2002 National Survey on Drug Use and Health

Sampling Error Report

RTI Project No. 7190
Contract No. 283-98-9008

Deliverable No. 19

Authors:

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Prepared for:

Substance Abuse and Mental Health Services Administration
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RTI International
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1. Introduction

As part of any survey data analysis, a good understanding of the resulting standard errors (SEs) and design effects (DEFFs), corresponding to a key set of outcome variables and other variables, is important for a number of reasons: (1) to evaluate how well the sample was designed in light of the target and realized precisions and design effects, (2) to obtain confidence intervals (CIs) for cross-sectional estimates (and for change estimates in the case of repeated surveys), (3) to obtain quick estimates of SEs for any user-specified outcome variable through generalized variance function (GVF) modeling based on a set of key outcome variables, and (4) to be able to incorporate realized design effects for future survey redesign.

This report compares the estimated (or realized) precisions of a key set of estimates with the targets for the 2002 National Survey on Drug Use and Health (NSDUH). The comparison was made with targets specified by the sponsor, the Substance Abuse and Mental Health Services Administration (SAMHSA), and with the predicted precision that statisticians from RTI International[1] anticipated during the design of the survey. In addition, tables of realized DEFFs are given. This report also contains SE tables based on GVF modeling that can be used for estimating the SEs of estimates (prevalences of drug recency of use in various domains, bounded between 0 and 1) from the 2002 NSDUH.

This report is organized as follows. Section 2 summarizes the 2002 sample design. Section 3 describes the calculation of relative standard errors (RSEs) and design effects. Section 4 presents tables that compare the observed precision with the expected precision. Section 5 compares median and mean design effects. Section 6 presents median and mean design effects for specific analysis domains. Section 7 gives tables of generalized SEs that can be used for estimating the SEs when direct estimates are unavailable. Finally, concluding remarks are given in Section 8.

[1] RTI International is a trade name of Research Triangle Institute.

2. Overview of the 2002 Sample Design

2.1. Target Population

The respondent universe for the 2002 National Survey on Drug Use and Health (NSDUH) was the civilian, noninstitutionalized population aged 12 years or older residing within the United States and the District of Columbia. Consistent with the NSDUH designs since 1991, the 2002 NSDUH universe included residents of noninstitutional group quarters (e.g., shelters, rooming houses, dormitories, and group homes), residents of Alaska and Hawaii, and civilians residing on military bases. Persons excluded from the 2002 universe included those with no fixed household address (e.g., homeless transients not in shelters) and residents of institutional group quarters, such as jails and hospitals.

2.2. Design Overview

The Substance Abuse and Mental Health Services Administration (SAMHSA) implemented major changes in the way the NSDUH would be conducted beginning in 1999 and continuing through subsequent years. The 1999 survey was the first in the survey series to use computer-assisted interviewing (CAI) methods. The 1999 survey also marked the first year in a transition to improved State estimates based on minimum sample sizes per State. The total targeted sample size of 67,500 is equally allocated across three age groups: 12 to 17 year olds, 18 to 25 year olds, and 26 year olds or older. This large sample size allowed SAMHSA to continue reporting precise demographic subgroups at the national level without needing to oversample specially targeted demographics, as required in the past. This large sample was referred to in the past as the "main sample" or the "CAI sample." The achieved sample for the 2002 CAI sample was 68,126 persons

The 2001 survey included an experimental study conducted to evaluate the effectiveness of respondent incentives on improving response rates and to examine the results of incentives on data quality, survey costs, and substance use estimates. The study compared the effectiveness of $40, $20, and $0 incentive payments. The results of the experiment showed that the $20 and $40 treatments produced significantly better interview response rates than the control group. Based on the results of this experiment, SAMHSA chose to institute a $30 incentive payment beginning with the 2002 NSDUH. As expected, response rates improved significantly in the 2002 survey. Due to these higher response rates, fewer selected households were required in 2002 than in previous surveys.

2.2.1 5-Year Design

A coordinated 5-year sample design was developed. The 2002 sample is a subsample of the 5-year sample. Although there is no overlap with the 1998 sample, a coordinated design for 1999-2003 facilitated 50 percent overlap in first-stage units (area segments) between each 2 successive years from 1999 through 2003. This design was intended to increase the precision of estimates in year-to-year trend analyses because of the expected positive correlation resulting from the overlapping sample between successive NSDUH years.

The 1999-2003 design provides for estimates by State in all 50 States plus the District of Columbia. States may therefore be viewed as the first level of stratification as well as a reporting variable. Eight States, referred to as the "large" States,[2] had a sample designed to yield 3,600 respondents per State for the 2002 survey. This sample size was considered adequate to support direct State estimates. The remaining 43 States[3] had a sample designed to yield 900 respondents per State in the 2002 survey. In these 43 States, adequate data were available to support reliable State estimates based on small area estimation (SAE) methodology.

Field interviewer (FI) regions were formed within each State. Based on a composite size measure, States were geographically partitioned into roughly equally sized regions. In other words, regions were formed such that each area yielded, in expectation, roughly the same number of interviews during each data collection period, thus distributing the workload equally among NSDUH interviewers. The smaller States were partitioned into 12 field interviewer regions, whereas the eight "large" States were divided into 48 regions. Therefore, the partitioning of the United States resulted in the formation of a total of 900 field interviewer regions.

For the first stage of sampling, each of the field interviewer regions was partitioned into noncompact clusters[4] of dwelling units by aggregating adjacent Census blocks. Consistent with the terminology used in previous NSDUHs, these geographic clusters of blocks are referred to as *segments*. A sample *dwelling unit* in the NSDUH refers to either a housing unit or a group-quarters listing unit, such as a dormitory room or a shelter bed. To support the overlapping sample design and any special supplemental samples or field tests that SAMHSA may wish to conduct, segments were formed to contain a minimum of 175 dwelling units[5] on average. In prior years, this average minimum segment dwelling unit size was only 90.

Before selecting sample segments, additional implicit stratification was achieved by sorting the first-stage sampling units by a metropolitan statistical area (MSA)/socioeconomic status (SES) indicator[6] and by the percentage of the population who are non-Hispanic and white. From this well-ordered sample frame, 96 segments[7] per field interviewer region were selected with probabilities proportionate to a composite size measure and with minimum replacement. The selected segments then were assigned at random to a survey year and quarter of data collection. A total of 24 of these segments were designated for the coordinated 5-year sample, while the other 72 were designated as "reserve" segments.

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[2] For the 1999-2003 NSDUHs, the “large” states are California, Florida, Illinois, Michigan, New York, Ohio, Pennsylvania, and Texas.

[3] For reporting and stratification purposes, the District of Columbia is treated the same as a State, and no distinction is made in the discussion.

[4] Noncompact clusters (selection from a list) differ from compact clusters in that not all units within the cluster are included in the sample. Although compact cluster designs are less costly and more stable, a noncompact cluster design was used because it provides for greater heterogeneity of dwellings within the sample. Also, social interaction (contagion) among neighboring dwellings is sometimes introduced with compact clusters (Kish, 1965, pp. 313-315).

[5] Dwelling unit counts were obtained from the 1990 Decennial Census data supplemented with revised population counts from Claritas.

[6] Four categories are defined: (1) MSA/low SES, (2) MSA/high SES, (3) non-MSA/low SES, (4) non-MSA/high SES.

[7] The 1999-2003 sample was planned such that 48 segments per field interviewer region would be selected. In the implementation, however, an additional 48 segments were added to support any supplemental or field test samples.

2.2.2 Sample Selection at Second and Third Stages

Once sample segments for the 2002 NSDUH study were selected, specially trained field household listers visited the areas and obtained complete and accurate lists of all eligible dwelling units within the sample segment boundaries. These lists served as the frames for the second stage of sample selection.

The primary objective of the second stage of sample selection (listing units) was to determine the minimum number of dwelling units needed in each segment to meet the targeted sample sizes for all age groups. Thus, listing unit sample sizes for the segment were determined using the age group with the largest sampling rate, referred to as the "driving" age group. Using 1990 Census data adjusted to more recent data from Claritas, State- and age-specific sampling rates were computed. These rates then were adjusted by the segment's probability of selection, the subsegmentation inflation factor,[8] if any, the probability of selecting a person in the age group (equal to the maximum or 0.99 for the driving age group), and an adjustment for the "maximum of two" rule.[9] In addition to these factors, historical data from the 2000, 2001, and 2002 NSDUHs were used to compute predicted screening and interviewing response rate adjustments. The final adjusted sampling rate then was multiplied by the actual number of dwelling units found in the field during counting and listing activities. The product represents the segment's listing unit sample size.

Some constraints were put on the listing unit sample sizes. For example, to ensure an adequate sample for the overlapping design and/or for supplemental studies, the listing unit sample size could not exceed 100, or half of the actual listing unit count. Similarly, if five unused listing units remained in the segment, a minimum of five listing units per segment was required for cost efficiency.

Using a random start point and interval-based (systematic) selection, the actual listing units were selected from the segment frame. After dwelling unit selections were made, an interviewer visited each selected dwelling unit to obtain a roster of all persons residing in the dwelling unit. As in previous years, during the data collection period, if an interviewer encountered any new dwelling units in a segment or found a dwelling unit that was missed during the original counting and listing activities, then the new/missed dwellings were selected into the 2002 NSDUH using the half-open interval selection technique.[10] The selection technique eliminates any frame bias that might be introduced by errors and/or omissions in the counting and listing activities, and it eliminates any bias that might be associated with using "old" segment listings.

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[8] Segments found to be very large in the field are partitioned in subsegments. Then one subsegment is chosen at random with probability proportional to size to be fielded. The subsegmentation inflation factor accounts for the narrowing down of the segment.

[9] Brewer's selection algorithm never allows for more than two persons per household to be chosen. Thus, sampling rates are adjusted to satisfy this constraint.

[10] In summary, this technique states that, if a dwelling unit is selected for the 2002 study and an interviewer observes any new or missed dwelling units between the selected dwelling unit and the dwelling unit appearing immediately after the selection on the counting and listing form, then all new/missed dwellings falling in this interval will be selected. If a large number (generally greater than 10) of new/missed dwelling units are encountered, then a sample of the missing dwelling units will be selected.

Using the roster information obtained from an eligible member of the selected dwelling unit, 0, 1, or 2 persons were selected for the survey. Sampling rates were preset by age group and State. Roster information was entered directly into the electronic screening instrument, which automatically implemented this third stage of selection based on the State and age group sampling parameters.

One exciting consequence of using an electronic screening instrument in the NSDUH is the ability to impose a more complicated person-level selection algorithm on the third stage of the NSDUH design. Beginning in 1999 and continuing through 2002, one feature included in the design was that any two survey-eligible people within a dwelling unit had some chance of being selected (i.e., all survey eligible pairs of people had some nonzero chance of being selected). This design feature was of interest to NSDUH researchers because, for example, it allows analysts to examine how the drug use propensity of one individual in a family relates to the drug use propensity of other family members residing in the same dwelling unit (e.g., the relationship of drug use between a parent and child).

