2021
National Survey on Drug Use and Health: Guide to State Tables and Summary of Small Area Estimation Methodology

Section A: Overview of NSDUH and Model-Based State Estimates

A.1 Introduction

This document provides information on the model-based small area estimates of substance use and mental health disorders in states based on data from the 2021 National Survey on Drug Use and Health (NSDUH). These estimates are available online along with other related information.[1]

NSDUH is an annual survey of the civilian, noninstitutionalized population aged 12 or older, conducted from January through December, and is sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA). The survey collects information from individuals residing in households, noninstitutionalized group quarters (e.g., shelters, rooming houses, dormitories), and civilians living on military bases. The 2021 NSDUH used multimode data collection, in which respondents completed the survey via the web or in person in eligible locations.[2] In 2021, NSDUH collected data from 69,850 respondents aged 12 or older.

NSDUH is planned and managed by SAMHSA's Center for Behavioral Health Statistics and Quality (CBHSQ). Data collection and analysis are conducted under contract with RTI International.[3] A summary of NSDUH's methodology is given in Section A.2. Section A.3 lists all the tables and files associated with the 2021 state estimates. Section A.4 provides details on the suppression criteria used for suppressing the estimates. Information is given in Section A.5 on the confidence intervals and margins of error and how to make interpretations with respect to the small area estimates. Section A.6 discusses related substance use measures and warns users about not drawing conclusions by subtracting small area estimates from two different measures. Section A.7 briefly discusses methodological changes for the 2021 NSDUH.

The survey-weighted hierarchical Bayes (SWHB) small area estimation (SAE) methodology used in the production of state estimates from the 1999 to 2019[4] surveys also was used in the production of the 2021 state estimates. The SWHB methodology is described in Appendix E of the 2001 state report (Wright, 2003b) and in Folsom and colleagues (1999). A general model description is given in Section B.1 of this document. A list of measures

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[1] Use the NSDUH link on the following webpage: https://www.samhsa.gov/data/nsduh/state-reports-NSDUH-2021.

[2] Eligibility of areas for in-person data collection was determined by state- and county-level COVID-19 metrics collected by Johns Hopkins University (Center for Systems Science and Engineering, Johns Hopkins University, 2021) (see Section 2.2.1 of the *2021 National Survey on Drug Use and Health (NSDUH): Methodological Summary and Definitions* report [CBHSQ, 2022b]).

[3] RTI International is a trade name of Research Triangle Institute. RTI and the RTI logo are U.S. registered trademarks of Research Triangle Institute.

[4] The 2019-2020 State SAEs were produced, but they have since been removed from SAMHSA's website. Methodological investigations found that the unusual societal circumstances in 2020 and the resulting methodological revisions to NSDUH data collection have affected the comparability of 2020 estimates with estimates from 2019 and earlier. Consequently, estimates that involve combining data from 2020 with previous years have been removed from the SAMHSA website.

(outcomes) for which small area estimates are produced is given in Section B.2. Predictors used in the 2021 SAE modeling are listed and described in Section B.3. Selection of predictors for SAE modeling is described in Section B.4.

Small area estimates obtained using the SWHB methodology are design consistent (i.e., the small area estimates for states with large sample sizes are close to the robust design-based estimates). Additionally, the national small area estimates[5] are very close to the national design-based estimates. However, to ensure internal consistency, it is desirable to have the national small area estimates exactly match the national design-based estimates. This process is called "benchmarking." The benchmarked state-level estimates are also potentially less biased than the unbenchmarked state-level estimates. Beginning in 2002, exact benchmarking was introduced, as described in Section B.5.[6] Tables of the estimated numbers of individuals associated with each measure are available online,[7] and an explanation of how these counts and their respective Bayesian confidence intervals[8] are calculated can be found in Section B.6. Section B.7 discusses the method to compute aggregated estimates by combining two age groups. The definition and explanation of the formula used in estimating the marijuana initiation rate are given in Section B.8. Note that, unlike the other outcomes discussed in this document, marijuana initiation is calculated as a ratio of two measures.

State estimates for the age groups 12 to 17, 18 to 25, 26 or older, 18 or older, and 12 or older[9] are provided for all measures except any mental illness (AMI), serious mental illness (SMI), receipt of mental health services, major depressive episode (MDE; i.e., depression), serious thoughts of suicide, suicide plans, and suicide attempts. Additionally, estimates for youths aged 12 to 17 are not available for past year heroin use because heroin use in the past year for youths aged 12 to 17 was extremely rare in the 2021 NSDUH. As a result, estimates of past year heroin for people aged 12 or older are also not produced.

Estimates of underage (aged 12 to 20) alcohol use and binge alcohol use were also produced.[10] Alcohol consumption is expected to differ significantly across the 18 to 25 age group because of the legalization of alcohol at age 21. Therefore, it was decided that it would be useful to produce small area estimates for people aged 12 to 20. A short description of the methodology used to produce underage drinking estimates is provided in Section B.9.

