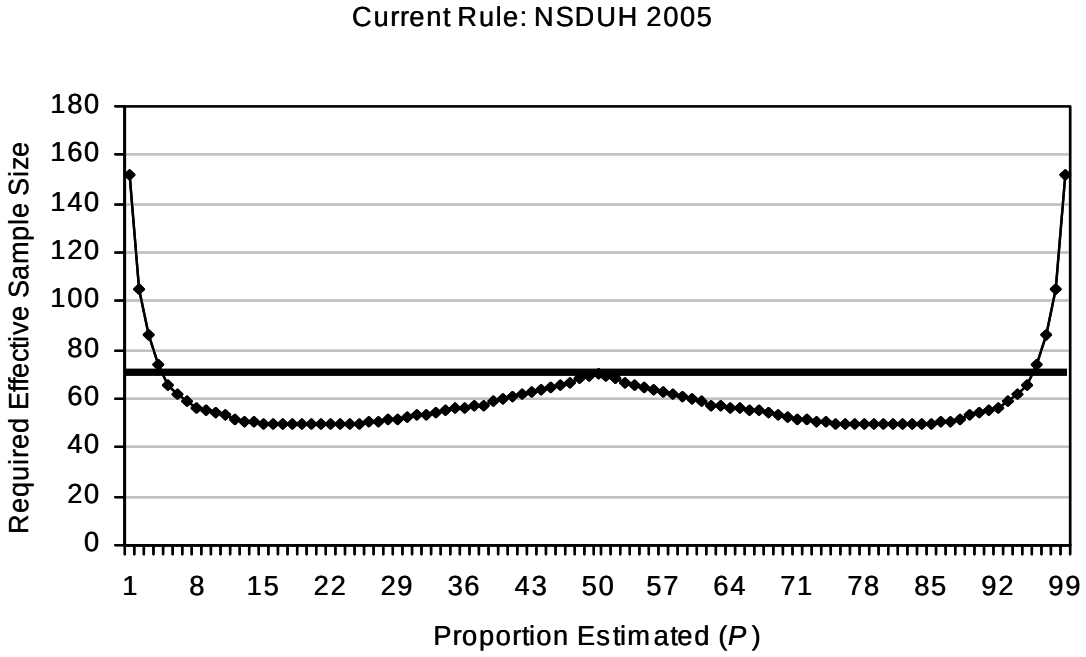
The separate formulas for $\hat{p} \le .5$ and $\hat{p} > .5$ produce a symmetric suppression rule; that is, if $\hat{p}$ is suppressed, $1-\hat{p}$ will be suppressed as well. See Figure 1 for a graphical representation of the required minimum effective sample sizes as a function of the proportion estimated. When $.05 < \hat{p} < .95,$ the symmetric properties of the rule produce local minimum effective sample sizes at $\hat{p} = .2$ and again at $\hat{p} = .8,$ such that an effective sample size of greater than 50 is required; this means that estimates would be suppressed for these values of $\hat{p}$ unless the effective sample sizes were greater than 50. Within this same interval of $.05 < \hat{p} < .95,$ a local maximum effective sample size of 68 is required at $\hat{p} = .5.$ So, to simplify requirements and maintain a conservative suppression rule, estimates of $\hat{p}$ between .05 and .95, which had effective sample sizes below 68, were suppressed.

The effective sample size for a domain is a function of the nominal sample size and the design effect (i.e., nominal sample size/design effect). During the original development of this suppression rule, the design effect was calculated outside SUDAAN[13] in SAS. Beginning with the 2005 National Survey on Drug Use and Health (NSDUH) analysis, the direct SUDAAN

[13]SUrvey DAta ANalysis (SUDAAN®) Software for Statistical Analysis of Correlated Data (RTI International, 2004b).

design effect was used to provide a more precise and accurate reflection of the design effect (due to the removal of several possible rounding errors) when compared with the SAS method used in the past. The differences between the direct SUDAAN design effects and the SAS-calculated design effects only occur at approximately the tenth decimal place or later; however, previously published estimates that were on the borderline of being suppressed or unsuppressed due to the effective sample size suppression rule may potentially change from suppressed to unsuppressed, or vice versa.

Figure 1. Required Effective Sample as a Function of the Proportion Estimated



A minimum nominal sample size suppression criterion (n = 100) that protects against unreliable estimates caused by small design effects and small nominal sample sizes was employed. Prevalence estimates also were suppressed if they were close to 0 or 100 percent (i.e., if $\hat{p} < .00005$ or if $\hat{p} \geq .99995$).

Estimates of other totals (e.g., number of initiates), along with means and rates not bounded between 0 and 1 (e.g., mean age at first use) were suppressed if the RSEs of the estimates were larger than .5.

Additionally, estimates of the mean age at first use were suppressed if the sample sizes were smaller than 10 respondents; also, the estimated number of initiates was suppressed if they rounded to 0.

The suppression criteria for various NSDUH estimates are summarized in Table 2.