3. Computing Relative Standard Errors and Design Effects

As mentioned in Section 1, there are several objectives for calculating relative standard errors (RSEs) and design effects (DEFFs) for the 2002 National Survey on Drug Use and Health (NSDUH). One is to provide a mechanism for comparing the expected precision of the 2002 design with the precision actually obtained. A second objective is to provide government analysts and other users of the NSDUH data with a methodology for determining a quick approximation of the precision of estimates obtained from the 2002 survey. The third objective is to build confidence intervals (CIs) of estimates of level and change. Finally, the magnitudes of the design effects are useful for future redesign of the survey.

The RSE of a domain- *d* prevalence estimate is the standard error (SE) of the estimate divided by the estimate, that is,

$$RSE\left(\hat{P}_d\right) = SE\left(\hat{P}_d\right) / \hat{P}. \tag{1}$$

The design effect for a prevalence estimate is its variance divided by the variance that would be observed if simple random sampling (SRS) had been used. Hence, the SE of the estimated prevalence can be written as follows:

$$SE(\hat{P}_d) = \left[DEFF\left(d\right) \hat{P}_d \left(1 - \hat{P}\right) / n_d \right]^{1/2}, \tag{2}$$

where $DEFF(d)$ and n_d are the median (or mean as the case may be) design effect and sample size of domain- *d*, respectively.

By substituting a prevalence rate of 0.10 into Equations 1 and 2, the RSE becomes

$$RSE\left(\hat{P} = .10\right) = \left[\left(DEFF\left(d\right) * 9 / n_d\right)\right]^{1/2}. \tag{3}$$

This shows that for the specified prevalence rate of 0.10, the RSE is purely a function of the design effect and sample size. In the tables given in this report, RSEs are expressed as percentages; that is, the right-hand side of Equation 3 is multiplied by 100.

Mean and median design effects were used for many of the calculations in this report. Design effects were calculated based on drug use variables displayed in the 2002 NSDUH sample design report (Odom, Bowman, Chromy, & Martin 2003).

As noted previously, the design effect is the ratio of the design-based variance estimate divided by the variance estimate that would have been obtained from a simple random sampling (SRS) of the same size. Therefore, the design effect summarizes the effects of stratification, clustering, and unequal weighting on the variance of a complex sample design. Because clustering and unequal weighting are expected to increase the variance and generally dominate the stratification effect, the design effect is generally expected to be greater than 1. However, design effects were sometimes less than 1 for prevalence rates near 0.

Note that the design effect is based on the with-replacement variance estimate as obtained from the SUrvey DAta ANalysis program (SUDAAN), which properly accounts for clustering, stratification, and unequal weighting. In the 1999 sampling error report, design effect was based on the maximum-of-three rule for computing design-based SEs under the premise that the precision loss anticipated due to clustering and unequal probability sampling offsets any gain due to stratification (i.e., the design effect should be at least 1). The three SEs correspond to the SUDAAN assumption of with-replacement (wr) primary sampling units (PSUs), stratified simple random sample, and simple random sample. Note that for the 2000 NSDUH onward, it was decided to use only the standard SUDAAN with replacement SE based on the PSU for the sake of simpler interpretation, as well for easier computation of the SE of functions of estimates, such as differences and ratios.

Design effects associated with prevalence estimates below 0.00005 or greater than or equal to 0.99995 (an ad hoc rule representing 0 or 1 in practice) or prevalence estimates exhibiting low precision were not used for determining the medians. To identify estimates with low precision, the suppression rule used in earlier years was applied. Specifically, design effects or the corresponding prevalence estimates were not included if the corresponding RSE of -ln(p) satisfies

$$RSE[-\ln(p)] > 0.175 \qquad \text{when } p \leq 0.5$$

or

$$RSE[-\ln(1-p)] > 0.175 \qquad \text{when } p > 0.5.$$

A rationale for this rule is that for a prevalence estimate of 0.10, the minimum required effective sample size (or the sample size under SRS) is around 50 (55.43 to be exact) when the maximum tolerable value of $RSE[-\ln(p)] = 0.175$. This can be derived as follows: under SRS, $RSE(p)$ is equal to the square root of $p(1-p)/np$, and using Taylor series, $SE[-\ln(p)]$ is approximately $SE(p)/p$, (i.e., $RSE(p)$). Therefore, under SRS, $RSE[-\ln(p)]$ is approximately $RSE(p)/[-\ln(p)]$. Then, substituting $p = 0.1$ and $RSE[-\ln(p)] = 0.175$, gives $n = 55.43$ under SRS. For complex designs, this can be interpreted as the minimum required effective sample size. In other words, if $DEFF(p)$ is 2, the minimum required sample size is the design effect times the effective sample size (i.e., 111).

It may be remarked that for a given sample size, the RSE increases as p decreases, and for a given p, it increases as the sample size decreases. The above discussion pertains to $p < 0.5$. For $p > 0.5$, $RSE(p)$ is not symmetric about $p = 0.5$ although $SE(p)$ is. Clearly, precision requirements should be identical for p or $1-p$. Therefore, it is convenient to use the convention that the suppression rule for $p < 0.5$ is also applied for $p > 0.5$ by replacing p with $1-p$.

4. Comparing Observed Precision with Expected Precision

The sample design optimization for the 2002 National Survey on Drug Use and Health (NSDUH) used the revised nine key classes of NSDUH outcomes. These outcomes included recency-of-use estimates, treatment received for alcohol and illicit drug use, and dependence on alcohol and illicit drug use. Specifically, the outcomes used for 2002 were:

- cigarette use in the past month,
- alcohol use in the past month,
- any illicit drug use in the past month,
- any illicit drug use other than marijuana in the past month,
- cocaine use in the past month,
- dependent on illicit drugs in the past year,
- dependent on alcohol and not illicit drugs in the past year,
- received treatment for illicit drug use in the past year, and
- received treatment for alcohol, but not illicit drugs, in the past year.

Precision requirements for the 2002 designs were specified in terms of targeted relative standard errors (RSEs) on a prevalence of 10 percent for age, race/ethnicity, and total domains and in terms of minimum sample sizes. The estimates and standard errors (SEs) for the above outcomes were scaled to a prevalence of 10 percent as given by Equation 3 in Section 3.

In this section, two benchmarks in the 2002 NSDUH are compared with the estimated achieved precision of important outcome measures. One is derived from requirements specified by the Substance Abuse and Mental Health Services Administration (SAMHSA); the other is the predicted precision that statisticians at RTI International anticipated during the design of the survey.

Due to changes in the variable definitions made in the treatment and dependent modules for 2002 NSDUH, it was not possible to use exactly the same dependence and treatment outcome variables that were used in defining benchmarks in the 2002 NSDUH sample design plan (Penne, Bowman, & Chromy 2003).

Consequently, corresponding outcome variables for the 2002 NSDUH that are as similar as possible to the ones used in the sample design plan were created. Table 4.1 shows the comparison to the nine outcomes from the sample design plan.

4.1. Precision Requirements

Initial requirements for the sample were defined in terms of the following:

- minimum sample sizes of 3,600 persons per State in eight large States and 900 persons in the remaining 43 States; and
- equal allocation of the sample across the three age groups: 12 to 17, 18 to 25, and 26 or older within each State.

In addition, for national estimates, the SAMHSA-specified, precision requirements were that the expected relative standard error on a prevalence of 10 percent not exceed the following:

- 3.0 percent for total population statistics;
- 5.0 percent for statistics in four age group domains: 12 to 17, 18 to 25, 26 to 34, and 35 or older;
- 11.0 percent for statistics computed among Hispanics in four age group domains: 12 to 17, 18 to 25, 26 to 34, and 35 or older;
- 11.0 percent for statistics computed among non-Hispanic blacks in four age group domains: 12 to 17, 18 to 25, 26 to 34, and 35 or older; and
- 5.0 percent for statistics computed among non-Hispanic, non-blacks in four age group domains: 12 to 17, 18 to 25, 26 to 34, and 35 or older.

The 2002 sample reflects SAMHSA's objective to develop more reliable State-level estimates using small area estimation (SAE) procedures. To achieve this objective, the targeted sample size by State was set to be at least 900 completed interviews; in eight States, the target was set at 3,600 completed interviews. The larger overall sample makes it possible to get adequate precision for Hispanic and non-Hispanic black populations without any targeted oversampling of areas of high concentration of these populations or any oversampling through screening for these target populations.

4.2. Observed Versus Expected Precision

Table 4.1 presents observed results compared with projections for sample sizes, design effects, and associated RSEs, by race/ethnicity and age group. The projected RSEs are averages over the nine outcome variables as given in the beginning of this chapter. Note that using Equation 3, the RSEs for all the outcome variables are scaled to the generic prevalence of 0.10. The projected design effect was derived as an average over the design effects for the nine variables corresponding to the projected RSEs via Equation 3 for various domains. For the observed RSE, as in the previous 3 years' reports, mean design effects for the nine outcomes listed above were substituted into Equation 3 to obtain mean RSEs for a prevalence of 0.10. The mean is used here for comparison purposes instead of the median because the mean was used for the purpose of sample allocation. Also, because the design effect is proportional to the squared RSE or relative variance, it is probably more meaningful to compute projected RSE over all nine outcomes as root mean relative variance rather than mean RSE. However, the difference between the two is only marginal. All of the nine prevalence estimates contributed to the means in Table 4.1; none was suppressed because of low precision. It is of interest to note that although the observed design effects and RSEs are generally higher than the projected, comparison with the targeted RSEs does not always share this problem. It is noted that the ones that do not meet the target RSE levels are all from the 26 to 34 age group. This can be explained by the fact that the projected sample size was considerably reduced (from 9352 to 6500) starting in 2001 compared with the years 1999 and 2000 (see Penne et al., 2003).