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[5] *National small area estimates = Population-weighted averages of state-level small area estimates*.

[6] The census region-level estimates in the tables are population-weighted aggregates of the state estimates. The published national estimates, however, are benchmarked to exactly match the design-based estimates.

[7] See Tables 1 to 35 in *2021 National Survey on Drug Use and Health: Model-Based Estimated Totals (in Thousands) (50 States and the District of Columbia)* (CBHSQ, forthcoming b).

[8] Note that in the 2004-2005 NSDUH state report (Wright et al., 2007) and prior reports, the term "prediction interval" (PI) was used to represent uncertainty in the state and regional estimates. However, that term also is used in other applications to estimate future values of a parameter of interest. That interpretation does not apply to NSDUH state report estimates; thus, "prediction interval" was dropped and replaced with "Bayesian confidence interval."

[9] For major depressive episode, estimates for people aged 12 or older are not included. For any mental illness, serious mental illness, receipt of mental health services, thoughts of suicide, suicide plans, and suicide attempts, estimates for youths aged 12 to 17 and people aged 12 or older are not included because youths are not asked these questions.

[10] Binge drinking is defined as having five or more drinks (for males) or four or more drinks (for females) on the same occasion on at least 1 day in the 30 days prior to the survey.

The remainder of Section B covers four additional topics:

- Section B.10 discusses marijuana vaping and its impact on marijuana and marijuana related outcomes.
- Section B.11 discusses the criteria used to define substance use disorder (SUD).
- Section B.12 discusses the definition for the needing but not receiving treatment outcomes.
- Section B.13 discusses the production of estimates for AMI, SMI, MDE (i.e., depression), and suicidal behaviors.

In Section C, the 2021 survey sample sizes, response rates, and population estimates are included in Tables C.1 to C.3, respectively.

A.2 Summary of NSDUH Methodology

NSDUH is the primary source of statistical information on the use of tobacco, alcohol, prescription pain relievers, and other substances (e.g., marijuana, cocaine) by the U.S. civilian, noninstitutionalized population aged 12 or older. The survey also includes several series of questions that focus on mental health issues. NSDUH has been ongoing since 1971 and is conducted by the federal government. The survey collects information from residents of households and noninstitutional group quarters (e.g., shelters, rooming houses, dormitories) and from civilians living on military bases. NSDUH excludes homeless people who do not use shelters, military personnel on active duty, and residents of institutional group quarters, such as jails and hospitals. From 1999 to 2019, the data were collected via face-to-face (in-person) interviews at a respondent's place of residence using a combination of computer-assisted personal interviewing conducted by an interviewer and audio computer-assisted self-interviewing. Because of the coronavirus disease 2019 (COVID-19) pandemic, an additional web data collection mode was introduced to the 2020 NSDUH and continued to be used in the 2021 survey.

SAMHSA suspended in-person data collection on the 2020 NSDUH on March 16, 2020, because of the COVID-19 pandemic, a situation that affected virtually all national surveys that collect data in person, including NSDUH. A small-scale data collection effort was conducted in July 2020 to test protocols to reduce the risk of COVID-19 infection through in-person data collection. Because of ongoing COVID-19 infection rates in the United States, however, it became evident that a return to full-scale in-person data collection would not be feasible for obtaining a representative sample with a sufficient number of interviews to produce national estimates with acceptable precision for people aged 12 or older. Therefore, SAMHSA approved multimode data collection (in-person and web-based data collection) for the 2020 NSDUH beginning in Quarter 4. In-person data collection resumed on October 1, 2020 (in locations where COVID-19 infection metrics were sufficiently low), and web-based data collection began on October 30, 2020. Therefore, in addition to the collection of data through multiple survey modes in 2020, there was a gap in full-scale data collection between Quarters 1 and 4. Detailed descriptions of the methodological changes to the 2020 NSDUH because of the COVID-19 pandemic are provided in Section A.7 of this document and in Chapters 2, 3, and 6 of the *2020*

National Survey on Drug Use and Health (NSDUH): Methodological Summary and Definitions report (CBHSQ, 2021b).

The 2021 sample was selected using the coordinated sample design developed for the 2014 through 2022 NSDUHs. The coordinated sample design is state based, with an independent, multistage area probability sample within each state and the District of Columbia. This design designates 12 states as large sample states. These 12 states have the following target sample sizes per year: 4,560 interviews in California; 3,300 interviews in Florida, New York, and Texas; 2,400 interviews in Illinois, Michigan, Ohio, and Pennsylvania; and 1,500 interviews in Georgia, New Jersey, North Carolina, and Virginia. Making the sample sizes more proportional to the state population sizes improves the precision of national NSDUH estimates. This change also allows for a more cost-efficient sample allocation to the largest states while slightly increasing the sample sizes in smaller states to improve the precision of state estimates (note that the target sample size per year in the small states is 960 interviews, except for Hawaii, where the target sample size is 967 interviews). The fielded sample sizes for each state in 2021 are provided in Table C.1.