Table 2. Summary of 2005 NSDUH Suppression Rules

Estimate	Suppress if:
Prevalence Rate, $\hat{p}$, with Nominal Sample Size, *n*, and Design Effect, *deff*	(1) The estimated prevalence rate, $\hat{p}$, is < 0.00005 or ≥ 0.99995, or (2) $\frac{\text{SE}(\hat{p}) \ / \ \hat{p}}{-\ln(\hat{p})} > 0.175$ when $\hat{p} \le 0.5$, or $\frac{\text{SE}(\hat{p}) \ / \ (1 - \hat{p})}{-\ln(1 - \hat{p})} > 0.175$ when $\hat{p} > 0.5$, or (3) Effective $n < 68$, where Effective $n = \frac{n}{deff}$ or (4) $n < 100$. Note: The rounding portion of this suppression rule for prevalence rates will produce some estimates that round at one decimal place to 0.0 or 100.0 percent but are not suppressed from the tables.
Estimated Number (Numerator of $\hat{p}$)	The estimated prevalence rate, $\hat{p}$, is suppressed. Note: In some instances when $\hat{p}$ is not suppressed, the estimated number may appear as a 0 in the tables. This means that the estimate is greater than 0 but less than 500 (estimated numbers are shown in thousands).
Mean Age at First Use, $\bar{x}$, with Nominal Sample Size, *n*	(1) $\text{RSE}(\bar{x}) > 0.5$, or (2) $n < 10$.
Number of Initiates, $\hat{t}$	(1) The number of initiates, $\hat{t}$, rounds to < 1,000 initiates, or (2) $\text{RSE}(\hat{t}) > 0.5$.

SE = standard error; RSE = relative standard error; deff = design effect.
Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2005.

References

Aldworth, J., Ault, K., Barnett-Walker, K., Carpenter, L., Copello, E., Frechtel, P., Licata, A., Liu, B., Martin, P., & Tillman, P. (2007, February). Imputation report. In *2005 National Survey on Drug Use and Health: Methodological resource book* (Section 11, prepared for the Substance Abuse and Mental Health Services Administration, Office of Applied Studies, under Contract No. 283-2004-00022, Deliverable No. 39, RTI/0209009.177.007). Research Triangle Park, NC: RTI International. [To be available as a PDF at http://www.oas.samhsa.gov/nsduh/methods.cfm#2k5]

Chen, P., Dai, L., Gordek, H., Laufenberg, J., Sathe, N., & Westlake, M. (2007, January). Person-level sampling weight calibration. In *2005 National Survey on Drug Use and Health: Methodological resource book* (Section 12, prepared for the Substance Abuse and Mental Health Services Administration, Office of Applied Studies, under Contract No. 283-2004-00022, Deliverable No. 39, RTI/0209009.174.002). Research Triangle Park, NC: RTI International. [To be available as a PDF at http://www.oas.samhsa.gov/nsduh/methods.cfm#2k5]

Chromy, J. R., & Penne, M. (2002). Pair sampling in household surveys. In *Proceedings of the 2002 Joint Statistical Meetings, American Statistical Association, Survey Research Methods Section, New York, NY [CD-ROM]* (pp. 552-554). Alexandria, VA: American Statistical Association.

Gfroerer, J., Hughes, A., Chromy, J., Heller, D., & Packer, L. (2004, July). Estimating trends in substance use based on reports of prior use in a cross-sectional survey. In S. B. Cohen & J. M. Lepkowski (Eds.), *Eighth Conference on Health Survey Research Methods: Conference proceedings [Peachtree City, GA]* (DHHS Publication No. PHS 04-1013, pp. 29-34). Hyattsville, MD: National Center for Health Statistics. [Available as a PDF at http://www.cdc.gov/nchs/data/misc/proceedings_hsrm2004.pdf]

Morton, K. B., Chromy, J. R., Hunter, S. R., & Martin, P.C. (2006, February). Sample design report. In *2005 National Survey on Drug Use and Health: Methodological resource book* (Section 2, prepared for the Substance Abuse and Mental Health Services Administration, Office of Applied Studies, under Contract No. 283-2004-00022, Phase 1, Deliverable Nos. 8 & 39, RTI/0209009.130.004). Research Triangle Park, NC: RTI International. [Available as a PDF at http://www.oas.samhsa.gov/nsduh/methods.cfm#2k5]

Office of Applied Studies. (2005). *Results from the 2004 National Survey on Drug Use and Health: National findings* (DHHS Publication No. SMA 05-4062, NSDUH Series H-28). Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies. [Available at http://www.oas.samhsa.gov/p0000016.htm#2k4]

Office of Applied Studies. (2006). *Results from the 2005 National Survey on Drug Use and Health: National findings* (DHHS Publication No. SMA 06-4194, NSDUH Series H-30). Rockville, MD: Substance Abuse and Mental Health Services Administration. [Available at http://www.oas.samhsa.gov/nsduh/2k5nsduh/2k5Results.htm]

RTI International. (2004a). *SUDAAN® language manual, Release 9.0*. Research Triangle Park, NC: Author.

RTI International. (2004b). *SUDAAN® manual v. 9.0 (beta)*. Research Triangle Park, NC: Author.

Ruppenkamp, J., Emrich, S., Aldworth, J., Hirsch, E., & Foster, M. (2006, February). *Missingness evaluation in the 2004 NSDUH* (Draft report, prepared for the Substance Abuse and Mental Health Services Administration, Office of Applied Studies, under Contract No. 283-03-9028, RTI/0208726.187.022). Research Triangle Park, NC: RTI International.

Wright, D., & Sathe, N. (2006). *State estimates of substance use from the 2003–2004 National Surveys on Drug Use and Health* (DHHS Publication No. SMA 06-4142, NSDUH Series H-29). Rockville, MD: Substance Abuse and Mental Health Services Administration, Office of Applied Studies. [Available at http://www.oas.samhsa.gov/states.htm]