Table 4.1 Estimated Precision Compared with Targeted and Projected Precision, by Race/Ethnicity and Age Group

Race/Ethnicity	Age Group	Sample Size			Mean Design Effect			Mean Relative Standard Error at p = 10%			
		Projected[1]	Observed	% Off	Projected	Observed	% Off	Projected	Target[2]	Observed[3]	% Off[4]
Total	Total	67,500	68,126	0.93	3.10	2.94	-5.27	2.01	3.00	1.95	-34.94
	12 -17	22,500	23,645	5.09	1.62	1.84	13.44	2.54	5.00	2.64	-47.18
	18 -25	22,500	23,066	2.52	1.68	1.89	12.41	2.59	5.00	2.70	-45.94
	26 -34	6,500	6,374	-1.94	1.51	1.74	15.45	4.55	5.00	4.96	-0.88
	35+	16,000	15,041	-5.99	1.42	1.55	9.39	2.81	5.00	3.03	-39.32
Hispanic	Total	7,188	8,811	22.58	2.74	2.93	6.96	5.80	.	5.40	.
	12 -17	2,744	3,264	18.95	1.42	1.85	29.97	6.82	11.00	7.11	-35.38
	18 -25	2,410	3,339	38.55	1.44	1.73	20.24	7.34	11.00	6.80	-38.20
	26 -34	755	943	24.90	1.30	1.83	40.82	12.46	11.00	13.17	19.76
	35+	1,152	1,265	9.81	1.28	1.60	24.77	9.97	11.00	10.50	-4.51
Black	Total	8,521	8,615	1.10	3.38	3.17	-6.18	5.96	.	5.73	.
	12 -17	3,003	3,313	10.32	1.46	1.44	-1.57	6.61	11.00	6.23	-43.39
	18 -25	2,997	3,027	1.00	1.60	1.59	-0.82	6.92	11.00	6.85	-37.77
	26 -34	908	759	-16.41	1.46	1.51	3.39	12.03	11.00	13.28	20.72
	35+	1,472	1,516	2.99	1.24	1.42	14.25	8.68	11.00	9.15	-16.82
White	Total	51,799	50,700	-2.12	2.91	2.85	-2.11	2.22	.	2.22	
	12 -17	16,757	17,068	1.86	1.59	1.79	12.75	2.92	5.00	3.07	-38.65
	18 -25	17,093	16,700	-2.30	1.74	1.84	5.99	3.03	5.00	3.14	-37.17
	26 -34	4,837	4,672	-3.41	1.39	1.63	16.99	5.09	5.00	5.59	11.71
	35+	13,374	12,260	-8.33	1.36	1.58	15.83	3.01	5.00	3.38	-32.46

[1]Distribution of the projected sample sizes for “26-34” and “35+”, over race groups, corresponds to the distribution in 2000.
[2]Some values of the target precision are missing as they were not specified in the sample design report (Odom et al., 2003).
[4]Calculated using Equation 2 with the observed sample size and the mean observed design effect.
[4]Percent relative difference from the target RSE.
Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

5. Comparison of Median and Mean Design Effects

The mean is more sensitive to outliers and is generally larger than the median. Table 5.1 compares the median and mean of 56 design effects for three age groups and over all ages in the 2002 design. Comparison also is given for the four race/Hispanicity categories although they were not used as stratification variables when selecting persons within households.

The median and design effect estimates were based on estimates from the following:

- *15 illicit drug use categories:* any illicit drug use, marijuana/hashish, cocaine, crack, inhalants, hallucinogens, LSD, PCP, heroin, nonmedical use of any psychotherapeutic, nonmedical use of stimulants, nonmedical use of sedatives, nonmedical use of tranquilizers, nonmedical use of pain relievers, any illicit drug except marijuana; and
- *3 licit drug use categories:* cigarettes, alcohol, and smokeless tobacco.

These were applied for each of three recency-of-use categories: ever used, used in past year, and used in past month.

The estimates of past month heavy drinking and binge drinking also were included in the licit drug use category, bringing the total number of estimates used for the mean versus median comparisons to 56. The median and the mean design effects were calculated from the above estimates for the total population, by age and by race/ethnicity. As seen from Table 5.1, contrary to expectation, the mean design effect turned out to be larger than the median design effect in only half of the eight domains. In fact, the maximum absolute difference (over 7%) when median deff is larger than the mean is relatively high compared to under 1.5% when mean deff is larger than the median.

Table 5.1 Comparison of Median and Mean Design Effects of 56 Outcomes

Outcome	Median Design Effect	Mean Design Effect	Difference (Mean- Median)	Percent Difference[1]
Total	3.00	3.00	-0.01	-0.25
Age (years)				
12-17	1.84	1.85	0.01	0.64
18-25	1.98	1.99	0.01	0.61
26+	1.69	1.71	0.02	1.34
Race/Ethnicity				
White	2.91	2.83	-0.08	-2.72
Black	3.40	3.16	-0.24	-7.14
Hispanic	3.09	3.00	-0.09	-3.06
Other	2.95	2.98	0.04	1.23

[1] Computed as 100*(Mean-Median)/Median.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

6. Use of Domain-Specific Design Effects for Approximating Standard Error

This section presents one of the two approaches considered for approximating standard error (SE) estimates when published 2002 National Survey on Drug Use and Health (NSDUH) estimates or computer software are unavailable. The first approach, considered in this section, is based on median domain design effects, while Section 7 presents SE estimates based on a prediction equation obtained from modeling design effects.

Domains were defined by cross-classifications of age and gender, by race/ethnicity, population density, geographic division of residence, adult education, current employment, and State. The 56 types of drug and recency categories given in Section 5 were used for the estimates on which the medians were computed. Design effects associated with percentage estimates exhibiting low precision as defined in Section 3 were not used. The median design effects (DEFFs) were computed separately for the three classifications: lifetime illicit drug use (Table 6.1), past year and past month illicit drug use (Table 6.2), and licit drug use (Table 6.3). Note that design effects for lifetime use are expected to be quite different from those for past year use and past month use; therefore, it is desirable to keep the two separate. However, this was not done for licit drugs because of the small number of drug use variables available for computing the median for each domain (a total of only 11). This is a limitation of this method based on medians, unlike the generalized variance function (GVF) method used in Section 7. These tables can be used to calculate an approximate variance estimate for a particular domain as follows:

$$var\left(p_d\right)_{appx} = DEFF_{d,MED} * \left[p_d\left(1-p_d\right)/n_d\right], \tag{4}$$

where

p_d = estimated proportion for domain *d*,

n_d = sample size for domain *d*, and

$DEFF_{d,MED}$ = median design effect for domain *d*.

The approximate SE estimate for p_d, $SE(p_d)_{appx}$, is the square root of $var(p_d)_{appx}$. These tables give the median design effects for the 8 large States, and the median of the 43 State medians for the remaining States. Results for the smaller States are given for reference only. Although design effects are of the same order as that for the larger States (because the sample design is the same for all States), the above approximate formula is not recommended for use with smaller States because of the instability of the prevalence estimates. The small area estimation (SAE) methodology should be used, as in the case of NSDUH reports since 1999. To get an idea of the magnitude of the 2002 drug-specific design effects used in computing the median design effect over the drugs, Table 6.4 lists the 56 individual design effects for each of the age groups and the national total.

Table 6.1 Median Design Effects of Lifetime Illicit Drug Use, by Age Group, Gender, and Demographic Characteristics

Demographic Characteristics	Age Group			Gender		Total
	12 to 17	18 to 25	26+	Male	Female	
Total	1.84	2.18	1.86	3.44	3.43	3.69
Gender						
Male	1.77	1.95	1.71	N/A	N/A	3.44
Female	1.70	1.86	1.75	N/A	N/A	3.43
Age (years)						
12 to 17	N/A	N/A	N/A	1.77	1.70	1.84
18 to 25	N/A	N/A	N/A	1.95	1.86	2.18
26+	N/A	N/A	N/A	1.71	1.75	1.86
Race/Ethnicity						
White	1.75	1.91	1.85	3.33	3.11	3.55
Black	1.56	1.46	1.74	4.12	3.04	3.86
Hispanic	2.15	2.09	1.64	3.32	3.61	3.38
Other	2.13	2.28	2.03	3.13	3.77	3.81
Population Density						
Large metropolitan	1.58	1.98	1.73	3.15	3.40	3.59
Small metropolitan	1.99	2.25	1.81	3.06	3.28	3.70
Nonmetropolitan	1.81	1.95	2.15	4.67	2.98	4.36
Census Division						
New England	1.74	3.07	3.30	5.49	5.87	7.67
Middle Atlantic	1.51	1.89	1.25	2.63	2.44	2.72
East North Central	1.27	1.78	1.18	2.58	2.20	2.52
West North Central	1.72	2.09	2.19	5.57	2.69	4.08
South Atlantic	1.96	2.51	1.96	3.35	3.33	3.73
East South Central	1.67	1.90	1.42	2.33	2.08	2.98
West South Central	1.36	1.38	1.38	2.58	1.89	2.70
Mountain	1.87	1.76	2.02	2.98	3.30	3.92
Pacific	1.77	2.01	1.77	2.88	4.15	3.59
County Type[1]						
Large metropolitan	1.64	1.96	1.68	3.07	3.33	3.44
Small metropolitan I	1.71	2.10	1.54	2.88	3.00	3.16
Small metropolitan II	2.16	2.55	2.55	4.37	3.70	4.83
Nonmetropolitan I	2.09	2.18	2.10	3.91	3.24	4.24
Nonmetropolitan II	2.02	2.21	1.73	3.37	2.51	3.51
Nonmetropolitan III	2.67	1.74	1.73	2.94	3.19	3.65
Adult Education[2]						
Less than high school	N/A	1.77	1.34	2.15	1.91	2.17
High school graduate	N/A	1.71	1.69	2.66	2.52	2.65
Some college	N/A	2.11	1.93	3.00	3.03	3.12
College graduate	N/A	1.78	1.94	2.15	2.58	2.56
Current Employment[3]						
Full-time	N/A	1.89	1.77	2.46	2.38	2.52
Part-time	N/A	1.73	1.95	3.47	3.26	3.67
Unemployed	N/A	1.81	1.92	3.69	2.54	3.39
Other[4]	N/A	1.87	1.45	2.06	2.04	2.22

See notes at end of table. (continued)

Table 6.1 Median Design Effects of Lifetime Illicit Drug Use, by Age Group, Gender, and Demographic Characteristics (continued)

Demographic Characteristics	Age Group			Gender		Total
	12 to 17	18 to 25	26+	Male	Female	
State						
California	1.36	1.53	1.25	2.09	3.24	2.68
Florida	1.75	1.51	1.19	2.24	2.24	2.29
Illinois	1.24	1.17	1.26	2.65	2.48	2.45
Michigan	1.15	2.03	1.22	2.43	1.78	2.57
New York	1.30	1.52	1.05	2.19	2.11	2.45
Ohio	1.00	1.25	1.18	2.51	1.97	2.36
Pennsylvania	1.15	1.80	1.15	2.91	1.67	2.34
Texas	1.17	1.25	1.29	2.79	1.69	2.59
All Other[5]	1.22	1.30	1.24	2.35	1.85	2.49

N/A = Not applicable.

Note: These design effects apply to the following drugs: any illicit drug use, marijuana/hashish, cocaine, crack, inhalants, hallucinogens, LSD, PCP, heroin, nonmedical use of any psychotherapeutics, nonmedical use of sedatives, nonmedical use of tranquilizers, nonmedical use of pain relievers, and any illicit drug except marijuana.

[1]Data on County Type defined as follows:

Large Metropolitan: Counties in metro areas with a population ≥1 million

Small metropolitan I: Counties in metro areas with a population between 250,000 and 1,000,000

Small metropolitan II: Counties in metro areas with a population <250,000

Nonmetropolitan I: Urban Populations not part of metro areas ≥20,000

Nonmetropolitan II: Urban Populations not part of metro areas between 2,500 and 19,999

Nonmetropolitan III: Completely Rural

[2]Data on adult education are not applicable for 12 to 17 year olds.