Nationally in 2021, a total of approximately 220,740 addresses were screened, and individuals responded within the screened addresses (see Table C.1). The weighted screening response rate (SRR) for 2021 was 22.2 percent, and the weighted interview response rate (IRR) was 46.2 percent, for an overall weighted response rate (ORR) of 10.3 percent (Table C.1). The ORRs for 2021 ranged from 7.1 percent in New Jersey to 18.6 percent in Vermont. Estimates have been adjusted to reflect the probability of selection, unit nonresponse, poststratification to known census population estimates, item imputation, and other aspects of the estimation process. These procedures are described in detail in *2021 National Survey on Drug Use and Health: Methodological Resource Book* (CBHSQ, 2022a).

All sampled households are screened to confirm eligibility and to select zero, one, or two household members to participate in the survey. The weighted SRR is defined as the weighted number of successfully screened households (or dwelling units)[11] divided by the weighted number of eligible households, or

$$SRR = \frac{\sum w_{hh} complete_{hh}}{\sum w_{hh} eligible_{hh}},$$

where w_{hh} is the inverse of the unconditional probability of selection for the household (*hh*) and excludes all adjustments for nonresponse and poststratification.

In successfully screened households, eligible household members who were selected were asked to complete the interview. The weighted IRR for NSDUH is defined as the weighted number of respondents divided by the weighted number of selected people, or

[11] A successfully screened household is one in which all screening questionnaire items were answered by an adult resident of the household and either zero, one, or two household members were selected for the NSDUH interview.

$$IRR = \frac{\sum w_i complete_i}{\sum w_i selected_i},$$

where w_i is the inverse of the probability of selection for the *i*th person and includes household-level nonresponse and poststratification adjustments. To be considered a completed interview, a respondent must provide enough data to pass the usable case rule.[12]

The weighted ORR is defined as the product of the weighted SRR and the weighted IRR or

$$ORR = SRR \times IRR.$$

For more details on the screening and response rates, see Section 3.3.1 in 2021 Methodological Resource Book (CBHSQ, 2022a).

A.3 Presentation of Data

This section lists all products associated with the 2021 state estimates. All estimates are based on data from the 2021 NSDUH only. Historically, starting with the 2002-2003 state report through the 2018-2019 state report, the state estimates have been produced by pooling two years of NSDUH data except for the 2002 state report where estimates were based only on 2002 data. The pooling of a current year's data with a previous year's data to produce state estimates was recommended by an SAE expert panel[13] to increase the precision of year-to-year change estimates (e.g., 2017-2018 vs. 2018-2019). The panel also noted that a single year of NSDUH data is sufficient to produce reliable state estimates.

As mentioned in Section A.2, there was a gap in full-scale data collection between Quarters 1 and 4 of 2020 due to COVID-19, which made the 2020 data not comparable with any other year. It is anticipated that 2021 will become a new baseline for monitoring NSDUH trends, and as a result, state estimates presented here are based on 2021 data alone and are not compared with prior state estimates.

The following products exclude age groups 12 to 17 and 12 or older for past year heroin use because in 2021 heroin use among youth was very rare. Additionally, a suppression rule was applied to the state SAEs and suppressed estimates are noted by an asterisk (*) in the various tables discussed below. Information about the suppression criteria can be found in Section A.4.

[12] The usable case rule requires that a respondent answer "yes" or "no" to the question on lifetime use of cigarettes and "yes" or "no" to at least nine additional lifetime use questions.

[13] The SAE expert panel, convened in 1999 and 2000, had six members: Dr. William Bell of the U.S. Bureau of the Census; Partha Lahiri, Professor of the Joint Program in Survey Methodology at the University of Maryland at College Park; Professor Balgobin Nandram of Worcester Polytechnic Institute; Wesley Schaible, formerly Associate Commissioner for Research and Evaluation at the Bureau of Labor Statistics; Professor J. N. K. Rao of Carleton University; and Professor Alan Zaslavsky of Harvard University.

In addition to this methodology document for the 2021 state estimates, the following products are available at https://www.samhsa.gov/data/nsduh/state-reports-NSDUH-2021:

- **2021 NSDUH: Model-Based Prevalence Estimates (50 States and the District of Columbia) (Tables 1 to 35, by Age Group)**: Tables of percentages and associated 95 percent Bayesian confidence intervals are included for youths aged 12 to 17, young adults aged 18 to 25, adults aged 26 or older, adults aged 18 or older, and all people aged 12 or older. Also included are tables for underage (12 to 20) alcohol use and underage binge alcohol use. These tables are available in Excel and PDF formats. Suppressed estimates are noted by an asterisk (*) in the tables (see Section A.4 for more information).
- **2021 NSDUH National Maps of Prevalence Estimates, by State (Figures 1a to 35c)**: The color of each state on these U.S. maps indicates how the state ranks relative to other states for each measure. States could fall into one of five groups according to their ranking by quintiles. Because 51 states were ranked for each measure, the middle quintile was assigned to 11 states, and the remaining quintiles were assigned 10 states each. In some cases, a "quintile" could have more or fewer states than desired because two (or more) states had the same estimate (to two decimal places). When such ties occurred at the "boundary" between two quintiles, all the states with the same estimate were conservatively assigned to the lower quintile. Those states with the highest rates for a given measure are in orange, with the exception of the perceptions of risk measures, for which the lowest perceptions of great risk are in orange. Those states with the lowest estimates are in dark blue, with the exception of the perceptions of risk measures, for which the highest perceptions of great risk are in dark blue. These maps are available in HTML and PDF formats. Note, maps were not produced for the following three outcome/age groups due to suppression of some state estimates: cocaine use in the past year among people 12 to 17, heroin use in the past year among people aged 18 to 25, and methamphetamine use in the past year among people aged 12 to 17. For more information about the suppression criteria, see Section A.4.
- **2021 NSDUH State Estimates Categorized into Five Groups, by Age Group**: This table shows the ranges of percentages for each outcome categorized into five groups (used to form the U.S. maps described above) from the lowest to highest estimate for youths aged 12 to 17, young adults aged 18 to 25, adults aged 26 or older, adults aged 18 or older, and people aged 12 or older. Also included are ranges for underage (12 to 20) alcohol use and underage binge alcohol use. If needed, users can use the estimates given in Tables 1 to 35 in *2021 National Survey on Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia)* (CBHSQ, 2022c) and the ranges of the map groups given in this table to reproduce their own maps using the colors of their choice. This table is available in HTML and PDF formats.
- **2021 NSDUH: Model-Based Estimated Totals (in Thousands) (50 States and the District of Columbia) (Tables 1 to 35)**: Tables showing estimated numbers (counts in thousands) and confidence intervals are included for youths aged 12 to 17, young adults aged 18 to 25, adults aged 26 or older, adults aged 18 or older, and

people aged 12 or older. Also included are tables for underage (12 to 20) alcohol use and underage binge alcohol use. These tables are available in Excel and PDF formats. Suppressed estimates are noted by an asterisk (*) in the tables (see Section A.4 for more information).

- **2021 NSDUH State-Specific Tables (Tables 1A to 112B)**: Tables are provided for each individual state and the District of Columbia, as well as for the total United States and the four census regions (i.e., Northeast, Midwest, South, and West). The tables (four per area) show the percentages and the numbers of individuals (counts in thousands). These tables are available in HTML and PDF formats. Suppressed estimates are noted by an asterisk (*) in the tables (see Section A.4 for more information).
- **2021 NSDUH: Other Sources of State-Level Data**: This document compares three outcomes (cigarette and alcohol and binge alcohol use) from NSDUH with data from the Behavioral Risk Factor Surveillance System (BRFSS). This document is available in HTML and PDF formats.
- **2021 NSDUH: Comparison of Population Percentages between the United States, Census Regions, States, and the District of Columbia**: The *p* values contained in these tables for each outcome and age group can be used to test the null hypothesis of no difference between population percentages for the following types of comparisons: total United States versus census region, total United States versus state, census region versus census region, census region versus state, and state versus state. These tables are available in Excel format, and the methodology used to compute these *p* values is provided in a document published with these Excel tables. This methodology document is available in HTML and PDF formats. Note, if either estimate in the comparison is suppressed, the *p* value is not produced.

A.4 Suppression Criteria for State Estimates

Beginning in 2021, suppression is applied to unreliable estimates. The estimates meeting the suppression criteria discussed here are designated as unreliable and are not shown in tables and are noted by asterisks (*). The suppression criterion is based on a combination of the relative standard error (RSE) of $[-\ln(p)]$ or $[-\ln(1-p)]$ and the effective sample size (EFN), where p denotes the unbenchmarked small area estimate and $\ln(p)$ denotes the natural logarithm of p. For $p \leq 50$ percent, an RSE of $[-\ln(p)]$ is used, and for $p > 50$ percent, an RSE of $[-\ln(1-p)]$ is used. The separate formulas for $p \leq 50$ percent and $p > 50$ percent produce a symmetric suppression rule; that is, if p is suppressed, then so will $(1-p)$. By using the first-order Taylor series approximation method, an estimate of an RSE of $[-\ln(p)]$ and an RSE of $[-\ln(1-p)]$ is given by

$$\text{RSE of } [-\ln(p)] = \frac{\sqrt{\text{var}(p)}}{p[-\ln(p)]} \text{ and}$$

$$\text{RSE of } [-\ln(1-p)] = \frac{\sqrt{\text{var}(1-p)}}{(1-p)[-\ln(1-p)]},$$