[3]Data on current employment are not applicable for 12 to 17 year olds.

[4]Retired, disabled, homemaker, student, or "other."

[5]Median of the median design effects for the 43 States.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 6.2 Median Design Effects of Past Year and Past Month Illicit Drug Use, By Age Group, Gender, and Demographic Characteristics

Demographic Characteristics	Age Group			Gender		Total
	12 to 17	18 to 25	26+	Male	Female	
Total	1.89	1.80	1.52	2.30	1.97	2.41
Gender						
Male	1.73	1.68	1.50	N/A	N/A	2.30
Female	1.75	1.65	1.42	N/A	N/A	1.97
Age (years)						
12 to 17	N/A	N/A	N/A	1.73	1.75	1.89
18 to 25	N/A	N/A	N/A	1.68	1.65	1.80
26+	N/A	N/A	N/A	1.50	1.42	1.52
Race/Ethnicity						
White	1.76	1.67	1.44	2.28	1.74	2.19
Black	1.55	1.60	1.42	2.63	1.73	2.26
Hispanic	2.17	1.93	1.50	2.19	1.94	2.14
Other	2.01	1.85	1.25	1.30	1.41	1.40
Population Density						
Large metropolitan	1.64	1.59	1.27	2.06	1.72	2.13
Small metropolitan	2.04	1.87	1.50	2.13	1.91	2.33
Nonmetropolitan	1.90	1.74	1.70	2.54	1.52	2.61
Census Division						
New England	1.71	2.32	2.41	1.25	2.48	2.50
Middle Atlantic	1.40	1.36	1.15	1.86	1.65	1.81
East North Central	1.14	1.74	1.00	1.68	1.35	1.58
West North Central	1.75	1.86	1.81	2.29	2.02	2.48
South Atlantic	2.14	1.93	1.42	2.11	2.02	2.63
East South Central	1.52	1.43	1.25	1.54	1.14	1.47
West South Central	1.29	1.30	1.10	1.69	1.00	1.40
Mountain	1.77	1.82	1.18	1.70	1.31	1.66
Pacific	1.79	1.51	1.46	2.31	1.82	2.34
County Type[1]						
Large metropolitan	1.66	1.58	1.29	2.03	1.73	2.10
Small metropolitan I	1.79	1.89	1.45	2.29	1.93	2.37
Small metropolitan II	2.37	1.76	1.59	2.02	1.91	2.36
Nonmetropolitan I	1.57	1.79	1.24	1.89	1.63	1.72
Nonmetropolitan II	1.90	1.74	1.24	1.88	1.51	2.04
Nonmetropolitan III	2.39	1.65	1.87	1.06	1.84	1.46
Adult Education[2]						
Less than high school	N/A	1.75	1.14	1.65	1.36	1.66
High school graduate	N/A	1.60	1.43	1.83	1.40	1.77
Some college	N/A	1.86	1.41	1.92	1.70	1.91
College graduate	N/A	1.49	1.70	1.76	1.81	2.02

See notes at end of table. (continued)

Table 6.2 Median Design Effects of Past Year and Past Month Illicit Drug Use, By Age Group, Gender, and Demographic Characteristics (continued)

	Age Group			Gender		
Demographic Characteristics	**12 to 17**	**18 to 25**	**26+**	**Male**	**Female**	**Total**
Current Employment[3]						
Full-time	N/A	1.74	1.55	1.77	1.55	1.87
Part-time	N/A	1.60	1.52	1.78	1.84	2.35
Unemployed	N/A	1.49	1.72	2.40	1.93	2.75
Other[4]	N/A	1.75	1.15	1.39	1.24	1.40
State						
California	1.31	1.14	1.00	1.68	1.15	1.62
Florida	1.57	1.36	1.08	1.74	1.79	1.79
Illinois	1.19	1.28	1.13	1.92	1.30	1.77
Michigan	1.20	1.35	1.00	1.08	1.29	1.56
New York	1.18	1.16	1.05	2.15	1.52	1.69
Ohio	1.02	1.33	1.00	1.52	1.00	1.28
Pennsylvania	1.21	1.41	1.00	1.87	1.31	1.68
Texas	1.08	1.11	1.00	1.43	1.00	1.36
All Other[5]	1.21	1.20	1.00	1.06	1.00	1.16

N/A = Not applicable.

Note: These design effects apply to the following drugs: any illicit drug use, marijuana/hashish, cocaine, crack, inhalants, hallucinogens, LSD, PCP, heroin, nonmedical use of any psychotherapeutics, nonmedical use of sedatives, nonmedical use of tranquilizers, nonmedical use of pain relievers, and any illicit drug except marijuana.

[1]Data on County Type defined as follows:

Large Metropolitan: Counties in metro areas with a population ≥1 million

Small metropolitan I: Counties in metro areas with a population between 250,000 and 1,000,000

Small metropolitan II: Counties in metro areas with a population <250,000

Nonmetropolitan I: Urban Populations not part of metro areas ≥20,000

Nonmetropolitan II: Urban Populations not part of metro areas between 2,500 and 19,999

Nonmetropolitan III: Completely Rural

[2]Data on adult education are not applicable for 12 to 17 year olds.

[3]Data on current employment are not applicable for 12 to 17 year olds.

[4]Retired, disabled, homemaker, student, or "other."

[5]Median of the median design effects for the 43 States.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 6.3 Median Design Effects of Licit Drug Use Estimates, by Age Group, Gender, and Demographic Characteristics

Demographic Characteristics	Age Group			Gender		Total
	12 to 17	18 to 25	26 to 34	Male	Female	
Total	1.80	2.26	2.01	3.43	3.76	3.82
Gender						
Male	1.78	2.03	1.73	N/A	N/A	3.43
Female	1.62	2.25	2.07	N/A	N/A	3.76
Age in Years						
12 to 17	N/A	N/A	N/A	1.78	1.62	1.80
18 to 25	N/A	N/A	N/A	2.03	2.25	2.26
26+	N/A	N/A	N/A	1.73	2.07	2.01
Race/Ethnicity						
White	1.57	2.10	2.04	3.37	3.38	3.50
Black	1.57	1.64	1.76	3.39	3.61	3.85
Hispanic	1.86	2.13	2.16	3.40	5.01	4.22
Other	2.19	2.35	2.51	4.86	4.00	4.71
Population Density						
Large metropolitan	1.69	1.82	1.69	2.98	3.00	3.38
Small metropolitan	1.84	2.76	2.11	3.77	3.75	3.91
Nonmetropolitan	1.87	2.42	2.01	3.82	4.67	4.21
Census Division						
New England	2.27	2.87	2.89	3.79	4.74	5.33
Middle Atlantic	1.44	1.91	1.41	2.96	2.99	3.02
East North Central	1.33	2.26	1.66	2.83	2.91	3.28
West North Central	2.18	1.73	2.03	3.70	4.17	3.71
South Atlantic	1.98	2.71	2.14	3.53	4.10	4.40
East South Central	2.00	2.23	1.64	2.64	2.86	3.11
West South Central	1.24	1.26	1.47	2.51	2.06	2.62
Mountain	1.69	2.25	2.13	3.71	3.14	3.72
Pacific	1.55	2.10	1.95	3.00	2.63	3.71
County Type[1]						
Large metropolitan	1.71	1.84	1.80	3.06	2.99	3.49
Small metropolitan I	1.74	2.60	1.99	3.63	3.19	3.98
Small metropolitan II	2.19	2.81	2.12	3.95	4.20	4.25
Nonmetropolitan I	2.11	2.38	2.21	3.44	3.74	4.17
Nonmetropolitan II	1.89	2.44	1.87	3.40	4.71	3.83
Nonmetropolitan III	2.20	2.26	1.98	3.73	4.06	3.93

See notes at end of table. (continued)

Table 6.3 Median Design Effects of Licit Drug Use Estimates, by Age Group, Gender, and Demographic Characteristics (continued)

Demographic Characteristics	Age Group			Gender		Total
	12 to 17	18 to 25	26 to 34	Male	Female	
Adult Education[2]						
Less than high school	N/A	1.85	1.89	2.83	3.58	3.25
High school graduate	N/A	1.96	1.73	2.85	2.82	2.82
Some college	N/A	2.33	1.89	2.81	3.12	3.01
College graduate	N/A	1.83	1.94	2.33	1.95	2.38
Current Employment[3]						
Full-time	N/A	1.88	1.75	2.41	2.29	2.50
Part-time	N/A	2.01	2.13	3.55	3.29	3.49
Unemployed	N/A	1.84	1.88	3.15	3.15	3.24
Other[4]	N/A	2.03	1.78	2.66	2.68	2.69
State						
California	1.33	1.61	1.29	2.35	2.27	2.54
Florida	1.64	1.96	1.41	2.57	2.03	3.00
Illinois	1.48	1.25	1.47	2.90	2.47	2.80
Michigan	1.14	2.67	1.27	2.39	2.18	2.77
New York	1.25	1.61	1.55	3.02	2.27	3.33
Ohio	1.05	1.31	1.37	2.01	2.21	2.57
Pennsylvania	1.24	1.83	1.00	2.89	1.93	2.24
Texas	1.21	1.06	1.52	2.39	1.96	2.45
All Other[5]	1.33	1.46	1.32	2.29	2.15	2.44

N/A = Not applicable.

Note: These design effects apply to the following drugs: cigarettes, alcohol, smokeless tobacco, binge drinking, and heavy alcohol use. Binge alcohol use is defined as drinking five or more drinks on the same occasion on at least 1 day in the past 30 days. Occasion means at the same time or within a couple of hours of each other. Heavy alcohol use is defined as drinking five or more drinks on the same occasion on each of 5 or more days in the past 30 days; all heavy alcohol users are also binge alcohol users.

[1]Data on County Type defined as follows:

Large Metropolitan: Counties in metro areas with a population ≥1 million

Small metropolitan I: Counties in metro areas with a population between 250,000 and 1,000,000

Small metropolitan II: Counties in metro areas with a population <250,000

Nonmetropolitan I: Urban Populations not part of metro areas ≥20,000

Nonmetropolitan II: Urban Populations not part of metro areas between 2,500 and 19,999

Nonmetropolitan III: Completely Rural

[2]Data on adult education are not applicable for 12 to 17 year olds.

[3]Data on current employment are not applicable for 12 to 17 year olds.

[4]Retired, disabled, homemaker, student, or "other."