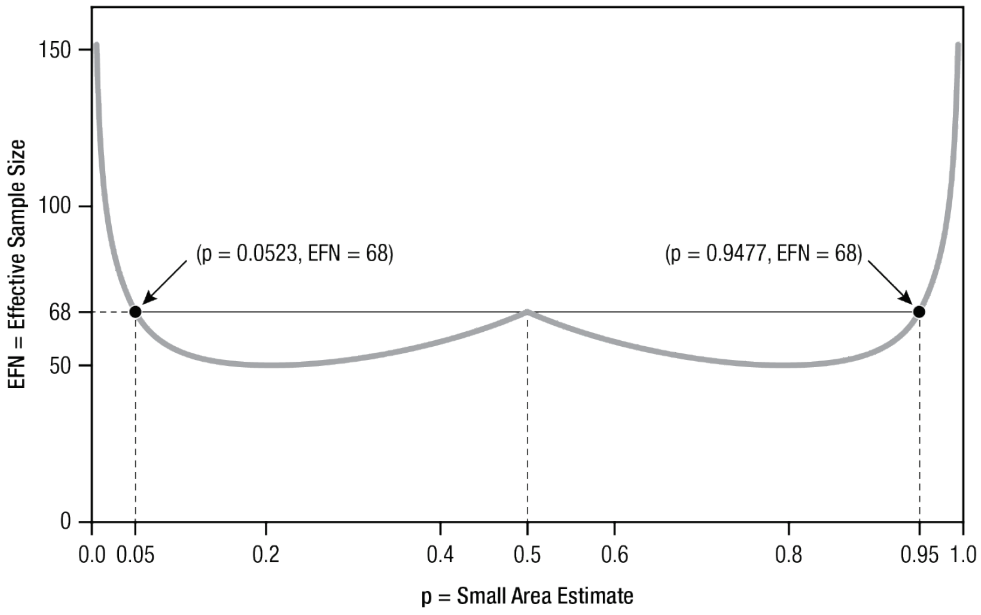
where $\text{var}(p)$ denotes the posterior variance of p. The EFN is defined as $\text{EFN}=\frac{n}{design\ effect}$, where n denotes the raw sample size and design effect is defined as $design\ effect=\frac{\text{var}(p)}{[p(1-p)/n]}$; hence, $\text{EFN}=\frac{p(1-p)}{\text{var}(p)}$. A lower bound of 0.2 also was imposed on the design effects (i.e., all design effects that were less than 0.2 were changed to 0.2) to avoid publishing state by age group estimates with very small sample sizes or small prevalence estimates.

The following criterion was used to suppress state small area estimates:

when $p < 5.23$ percent, then suppress if an RSE of $[-\ln(p)] > 17.5$ percent;
when 5.23 percent $\leq p \leq 94.77$ percent, then suppress if the EFN ≤ 68; and
when $p > 94.77$ percent, then suppress if an RSE of $[-\ln(1-p)] > 17.5$ percent.

A graph is shown in Figure 1 in order to describe the relationship between p and the EFN for an RSE of $[-\ln(p)]= 17.5$ percent when $p \leq 50$ percent and for an RSE of $[-\ln(1-p)]=17.5$ percent when $p > 50$ percent. The suppression criterion switches to EFN between 5.23 percent and 94.77 percent so that the EFN is not allowed to fall below the EFN of 68 required at $p = 50$ percent.

Figure 1. Small Area Estimate versus Effective Sample Size when the Relative Standard Error Equals 17.5 Percent



A.5 Confidence Intervals and Margins of Error

At the top of each of the 35 tables showing state-level model-based estimates[14] is the design-based national estimate along with a 95 percent design-based confidence interval, all of which are based on the survey design, the survey weights, and the reported data. The state estimates are model-based statistics (using SAE methodology) that have been adjusted (benchmarked) such that the population-weighted mean of the estimates across the 50 states and the District of Columbia equals the design-based national estimate. For more details on this benchmarking, see Section B.5. The region-level estimates are also benchmarked and are obtained by taking the population-weighted mean of the associated state-level benchmarked estimates. Associated with each state and regional estimate is a 95 percent Bayesian confidence interval. These intervals indicate the uncertainty in the estimate due to both sampling variability and model fit. For example, the state with the highest estimate of past month use of marijuana for young adults aged 18 to 25 in 2021 was Arizona, with an estimate of 40.0 percent and a 95 percent Bayesian confidence interval that ranged from 31.8 to 48.8 percent (see Table 3 of the state model-based prevalence estimates' tables [CBHSQ, 2022c]). Assuming that sampling and modeling conditions held, the Bayes posterior probability was 0.95 that the true percentage of past month marijuana use in Arizona for young adults aged 18 to 25 in 2021 was between 31.8 and 48.8 percent. As noted earlier in footnote 8, the term "prediction interval" (PI) was used in the 2004-2005 NSDUH state report (Wright et al., 2007) and prior reports to represent uncertainty in the state and regional estimates. However, that term also is used in other applications to estimate future values of a parameter of interest. That interpretation does not apply to NSDUH state model-based estimates, so PI was replaced with "Bayesian confidence interval."

"Margin of error" is another term used to describe uncertainty in the estimates. For example, if (l, u) is a 95 percent symmetric confidence interval for the population proportion (p) and $\hat{p}$ is an estimate of p obtained from the survey data, then the margin of error of $\hat{p}$ is given by $(u - \hat{p})$ or $(\hat{p} - l)$. When (l, u) is a symmetric confidence interval, $(u - \hat{p})$ will be the same as $(\hat{p} - l)$. The margin of error will vary for each estimate and will be affected not only by the sample size (e.g., the larger the sample, the smaller the margin of error) but also by the sample design (e.g., telephone surveys using random digit dialing and surveys employing a stratified multistage cluster design will, more than likely, produce a different margin of error) (Scheuren, 2004).

The confidence intervals shown in NSDUH state reports are asymmetric, meaning that the distance between the estimate and the lower confidence limit will not be the same as the distance between the upper confidence limit and the estimate. For example, Utah's 2021 past month marijuana use estimate is 16.0 percent for young adults aged 18 to 25, with a 95 percent Bayesian confidence interval equal to 12.3 to 20.6 percent (see Table 3 of the state model-based prevalence estimates' tables [CBHSQ, 2022c]). Therefore, Utah's estimate is 3.7 (i.e., 16.0 – 12.3) percentage points from the lower 95 percent confidence limit and 4.6 (i.e., 20.6 – 16.0) percentage points from the upper limit. These asymmetric confidence intervals work well for small percentages often found in NSDUH state estimate tables and reports while still being

[14] See Tables 1 to 35 in 2021 Model-Based Prevalence Estimates (CBHSQ, 2022c).

appropriate for larger percentages. Some surveys or polls provide only one margin of error for all reported percentages. This single number is usually calculated by setting the sample percentage estimate $(\hat{p})$ equal to 50 percent, which will produce an upper bound or maximum margin of error. Such an approach would not be feasible in this situation because the NSDUH state estimates vary from less than 1 percent to more than 75 percent; hence, applying a single margin of error to these estimates could significantly overstate or understate the actual precision levels. Therefore, given the differences mentioned above, it is more useful and informative to report the confidence interval for each estimate instead of a margin of error.

When it is indicated that a state has the highest or lowest estimate, it does not imply that the state's estimate is significantly higher or lower than the next highest or lowest state's estimate. Additionally, two significantly different state estimates (at the 5 percent level of significance) may have overlapping 95 percent confidence intervals. For details on a more accurate test to compare state estimates, see *2021 National Survey on Drug Use and Health: Comparison of Population Percentages from the United States, Census Regions, States, and the District of Columbia* (CBHSQ, forthcoming a).

A.6 Related Substance Use Measures

State estimates are produced for a number of related measures, such as marijuana use in the past month and illicit drug use in the past month, or alcohol use disorder in the past year and needing but not receiving treatment at a specialty facility for alcohol use in the past year. It might appear that one could draw conclusions by subtracting one from the other (e.g., subtracting the percentage who misused pain relievers in the past year from the percentage who misused opioids [misuse of pain relievers or use of heroin] in the past year to find the percentage who used only heroin in the past year but did not misuse pain relievers). Because related measures have been estimated separately with different models, subtracting one measure from another related measure at the state or census region level can give misleading results, perhaps even a "negative" estimate, and should be avoided. Users are advised to view the estimates along with their respective confidence intervals to get a better idea of the range in which the "true" value of the prevalence rate might fall (see Section A.5 for more details).

However, at the national level, because these estimates are design-based estimates, such comparisons can be made. For example, at the national level, subtracting estimates for cigarette use in the past month from the estimates of tobacco use in the past month will give the estimate of people who did not use cigarettes in the past month but used other forms of tobacco, such as cigars, pipes, or smokeless tobacco, in the past month.

A.7 2021 NSDUH Methodological Changes and Implication for Estimates

Similar to the 2020 NSDUH, the COVID-19 pandemic affected data collection for the 2021 NSDUH. The 2021 NSDUH continued the use of multimode data collection procedures that were first implemented in October 2020 for the 2020 NSDUH. Multimode data collection was used for the entire 2021 NSDUH sample; however, the proportion of in-person interviews gradually increased from the beginning to the end of 2021. Even so, the multimode nature of the

2021 NSDUH is an important methodological difference from previous years. This section discusses special methodological issues specific to the 2021 NSDUH. More detailed information can be found in Chapter 6 of the 2021 Methodological Summary and Definitions report (CBHSQ, 2022b).