[5]Median of the median design effects for the 43 States.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 6.4 Design Effects, by Age, for the Outcomes Used in the Medians in Tables 6.1, 6.2, and 6.3

Outcome	Age Group 12 to 17	Age Group 18 to 25	Age Group 26+	Total
Illicit Drugs, Lifetime Recency				
Any illicit drug	1.97	2.42	2.35	4.60
Marijuana	1.84	2.38	2.17	4.25
Cocaine	1.90	2.37	1.64	3.40
Crack	1.75	1.69	1.61	3.35
Inhalants	1.82	2.22	1.77	3.15
Hallucinogens	1.68	2.55	1.79	3.58
LSD	1.67	2.37	1.74	3.49
PCP	1.59	1.87	1.54	3.24
Heroin	1.90	1.87	1.90	4.01
Nonmedical use of psychotherapeutics	1.84	2.18	2.14	4.21
Nonmedical use of stimulants	1.94	1.96	1.78	3.69
Nonmedical use of sedatives	1.92	1.81	1.86	4.16
Nonmedical use of tranquilizers	1.82	2.45	2.00	3.91
Nonmedical use of pain relievers	1.75	2.14	2.01	4.04
Any illicit drug except marijuana	1.87	1.99	1.96	3.63
Illicit Drugs, Past Year Recency				
Any illicit drug	2.02	2.14	1.89	3.35
Marijuana	1.83	2.09	1.68	2.80
Cocaine	1.97	2.09	1.47	2.47
Crack	1.84	1.55	1.49	2.90
Inhalants	1.81	1.84	1.64	1.26
Hallucinogens	1.70	2.06	1.20	1.43
LSD	1.95	2.64	1.12	1.17
PCP	1.49	1.50	1.00	1.00
Heroin	2.32	1.72	1.38	2.18
Nonmedical use of psychotherapeutics	1.90	1.82	1.86	3.00
Nonmedical use of stimulants	1.82	2.15	1.38	2.05
Nonmedical use of sedatives	1.88	1.46	2.26	4.02
Nonmedical use of tranquilizers	1.93	1.98	1.74	2.89
Nonmedical use of pain relievers	1.99	1.68	1.93	3.08
Any illicit drug except marijuana	1.92	1.75	1.67	2.49

See notes at end of table. (continued)

Table 6.4 Design Effects, by Age, for the Outcomes Used in the Medians in Tables 6.1, 6.2, and 6.3 (continued)

Outcome	Age Group			Total
	12 to 17	18 to 25	26+	
Illicit Drugs, Past Month Recency				
Any illicit drug	1.89	2.01	1.52	2.44
Marijuana	1.74	2.04	1.34	2.17
Cocaine	2.25	1.68	1.37	2.38
Crack	2.72	1.25	1.06	2.34
Inhalants	1.57	1.65	2.06	1.89
Hallucinogens	1.53	1.86	1.51	1.56
LSD	2.39	1.32	1.00	1.00
PCP	1.45	1.77	1.00	1.18
Heroin	2.30	1.84	1.66	3.02
Nonmedical use of psychotherapeutics	1.79	1.68	1.59	2.51
Nonmedical use of stimulants	1.89	1.78	1.27	1.92
Nonmedical use of sedatives	1.49	1.33	1.40	2.72
Nonmedical use of tranquilizers	1.93	1.83	1.69	2.61
Nonmedical use of pain relievers	1.63	1.93	1.72	2.99
Any illicit drug except marijuana	1.92	1.60	1.54	2.34
Licit Drugs, Lifetime Recency				
Alcohol	1.70	2.69	2.43	4.82
Cigarettes	1.86	2.23	2.01	4.05
Smokeless tobacco	1.49	1.80	1.56	2.99
Licit Drugs, Past Year Recency				
Alcohol	1.78	2.26	2.43	3.82
Cigarettes	2.07	2.26	2.24	4.10
Smokeless tobacco	1.98	2.34	1.72	3.68
Licit Drugs, Past Month Recency				
Alcohol	1.88	2.23	2.46	4.67
Cigarettes	1.82	2.29	2.05	4.06
Smokeless tobacco	1.61	1.97	1.61	2.89
Binge drinking	1.80	2.58	1.95	3.74
Heavy drinking	1.45	2.36	1.51	3.01

Source: SAMHSA, Office of Applied Studies, National Household Survey on Drug Use and Health, 2002.

7. Generalized Variance Functions

7.1. GVF Modeling

For a drug recency-of-use variable, when a median design effect for a domain under investigation is not listed in Tables 6.1, 6.2, or 6.3, an alternative standard error (SE) approximation based on generalized variance function (GVF) is recommended. This approximation uses a prediction equation obtained from modeling the estimated ln(*RSE*) or ln(*CV*). Here, ln(*CV*) is treated as the dependent variable in a linear regression model, and the model parameters are estimated using ordinary least squares. In the years prior to the 1999 National Survey on Drug Use and Health (NSDUH), logs of estimated design effects, ln(*deff*), were modeled. As noted in 1999 (Wheeless, Gordek, & Singh, 2001), with the same set of predictors, it turns out that a transformed log design effect, ln(*RSE*), gives a much higher R^2, although the predicted values, rather interestingly, do not change. It happens because the transformed dependent variable continues to be a linear function of the original variable and the predictor variables. This provides a good justification of the previously used model. Note that Wolter (1985) also suggested modeling ln(*CV*) for obtaining a GVF.

The definition of the design effect is the basis for the regression model that was used for obtaining estimates of the design-based SEs in 1998 and previous years:

$$deff\,(p) = var(p) / \left[p(1-p)/n \right],$$

where

var(*p*)= design-based variance estimate of *p*,

and

$\left[p(1-p)/n \right]$ [*p*(1-*p*)/*n*] = simple random sample (SRS) variance estimate of *p*.

The above equation can be rewritten as

$$CV^2(p) = deff\,(p)\left[(1-p)/np\right].$$

Taking the log of both sides of the above equation leads to the following log-linear model:

$$\ln\left[CV^2(p)\right] = \beta_0 + \beta_1 \ln(p) + \beta_2 \ln(1\text{-}p) + \beta_3 \ln(n), \qquad (5)$$

where

β_0, β_1, β_2, β_3 = regression coefficients for the intercept, ln(*p*), ln(1-*p*), and ln(*n*), respectively.

Here, β_0 corresponds to the ln design effect, which is treated approximately as constant. However, other terms in the model help to pick up departures from this assumption. Notice that the previously used model is given by

$$\ln\left[DEFF\left(p\right)\right] = \beta_0' + \beta_1' \ln\left(p\right) + \beta_2' \ln\left(1- p\right) + \beta_3' \ln(n). \tag{6}$$

Because the dependent variable given by the realized values of the left-hand side of Equation 6 is a linear function of the left-hand side of Equation 5 and the covariates, Equation 6 gives predicted variances identical to model Equation 5. However, it has a much lower R^2 (0.13 vs. 0.98 for illicit, and 0.15 vs. 0.96 for licit). Besides much higher R^2, Equation 5 instead of Equation 6 led to an alternative model given by the following:

$$\log\left[CV^2\left(p\right) - \left(1-p\right)/np\right] = \beta_0'' + \beta_1'' \log\left(p\right) + \beta_2'' \log\left(1- p\right) + \beta_3'' \log(n). \tag{7}$$

The model in Equation 7 has the property that predicted design effects are always greater than 1, although R^2 is somewhat lower, 0.85 for illicit, and 0.79 for licit. This alternative model would be desirable if it is believed that the design is such that effects of clustering and unequal weighting outweigh the effects of stratification. In terms of the closeness to the design-based SEs, there is no clear preference between the predicted SEs based on Equations 5 and 7. However, Equation 5 tends to be conservative relative to Equation 7.

7.2. Model Fitting to NSDUH data

Using the models given in Equations 5 and 7, separate models were fit for the illicit and licit drug recency outcome variables. The input data for the simple regression model fitting consists of *n*, *p*, and $CV^2(p)$, where *n* denotes the total number of data points (i.e., the number of estimates) corresponding to various drug use by domains. For the application, a total of 29,222 (19,831 for illicit, and 9,391 for licit) estimates were used. From these, 2,756 estimates were dropped because of low precision, and 5612 were omitted as the design effect was ≤ 1, resulting in a total of 20,854 estimates overall. It was decided to drop the estimates with design effect ≤ 1 to avoid undue influence of this extreme subset in GVF modeling. This was also desirable because design effect in practice is generally expected to be greater than 1. The total of 29,222 can be obtained from Table 6.2 as 56 drugs times 87 domains including the 51 States times the 6 columns corresponding to age and gender minus 10 empty cells (5 for each illicit and licit) to avoid double counting.

All State estimates, along with the national estimates, were included in model fitting because it would be of interest to see how the GVF model-predicted SEs compared for the large and small States. The possible influence of unstable State estimates on estimated model parameters was avoided by using the suppression rule for low precision estimates. The coefficients of variation (CVs) based on the design effects used to calculate the medians in Tables 6.1, 6.2, and 6.3 were used as part of the input data for model fitting. In the interest of obtaining unique predicted SE for *p* or 1-*p*, values of $p < 0.5$ in the input data were converted to 1-*p* when the model was fit. The estimated regression coefficients for the Models 5 and 7 are shown below.

Beta Coeff	Illicit		Licit	
	Model 5	Model 7	Model 5	Model 7
b_0	0.33336	-1.26295	0.22200	-1.30382
b_1	-1.09492	-0.86759	-1.11094	-0.95894
b_2	1.07659	1.24280	1.08488	1.25255
b_3	-0.92622	-0.77295	-0.90344	-0.75672

A prediction equation for the approximate SE is obtained from Equation 5 as follows:

$$SE_i\left(p\right)_{appx} = \left\{e^{\left(b_{0i}/2\right)} * p^{\left(2+b_{1i}\right)/2} * \left(1-p\right)^{\left(b_{2i}/2\right)} * n^{\left(b_{3i}/2\right)}\right\},$$

where

b_{0i}, b_{1i}, b_{2i}, b_{3i} = estimates of regression coefficients for the intercept, ln(p), ln(1-p), and ln(n), respectively, in Equation 5.

The index -*i* indicates whether the SE approximation is for a licit drug or illicit drug prevalence estimate.

After solving for the regression coefficients, the above approximation reduces to the following two prediction equations:

$$SE\left(p_{illicit}\right)_{appx} = \left[e^{0.33336} * p^{0.90508} * \left(1-p\right)^{1.07659} * n^{-0.92622}\right]^{1/2} \tag{8}$$

and

$$SE\left(p_{licit}\right)_{appx} = \left[e^{0.22200} * p^{0.88906} * \left(1-p\right)^{1.08488} * n^{-0.90344}\right]^{1/2} \tag{9}$$

The corresponding formulas for Model 7 can be similarly obtained. Tables 7.1 and 7.2 present generalized SEs for various percentages (from 1 to 99 percent) and sample sizes (from 100 to 68,126) for the 2002 NSDUH, predicted using Equation 5. The model based on Equation 7 was not used because the model based on Equation 5 was deemed to be favorable as explained in the following paragraph. The entries in the tables marked (*) signify that the corresponding estimates would be suppressed using the rule for low precision given in Section 3.