A.7.1 Methodological Changes

A.7.1.1 Data Collection Mode

Before October 2020, all NSDUH data were collected in person, mainly in respondents' homes. It was known that the use of multimode data collection for the 2020 NSDUH could affect the validity of comparisons between estimates from 2020 and those from prior years. However, the benefits of including a web-based interview option outweighed this concern, especially given the limitations on in-person data collection imposed by the COVID-19 pandemic. The COVID-19 pandemic forced all in-person data collection for NSDUH to stop in mid-March 2020. Except for a brief data collection period in July 2020 to test in-person safety protocols, data collection did not resume until Quarter 4 of 2020 (i.e., October 2020). The web data collection mode was introduced for NSDUH in Quarter 4 of 2020, and more than 90 percent of interviews in that quarter were conducted via the web. This multimode design continued into 2021, although some modifications were made to the data collection procedures, as discussed in Section 2.2 of the 2021 Methodological Summary and Definitions report (CBHSQ, 2022b). More than three quarters of interviews in Quarter 1 were completed via the web (76.6 percent). By Quarter 4, fewer than half of the interviews (41.5 percent) were completed that way. Altogether, 54.6 percent of the 2021 interviews were completed via the web.

National estimates differed significantly by web and in-person modes of data collection (also known as a "mode effect"). These differences were observed even in analyses that adjusted for demographic characteristics of respondents such as age, gender, race, and Hispanic origin. Consequently, estimates based on both web and in-person interviews were not comparable with estimates based on only one of these data collection modes. Weighting for the demographic characteristics of the sample to match the demographic characteristics of the population only partially adjusts for this difference. Differences between web and in-person respondents for most measures were not consistent across quarters. See Section 6.2.2 of CBHSQ (2022b) for more information about the findings from the assessments of multimode methodological changes in 2021. The estimates based on 2021 data represent an overall average of temporal (over 4 quarters) and data collection mode effects. Due to these methodological differences, it is not recommended to compare 2021 data with data from prior surveys.

A.7.1.2 Use of 2020 Census Data in Weighting

NSDUH person-level weights are calibrated to population estimates for the state and demographic domains provided by the U.S. Census Bureau. For the 2011-2020 NSDUHs, the population estimates used in the poststratification adjustment were based on population estimates projected from the 2010 decennial census. Starting with the 2021 NSDUH, population estimates based on the 2020 decennial census were used in developing the person-level analysis weights.

The 2020 decennial census population estimates represent the current population characteristics more accurately than the population estimates calculated from the 2010 decennial

census. As the U.S. Census Bureau noted in a press release on the quality indicators for the 2020 census,[15] "Despite all the challenges of the pandemic, the completeness and accuracy of 2020 Census results are comparable with recent censuses." For more details on how the 2021 NSDUH weights were developed, refer to Section 2.3.4 of CBHSQ (2022b).

A.7.2 Comparisons with Prior Years

The multimode data collection affected all methodological areas such as imputation procedures, weighting procedures, presentation of the data, and analysis and interpretation of the data. Given the impact of methodological differences in 2021, on the estimates (see Sections 6.1 and 6.2 of CBHSQ [2022b]), it was decided that it would not be appropriate to compare estimates from the 2021 NSDUH with those from prior years. For this reason, no statistical comparisons between the 2021 state estimates and estimates from prior years were done.

[15] See https://www.census.gov/newsroom/press-releases/2021/quality-indicators-on-2020-census.html.

Section B: State Model-Based Estimation Methodology

B.1 General Model Description

The state small area estimation (SAE) model is a complex mixed[16] (including both fixed and random effects) logistic regression model of the following form:

$$\log[\pi_{aijk} / (1-\pi_{aijk})] = x'_{aijk}\beta_a + \eta_{ai} + \nu_{aij},$$

where π_{aijk} is the probability of engaging in the behavior of interest (e.g., using marijuana in the past month) for person-*k* belonging to age group-*a* in grouped state sampling region (SSR)-*j* of state-*i*.[17] Let x_{aijk} denote a $p_a \times 1$ vector of predictor variables (independent variables or fixed effects) associated with age group-*a* (12 to 17, 18 to 25, 26 to 34, and 35 or older) and β_a denote the associated vector of the regression parameters. The age group-specific vectors of the auxiliary variables are defined for every block group in the nation and also include person-level demographic variables, such as race/ethnicity and gender. The vectors of state-level random effects $\eta_i = (\eta_{1i}, \cdots, \eta_{Ai})'$ and grouped SSR-level random effects $\nu_{ij} = (\nu_{1ij}, \cdots, \nu_{Aij})'$ are assumed to be mutually independent with $\eta_i \sim N_A(0, D_\eta)$ and $\nu_{ij} \sim N_A(0, D_\nu)$, where A is the total number of individual age groups modeled (generally, $A = 4$). For hierarchical Bayes (HB) estimation purposes, an improper uniform prior distribution is assumed for β_a, and proper Wishart prior distributions are assumed for D_η^{-1} and D_ν^{-1}. The HB solution for π_{aijk} involves a series of complex Markov Chain Monte Carlo (MCMC) steps to generate values of the desired fixed and random effects from the underlying joint posterior distribution. The basic