7.3. GVF Model Diagnostics

Tables 7.3 and 7.4 give an example of the results of the SE estimates using simple random sample (SRS) formulas, SUDAAN, the mean and median design effects using Equation 4 and Tables 6.2 for illicit drugs and 6.3 for licit drugs, and the two GVF models. In this example, the estimates used are the percentage of persons with any illicit drug use in the past year and the percentage using cigarettes in the past year. Results are given for the total, by age, and by race/ethnicity. Observe that in these examples median- and model-based SEs are both overestimating and underestimating the design-based SEs obtained from SUDAAN. Overall the two models (based on Equations 5 and 7), seem to perform quite at par. However, Model 5 may be preferable as it allows for predicted DEFF to be less than 1. Note that GVF results for small States confirm that the direct estimates may be quite unstable because of high SE, and alternative methods based on small area estimation (SAE) techniques for point and interval estimation should be used (see also the comment in Section 6).

The GVF Model 5 was developed using estimates with DEFF >1 that did not meet the suppression criterion. As a further model diagnostic, it was found that for the illicit drug use estimates with DEFF ≤1, the predicted DEFF using this model was always greater than 1. This may be deemed reasonable because estimates with DEFF ≤1 are expected to be associated with low prevalence outcomes that exhibit low clustering effects due to the sample not being large enough. For illicit drug use estimates with DEFF >1, all the predicted DEFF out of a total of 15857 estimates were >1 as expected. Next, for the sake of illustration, Model 5 also was fit using all the illicit drug use estimates (a total of 20,934) with both DEFF ≤or > 1, and it was found that for estimates with DEFF ≤1, more than 46 percent of the predicted DEFF were >1, while for estimates with DEFF >1, about 9 percent of the predicted DEFF were ≤1. This inconsistency is clearly undesirable and lends support to the use of estimates with DEFF >1 in GVF modeling. The results are somewhat similar in the case of licit drugs. For estimates (a total of 535) with DEFF ≤1, and for estimates (a total of 5007) with DEFF >1, the proposed model gave rise to all the predicted DEFF >1. However, when Model 5 was fit using the entire licit drug use estimates (a total of 5542), for estimates with DEFF ≤1, more than 91 percent predicted DEFF were >1, while for estimates with DEFF >1, only half a percent had predicted DEFF ≤1.

More diagnostics for the proposed Model 5 were obtained by checking how often the predicted or GVF model-based RSE of estimates meet low precision criterion. It was found that for estimates meeting suppression criterion with SUDAAN-based RSE, 82 percent of the predicted RSE continued to meet the suppression criterion (i.e., were classified as having low precision). Among the estimates not meeting the suppression criterion but with DEFF ≤1, more than 53 percent of predicted RSEs did not meet the suppression criterion, and among those with DEFF >1, more than 94 percent of predicted RSEs did not meet the suppression criterion. These results indicate that the proposed GVF model behaves reasonably well in view of the fact that the model based predicted DEFF tends to be >1.

7.4. Application of GVF to Mental Health and Substance Abuse Treatment Variables

Since GVF and alternative models considered in this report are based on the idea of constant DEFF over a group of estimates, they should be applicable in general to predict SE for any estimate whose DEFF is similar to the approximately constant DEFF for the group used for the model. It is therefore of interest to check the applicability of GVF modeling to the important set of estimates for Mental Health and Substance Abuse Treatment variables. Tables 7.5a-c and 7.6a-c show a comparison of estimated SEs analogous to Tables 7.3 and 7.4. Methods based on median and mean DEFF were also included in the comparison.

As shown in Table 7.7, various models for SE estimation were compared using mean absolute relative error (MARE) over a set of variables related to Mental Health and Substance Abuse Treatment where SUDAAN SE is used as a benchmark. It is seen that the model based on illicit drug use variables generally works more favorably for the Mental Health and Treatment variables.

Table 7.1 Generalized Standard Errors for Estimated Percentages of Illicit Drug Use Estimates

Sample Size for Base of Percentage, *n*	Estimated Percent (Proportion *p*, Multiplied by 100)								
	1, 99	**2, 98**	**3, 97**	**5, 95**	**10, 90**	**20, 80**	**30, 70**	**40, 60**	**50, 50**
100	1.73*	2.36*	2.82*	3.51*	4.67*	5.99*	6.70*	7.03*	7.05*
300	1.04*	1.42*	1.69	2.11	2.81	3.60	4.03	4.22	4.24
500	0.82*	1.12	1.34	1.67	2.21	2.84	3.18	3.33	3.34
700	0.70	0.96	1.14	1.43	1.90	2.43	2.72	2.85	2.86
900	0.63	0.85	1.02	1.27	1.69	2.17	2.42	2.54	2.55
1,000	0.60	0.81	0.97	1.21	1.61	2.06	2.31	2.42	2.43
1,250	0.54	0.73	0.87	1.09	1.45	1.86	2.08	2.18	2.19
1,500	0.49	0.67	0.80	1.00	1.33	1.71	1.91	2.00	2.01
2,000	0.43	0.59	0.70	0.88	1.17	1.50	1.67	1.75	1.76
2,500	0.39	0.53	0.63	0.79	1.05	1.35	1.51	1.58	1.59
5,000	0.28	0.39	0.46	0.57	0.76	0.98	1.09	1.15	1.15
7,500	0.23	0.32	0.38	0.48	0.63	0.81	0.91	0.95	0.95
10,000	0.21	0.28	0.33	0.42	0.55	0.71	0.79	0.83	0.83
20,000	0.15	0.20	0.24	0.30	0.40	0.52	0.58	0.60	0.61
30,000	0.12	0.17	0.20	0.25	0.33	0.43	0.48	0.50	0.50
40,000	0.11	0.15	0.18	0.22	0.29	0.37	0.42	0.44	0.44
50,000	0.10	0.13	0.16	0.20	0.26	0.34	0.38	0.40	0.40
68,126[1]	0.08	0.11	0.14	0.17	0.23	0.29	0.32	0.34	0.34

Note: Obtained using the model given in Equation 5 for illicit drug recency of use.

[*] The corresponding estimates would suppressed using the rule in Section 3.

[1]The total sample size for the 2002 NSDUH was 68,126.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.2 Generalized Standard Errors for Estimated Percentages of Licit Drug Use Estimates

Sample Size for Base of Percentage, *n*	Estimated Percent (Proportion *p*, Multiplied by 100)								
	1, 99	**2, 98**	**3, 97**	**5, 95**	**10, 90**	**20, 80**	**30, 70**	**40, 60**	**50, 50**
100	1.79*	2.43*	2.89*	3.58*	4.74*	6.05*	6.73*	7.04*	7.04*
300	1.09*	1.48*	1.76	2.18	2.88	3.68	4.10	4.29	4.29
500	0.87*	1.17	1.40	1.73	2.29	2.92	3.26	3.40	3.40
700	0.74	1.01	1.20	1.49	1.97	2.51	2.80	2.92	2.92
900	0.66	0.90	1.07	1.33	1.76	2.24	2.50	2.61	2.61
1,000	0.63	0.86	1.02	1.27	1.67	2.14	2.38	2.49	2.49
1,250	0.57	0.77	0.92	1.15	1.51	1.93	2.15	2.25	2.25
1,500	0.53	0.71	0.85	1.05	1.39	1.78	1.98	2.07	2.07
2,000	0.46	0.63	0.75	0.93	1.22	1.56	1.74	1.82	1.82
2,500	0.42	0.57	0.67	0.84	1.11	1.41	1.57	1.64	1.65
5,000	0.31	0.41	0.49	0.61	0.81	1.03	1.15	1.20	1.20
7,500	0.25	0.34	0.41	0.51	0.67	0.86	0.96	1.00	1.00
10,000	0.22	0.30	0.36	0.45	0.59	0.76	0.84	0.88	0.88
20,000	0.16	0.22	0.26	0.33	0.43	0.55	0.61	0.64	0.64
30,000	0.14	0.18	0.22	0.27	0.36	0.46	0.51	0.54	0.54
40,000	0.12	0.16	0.19	0.24	0.32	0.40	0.45	0.47	0.47
50,000	0.11	0.15	0.17	0.22	0.29	0.37	0.41	0.42	0.43
68,126[1]	0.09	0.13	0.15	0.19	0.25	0.32	0.35	0.37	0.37

Note: Obtained using the model given in Equation 5 for illicit drug recency of use.

[*] The corresponding estimates would suppressed using the rule in Section 3.

[1]The total sample size for the 2002 NSDUH was 68,126.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.3 Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Using Any Illicit Drug in the Past Year, by Age and Race/Ethnicity

	Standard Error Estimates							
Characteristics	**Sample Size**	**Prevalence Percentage**	**SRS**	**Design Based[1]**	**Median DEFF[2]**	**Mean DEFF[3]**	**GVF[4]**	**GVF[5]**
Total	68126	14.94	0.14	0.25	0.21	0.21	0.23	0.24
Age (years)								
12-17	23645	22.19	0.27	0.38	0.37	0.37	0.44	0.46
18-25	23066	35.46	0.32	0.46	0.42	0.42	0.53	0.55
26+	21415	10.39	0.21	0.29	0.26	0.26	0.33	0.33
Race/Ethnicity								
White	47164	14.93	0.16	0.28	0.24	0.24	0.27	0.28
Black	8615	17.04	0.41	0.71	0.61	0.64	0.63	0.63
Hispanic	8811	15.02	0.38	0.73	0.56	0.58	0.59	0.59
Other	3536	10.17	0.51	0.90	0.60	0.71	0.75	0.72
States								
California	3599	17.50	0.63	1.15	0.81	0.82	0.96	0.93
Florida	3653	15.38	0.60	1.05	0.80	0.82	0.90	0.87
Illinois	3729	13.16	0.55	0.79	0.74	0.83	0.83	0.80
Michigan	3792	17.19	0.61	0.96	0.77	0.75	0.93	0.90
New York	3716	15.43	0.59	0.87	0.77	0.76	0.89	0.87
Ohio	3554	15.78	0.61	0.77	0.69	0.74	0.92	0.89
Pennsylvania	3606	12.61	0.55	0.91	0.72	0.72	0.82	0.80
Texas	3649	12.57	0.55	0.71	0.64	0.66	0.82	0.79
Remainder of States[6]	909	15.04	1.18	1.65	1.28	1.50	1.68	1.59

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.4 Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Using Cigarettes in the Past Year, by Age and Race/Ethnicity

	Standard Error Estimates							
Characteristics	**Sample Size**	**Prevalence Percentage**	**SRS**	**Design Based[1]**	**Median DEFF[2]**	**Mean DEFF[3]**	**GVF[4]**	**GVF[5]**
Total	68126	30.33	0.18	0.36	0.34	0.34	0.33	0.35
Age in Years								
12-17	23645	20.35	0.26	0.35	0.35	0.35	0.45	0.46
18-25	23066	49.04	0.33	0.50	0.50	0.50	0.60	0.62
26+	21415	28.47	0.31	0.44	0.44	0.44	0.54	0.55
Race/Ethnicity								
White	47164	31.06	0.21	0.44	0.40	0.40	0.39	0.41
Black	8615	29.56	0.49	0.95	0.96	0.98	0.82	0.82
Hispanic	8811	28.49	0.48	0.99	0.99	0.94	0.80	0.80
Other	3536	26.33	0.74	1.61	1.61	1.60	1.18	1.15
States								
California	3599	24.19	0.71	1.13	1.14	1.20	1.13	1.10
Florida	3653	28.54	0.75	1.44	1.29	1.30	1.20	1.17
Illinois	3729	31.79	0.76	1.47	1.28	1.30	1.23	1.20
Michigan	3792	32.69	0.76	1.37	1.27	1.18	1.24	1.20
New York	3716	30.82	0.76	1.38	1.38	1.31	1.22	1.19
Ohio	3554	35.45	0.80	1.16	1.29	1.28	1.30	1.27
Pennsylvania	3606	31.81	0.78	1.16	1.16	1.21	1.25	1.22
Texas	3649	29.15	0.75	1.18	1.18	1.20	1.21	1.18
Remainder of States[6]	909	31.07	1.53	2.46	2.40	2.52	2.31	2.19

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.5a Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Having Serious Mental Illness (SMI), by Age and Race/Ethnicity (18+)

Characteristics	Standard Error Estimates											
	Sample Size	Prevalence Percentage	SRS	Design Based[1]	Median DEFF[2]		Mean DEFF[3]		GVF[4]		GVF[5]	
					licit	illicit	licit	illicit	licit	illicit	licit	illicit
Total	44481	8.31	0.13	0.21	0.26	0.20	0.26	0.20	0.22	0.21	0.22	0.22
Age in Years												
12-17	.	.	.	.	.	.	.	.	.	.	.	.
18-25	23066	13.17	0.22	0.30	0.34	0.30	0.34	0.30	0.37	0.35	0.38	0.36
26+	21415	7.47	0.18	0.24	0.25	0.22	0.25	0.22	0.29	0.28	0.29	0.28
Race/Ethnicity												
White	31293	8.50	0.16	0.25	0.29	0.23	0.30	0.23	0.26	0.25	0.26	0.25
Black	5302	8.74	0.39	0.66	0.76	0.58	0.77	0.61	0.59	0.58	0.57	0.56
Hispanic	5547	6.85	0.34	0.58	0.70	0.50	0.66	0.52	0.52	0.50	0.49	0.48
Other	2339	8.13	0.57	1.14	1.23	0.67	1.22	0.79	0.83	0.81	0.79	0.78
States												
California	2298	6.80	0.53	0.63	0.84	0.67	0.88	0.68	0.76	0.75	0.72	0.71
Florida	2439	8.11	0.55	0.83	0.96	0.74	0.96	0.76	0.81	0.79	0.77	0.76
Illinois	2427	7.25	0.53	0.79	0.88	0.70	0.90	0.79	0.77	0.75	0.73	0.72
Michigan	2494	7.66	0.53	0.67	0.89	0.67	0.83	0.66	0.78	0.76	0.74	0.73
New York	2482	9.45	0.59	0.92	1.07	0.76	1.02	0.75	0.87	0.85	0.83	0.82
Ohio	2335	9.93	0.62	0.92	0.99	0.70	0.99	0.74	0.92	0.90	0.87	0.86
Pennsylvania	2362	7.67	0.55	0.87	0.82	0.71	0.86	0.71	0.80	0.78	0.76	0.75
Texas	2425	6.94	0.52	0.56	0.81	0.60	0.82	0.62	0.75	0.74	0.71	0.70
Remainder[6]	591	8.86	1.16	1.53	1.83	1.26	1.92	1.48	1.60	1.59	1.51	1.50

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.5b Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Having Received Prescription Medicine for Mental Health Treatment in the Past Year (AMHRX2), by Age and Race/Ethnicity (18+)

Characteristics	Standard Error Estimates											
	Sample Size	Prevalence Percentage	SRS	Design Based[1]	Median DEFF[2]		Mean DEFF[3]		GVF[4]		GVF[5]	
					licit	illicit	licit	illicit	licit	illicit	licit	illicit
Total	44410	10.48	0.15	0.25	0.28	0.23	0.28	0.22	0.25	0.23	0.25	0.24
Age in Years												
12-17	.	.	.	.	.	.	.	.	.	.	.	.
18-25	23033	7.47	0.17	0.22	0.26	0.23	0.26	0.23	0.28	0.27	0.28	0.27
26+	21377	11.00	0.21	0.29	0.30	0.26	0.30	0.26	0.35	0.34	0.35	0.34
Race/Ethnicity												
White	31257	12.15	0.18	0.32	0.35	0.27	0.35	0.27	0.31	0.30	0.32	0.31
Black	5290	6.08	0.33	0.53	0.64	0.49	0.65	0.52	0.49	0.48	0.47	0.46
Hispanic	5533	6.10	0.32	0.54	0.66	0.47	0.63	0.49	0.49	0.47	0.46	0.46
Other	2330	6.88	0.52	1.35	1.14	0.62	1.14	0.73	0.76	0.75	0.72	0.71
States												
California	2294	9.01	0.60	0.79	0.95	0.76	1.00	0.78	0.88	0.86	0.84	0.82
Florida	2436	9.99	0.61	0.81	1.05	0.81	1.06	0.83	0.90	0.88	0.86	0.85
Illinois	2421	9.34	0.59	1.00	0.99	0.79	1.01	0.89	0.88	0.85	0.83	0.82
Michigan	2488	10.92	0.63	0.75	1.04	0.78	0.97	0.77	0.93	0.91	0.89	0.88
New York	2478	10.01	0.60	1.20	1.10	0.78	1.05	0.77	0.90	0.87	0.86	0.84
Ohio	2332	10.85	0.64	0.94	1.03	0.73	1.03	0.78	0.96	0.94	0.91	0.90
Pennsylvania	2357	9.98	0.62	0.92	0.92	0.80	0.97	0.80	0.92	0.89	0.87	0.86
Texas	2422	9.07	0.58	0.73	0.91	0.68	0.93	0.70	0.86	0.84	0.82	0.81
Remainder[6]	591	11.58	1.30	1.76	2.06	1.42	2.17	1.66	1.81	1.80	1.71	1.69

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.5c Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Having Received Mental Health Treatment in Past Year Because Felt Depressed (REASDEPR), by Age and Race/Ethnicity (12-17)

Characteristics	Standard Error Estimates											
	Sample Size	Prevalence Percentage	SRS	Design Based[1]	Median DEFF[2]		Mean DEFF[3]		GVF[4]		GVF[5]	
					licit	illicit	licit	illicit	licit	illicit	licit	illicit
Total	3885	49.49	0.80	1.05	1.57	1.25	1.56	1.22	1.35	1.29	1.31	1.25
Age in Years												
12-17	3885	49.49	0.80	1.05	1.08	1.10	1.07	1.10	1.35	1.29	1.31	1.25
18-25	.	.	.	.	.	.	.	.	.	.	.	.
26+	.	.	.	.	.	.	.	.	.	.	.	.
Race/Ethnicity												
White	2663	51.39	0.97	1.23	1.81	1.43	1.84	1.41	1.59	1.54	1.53	1.47
Black	535	40.69	2.12	2.68	4.16	3.19	4.22	3.37	3.18	3.13	2.99	2.91
Hispanic	507	51.03	2.22	3.16	4.56	3.25	4.34	3.40	3.37	3.32	3.14	3.06
Other	180	45.23	3.71	5.91	8.05	4.39	8.03	5.19	5.33	5.30	4.93	4.84
States												
California	195	45.56	3.57	4.80	5.68	4.53	5.98	4.63	5.14	5.11	4.76	4.67
Florida	191	43.17	3.58	4.05	6.20	4.79	6.24	4.90	5.14	5.11	4.77	4.68
Illinois	211	49.55	3.44	3.64	5.76	4.58	5.88	5.18	5.02	4.98	4.63	4.53
Michigan	252	50.02	3.15	2.83	5.24	3.94	4.90	3.88	4.64	4.59	4.28	4.18
New York	215	45.91	3.40	4.12	6.20	4.42	5.89	4.34	4.93	4.89	4.56	4.47
Ohio	173	44.74	3.78	3.39	6.06	4.27	6.05	4.55	5.41	5.39	5.01	4.92
Pennsylvania	197	51.44	3.56	3.20	5.33	4.62	5.57	4.64	5.17	5.13	4.77	4.67
Texas	189	48.76	3.64	3.18	5.69	4.24	5.80	4.39	5.27	5.23	4.86	4.76
Remainder[6]	59.5	51.78	6.46	5.93	10.13	6.98	10.66	8.18	8.81	8.87	8.14	8.03

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.6a Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Having Received Treatment from any Location for Alcohol or Drugs - Past Year (TXILLALC), by Age and Race/Ethnicity

	Standard Error Estimates											
					Median DEFF[2]		Mean DEFF[3]		GVF[4]		GVF[5]	
Characteristics	**Sample Size**	**Prevalence Percentage**	**SRS**	**Design Based[1]**	**licit**	**illicit**	**licit**	**illicit**	**licit**	**illicit**	**licit**	**illicit**
Total	68126	1.48	0.05	0.08	0.09	0.07	0.09	0.07	0.07	0.07	0.07	0.07
Age in Years												
12-17	23645	1.49	0.08	0.11	0.11	0.11	0.10	0.11	0.12	0.11	0.11	0.11
18-25	23066	2.21	0.10	0.12	0.15	0.13	0.15	0.13	0.15	0.14	0.14	0.14
26+	21415	1.35	0.08	0.09	0.11	0.10	0.11	0.10	0.12	0.11	0.11	0.11
Race/Ethnicity												
White	47164	1.44	0.05	0.09	0.10	0.08	0.10	0.08	0.09	0.08	0.08	0.08
Black	8615	2.26	0.16	0.30	0.31	0.24	0.32	0.25	0.24	0.23	0.22	0.22
Hispanic	8811	1.27	0.12	0.17	0.25	0.17	0.23	0.18	0.17	0.17	0.16	0.16
Other	3536	0.82	0.15	0.25	0.33	0.18	0.33	0.21	0.21	0.20	0.19	0.19
States												
California	3599	1.33	0.19	0.20	0.30	0.24	0.32	0.25	0.26	0.26	0.25	0.24
Florida	3653	1.66	0.21	0.35	0.37	0.28	0.37	0.29	0.29	0.29	0.28	0.27
Illinois	3729	1.26	0.18	0.29	0.31	0.24	0.31	0.27	0.25	0.25	0.24	0.23
Michigan	3792	1.91	0.22	0.29	0.37	0.28	0.35	0.27	0.31	0.31	0.29	0.29
New York	3716	1.39	0.19	0.27	0.35	0.25	0.33	0.25	0.27	0.26	0.25	0.25
Ohio	3554	1.64	0.21	0.27	0.34	0.24	0.34	0.26	0.30	0.29	0.28	0.27
Pennsylvania	3606	1.30	0.19	0.26	0.28	0.24	0.29	0.25	0.26	0.26	0.24	0.24
Texas	3649	1.00	0.17	0.19	0.26	0.19	0.26	0.20	0.23	0.22	0.21	0.21
Remainder[6]	909	1.60	0.41	0.51	0.65	0.45	0.68	0.53	0.54	0.53	0.50	0.50

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.6b Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Having Received Last/Current Treatment for Marijuana (TXLTMJ2), by Age and Race/Ethnicity

	Standard Error Estimates												
					Median DEFF[2]		Mean DEFF[3]		GVF[4]		GVF[5]		
Characteristics	Sample Size	Prevalence Percentage	SRS	Design Based[1]	licit	illicit	licit	illicit	licit	illicit	licit	illicit	
Total	68126	0.41	0.02	0.04	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.03	
Age in Years													
12-17	23645	0.82	0.06	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.08	
18-25	23066	0.85	0.06	0.08	0.09	0.08	0.09	0.08	0.09	0.09	0.08	0.08	
26+	21415	0.28	0.04	0.05	0.05	0.04	0.05	0.04	0.05	0.05	0.05	0.05	
Race/Ethnicity													
White	47164	0.39	0.03	0.05	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	
Black	8615	0.66	0.09	0.15	0.17	0.13	0.17	0.14	0.12	0.12	0.11	0.11	
Hispanic	8811	0.34	0.06	0.08	0.13	0.09	0.12	0.10	0.08	0.08	0.08	0.08	
Other	3536	0.31	0.09	0.11	0.20	0.11	0.20	0.13	0.12	0.12	0.11	0.11	
States													
California	3599	0.35	0.10	0.10	0.16	0.13	0.17	0.13	0.13	0.13	0.12	0.12	
Florida	3653	0.61	0.13	0.21	0.22	0.17	0.22	0.18	0.17	0.17	0.16	0.16	
Illinois	3729	0.32	0.09	0.12	0.15	0.12	0.16	0.14	0.12	0.12	0.11	0.11	
Michigan	3792	0.60	0.13	0.14	0.21	0.16	0.20	0.15	0.17	0.17	0.16	0.16	
New York	3716	0.35	0.10	0.09	0.18	0.13	0.17	0.12	0.13	0.12	0.12	0.12	
Ohio	3554	0.66	0.14	0.15	0.22	0.15	0.22	0.16	0.18	0.18	0.17	0.17	
Pennsylvania	3606	0.30	0.09	0.09	0.14	0.12	0.14	0.12	0.12	0.12	0.11	0.11	
Texas	3649	0.24	0.08	0.11	0.13	0.09	0.13	0.10	0.10	0.10	0.10	0.10	
Remainder[6]	908	0.41	0.19	0.17	0.33	0.23	0.35	0.27	0.23	0.24	0.22	0.22	

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.6c Comparison of Simple Random Sample, Design-Based (SUDAAN), Median Design Effects, Mean Design Effects, and Generalized Variance Functions (GVFs) for Estimating the Standard Errors for Percentages Having Needed Alcohol Treatment, but not Receiving Treatment at a Specialty Facility - Past Year (TXGAPALC), by Age and Race/Ethnicity

	Standard Error Estimates												
	Sample Size	Prevalence Percentage	SRS	Design Based[1]	Median DEFF[2]		Mean DEFF[3]		GVF[4]		GVF[5]	
Characteristics					licit	illicit	licit	illicit	licit	illicit	licit	illicit
Total	68126	7.27	0.10	0.17	0.19	0.15	0.19	0.15	0.17	0.16	0.17	0.17
Age in Years												
12-17	23645	5.55	0.15	0.20	0.20	0.20	0.20	0.21	0.24	0.23	0.24	0.23
18-25	23066	17.13	0.25	0.36	0.37	0.33	0.37	0.33	0.42	0.40	0.43	0.41
26+	21415	5.80	0.16	0.21	0.23	0.20	0.23	0.20	0.26	0.25	0.25	0.25
Race/Ethnicity												
White	47164	7.38	0.12	0.20	0.23	0.18	0.23	0.18	0.20	0.19	0.21	0.20
Black	8615	6.69	0.27	0.50	0.53	0.40	0.54	0.43	0.42	0.40	0.40	0.39
Hispanic	8811	8.14	0.29	0.50	0.60	0.43	0.57	0.45	0.46	0.44	0.44	0.43
Other	3536	4.85	0.36	0.65	0.78	0.43	0.78	0.51	0.53	0.51	0.50	0.49
States												
California	3599	6.86	0.42	0.62	0.67	0.54	0.71	0.55	0.63	0.61	0.60	0.59
Florida	3653	6.53	0.41	0.64	0.71	0.55	0.71	0.56	0.61	0.59	0.58	0.57
Illinois	3729	8.40	0.45	0.58	0.76	0.60	0.78	0.68	0.68	0.66	0.65	0.64
Michigan	3792	9.27	0.47	0.71	0.78	0.59	0.73	0.58	0.71	0.69	0.68	0.67
New York	3716	7.35	0.43	0.69	0.78	0.56	0.74	0.55	0.64	0.62	0.61	0.60
Ohio	3554	7.46	0.44	0.62	0.71	0.50	0.70	0.53	0.66	0.64	0.63	0.62
Pennsylvania	3606	6.07	0.40	0.58	0.59	0.52	0.62	0.52	0.59	0.57	0.56	0.55
Texas	3649	7.93	0.45	0.66	0.70	0.52	0.71	0.54	0.67	0.65	0.64	0.63
Remainder[6]	909	7.68	0.89	1.29	1.38	0.95	1.45	1.12	1.24	1.23	1.17	1.16

[1] Calculated using SUDAAN—with replacement variance.
[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$-(1-p)/np] (Equation 7).
[6] Calculated as median of the 43 State estimates.

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

Table 7.7 Mean Absolute Relative Error (MARE[1] in %) over Mental Health and Substance Abuse Treatment Variables for Different Models for SE

Variable	Type	Median[2]	Mean[3]	GVF1[4]	GVF2[5]
SMI	Illicit	12.21	9.77	11.81	12.93
	Licit	18.18	18.00	12.67	13.43
AMHRX2	Illicit	15.03	12.07	13.92	14.04
	Licit	15.82	16.61	13.97	13.98
REASDEPR	Illicit	20.40	23.08	32.54	24.25
	Licit	53.10	53.52	34.20	26.52
TXILLALC	Illicit	10.43	8.71	12.17	12.07
	Licit	22.04	22.41	12.47	12.04
TXLTMJ2	Illicit	13.33	16.92	15.92	13.58
	Licit	39.51	39.90	16.74	13.67
TXGAPALC	Illicit	14.85	13.37	8.89	10.31
	Licit	11.25	11.49	9.03	10.34

[1] Calculated as the average of the absolute difference between estimated and SUDAAN-based standard errors from Tables 7.5a-7.6c

[2] Calculated using Equation 4 and the domain-specific median design effects of Table 6.2.
[3] Calculated using Equation 4 and domain-specific mean design effects.
[4] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)$] (Equation 5).
[5] Calculated as predicted SEs from the GVF function based on ln [$CV^2(p)-(1-p)/np$] (Equation 7).

Source: SAMHSA, Office of Applied Studies, National Survey on Drug Use and Health, 2002.

8. Conclusion

As stated in the Introduction, as part of any survey data analysis, it is important to have a good understanding of the resulting standard errors (SEs) and design effects (DEFFs) corresponding to a set of key outcome variables and other variables. One reason for this is to evaluate how well the sample was designed in light of the target and realized precisions and design effects. The 2002 National Survey on Drug Use and Health (NSDUH) met its precision goals for 13 of the 17 target domains defined by five age groups (12 to 17, 18 to 25, 26 to 34, 35 or older, and total (i.e., 12 or older)) crossed by four race/Hispanicity groups (Hispanic, black, white, and total). Three domains corresponding to the combined age group for Hispanic, black, and white were excluded because the corresponding target SEs were not specified. For all race/Hispanicity groups except the total, in the 26 to 34 year old age group, the RSE was moderately off (i.e., worse) compared with the target. Reasons for not meeting the precision are partly due to the planned smaller sample size for the 26 to 34 age group and partly due to larger design effect relative to the value projected in the sample design plan.

Another important reason for the examination of SEs and DEFFs is to obtain quick estimates of SEs for any user-specified outcome variable through some form of modeling. Although SEs of several prevalence estimates are available from published analysis reports on the survey, SEs of other estimates of interest by the user may not be available in the published tables. If the user has access to the primary data source, the user can compute the SE using commercially available software such as SUDAAN. However, often the user has access to only a secondary data source. For this case, it would be useful to have a provision for computing quick and approximate SEs. If the secondary data source contains information about median design effects (over a set of drug use variables) for selected demographic domains such as age and race/ethnicity, then a rough approximate SE can be easily obtained using the formula (Equation 4) for variance as a function of DEFF, domain sample size, and the prevalence estimate. The formula is:

$$var\left(p_d\right)_{appx} = DEFF_{d,MED} * \left[p_d \left(1 - p_d\right) n_d \right],$$

Note that the use of a known median DEFF in place of a variable-specific unknown DEFF provides a simple type of modeling. One could also use mean DEFF instead of median DEFF. This report contains tables showing median and mean DEFFs for a number of domains. The differences are generally small.

The above simple way of modeling SE via median deff is not applicable if the available median DEFF does not correspond to the domain of interest. In general, a better approach to modeling SE is provided by generalized variance functions (GVF). By modeling the logarithm of RSE as a linear function of the logarithms of the prevalence estimates, the complement of the prevalence estimates, and the domain sample size, the following formulas (Equations 8 and 9) can be used for approximating SEs of estimates of illicit and licit drug recency of use.

$$SE\left(p_{illicit}\right)_{appx} = \left[e^{0.33336} * p^{0.90508} * \left(1-p\right)^{1.07659} * n^{-0.92622}\right]^{1/2}$$

$$SE\left(p_{illicit}\right)_{appx} = \left[e^{0.222000} * p^{0.88906} * \left(1-p\right)^{1.08488} * n^{-0.90344}\right]^{1/2}$$

In summary, the user may obtain SE estimates for the 2002 NSDUH for drug recency outcomes from the following in recommended order sources:

1. commercially available variance estimation software packages, such as SUDAAN; otherwise,
2. published SEs from reports using data from the 2002 NSDUH (available at http://www.drugabusestatistics.samhsa.gov/ or upon request from the Office of Applied Studies at Substance Abuse and Mental Health Services Administration); otherwise,
3. median domain design effects appearing in Tables 6.1, 6.2, and 6.3 and application of Equation 4 for drug recency of use; otherwise,
4. model-based prediction for national and the eight large State estimates for drug recency of use, via Equations 8 and 9 for illicit and licit drugs respectively.

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