[16] The use of mixed models (fixed and random effects) allows additional error components (random effects) to be included. These account for differences between states and within-state variations that are not taken into account by the predictor variables (fixed effects) alone. It is also difficult (if not impossible) to produce valid mean squared errors (MSEs) for small area estimates based solely on a fixed-effect national regression model (i.e., synthetic estimation) (Rao, 2003, p. 52). The mixed models produce estimates that are approximately represented by a weighted combination of the direct estimate from the state data and a regression estimate from the national model. The regression coefficients of the national model are estimated using data from all of the states (i.e., borrowing strength), and the regression estimate for a particular state is obtained by applying the national model to the state-specific predictor data. The regression estimate for the state is then combined with the direct estimate from the state data in a weighted combination where the weights are obtained by minimizing the MSE (variance + squared bias) of the small area estimate.

[17] To increase the precision of the estimated random effects at the within-state level, three SSRs from the 2021 sample were grouped together to form 250 grouped SSRs. California had 12 grouped SSRs; Florida, New York, and Texas each had 10 grouped SSRs; Illinois, Michigan, Ohio, and Pennsylvania each had 8 grouped SSRs; Georgia, New Jersey, North Carolina, and Virginia each had 5 grouped SSRs; and the rest of the states and the District of Columbia each had 4 grouped SSRs.

process is described in Folsom and colleagues (1999); Shah and colleagues (2000); and Wright (2003a, 2003b).

Once the required number of MCMC samples (1,250 in all) for the parameters of interest are generated and tested for convergence properties (see Raftery & Lewis, 1992), the small area estimates for each race/ethnicity × gender cell within a block group can be obtained for each age group. These block group–level small area estimates then can be aggregated using the appropriate population count projections for the desired age group(s) to form state-level small area estimates. These state-level small area estimates are benchmarked to the national design-based estimates as described in Section B.5.

B.2 Measures (Outcomes) Modeled

The following list contains all binary (0,1) measures for which age group–specific state estimates were produced. For all measures listed below, 2021 National Survey on Drug Use and Health (NSDUH) data were used to produce estimates.

1. illicit drug use in the past month,
2. marijuana use in the past year,
3. marijuana use in the past month,
4. perceptions of great risk from smoking marijuana once a month,
5. first use of marijuana in the past year among people at risk for initiation of marijuana,[18]
6. illicit drug use other than marijuana in the past month,
7. cocaine use in the past year,
8. perceptions of great risk from using cocaine once a month,
9. heroin use in the past year,
10. perceptions of great risk from trying heroin once or twice,
11. methamphetamine use in the past year,
12. prescription pain reliever misuse in the past year,
13. opioid misuse in the past year[19],
14. alcohol use in the past month,[20]
15. binge alcohol use in the past month,[21]
16. perceptions of great risk from having five or more drinks of an alcoholic beverage once or twice a week,

[18] For details on how this outcome is calculated, see Section B.8 of this document.

[19] This is the first time state estimates of opioid misuse in the past year have been published by the Substance Abuse and Mental Health Services Administration (SAMHSA).

[20] Estimates of underage (aged 12 to 20) alcohol use were also produced.

[21] Estimates of underage (aged 12 to 20) binge alcohol use were also produced.

17. tobacco product use in the past month,
18. cigarette use in the past month,
19. perceptions of great risk from smoking one or more packs of cigarettes per day,
20. drug use disorder in the past year,
21. pain reliever use disorder in the past year,
22. opioid use disorder in the past year,[22]
23. alcohol use disorder in the past year,
24. substance use disorder (SUD) in the past year,
25. needing but not receiving treatment for illicit drug use at a specialty facility in the past year,
26. needing but not receiving treatment for alcohol use at a specialty facility in the past year,
27. needing but not receiving treatment for substance use at a specialty facility in the past year,
28. any mental illness (AMI) in the past year,
29. serious mental illness (SMI) in the past year,
30. major depressive episode (MDE; i.e., depression) in the past year,
31. had serious thoughts of suicide in the past year,
32. made any suicide plans in the past year,
33. attempted suicide in the past year, and
34. received mental health services in the past year.

B.3 Predictors Used in Mixed Logistic Regression Models

Local area data used as potential predictor variables in the mixed logistic regression models were obtained from the following sources:

- *Claritas*. Claritas[23] population projections are used to update age group, gender, and race/ethnicity predictor variables each year.
- *U.S. Census Bureau*. The 2010 census (demographic and geographic variables) and 2019 food stamp participation estimates were used (https://www.census.gov/data/datasets/time-series/demo/saipe/model-tables.html). The Census Bureau's Small Area Income and Poverty Estimates (SAIPE) program obtains Food Stamp program (now known as the Supplemental Nutrition Assistance Program [SNAP]) participation estimates from the U.S. Department of Agriculture,

[22] This is the first-time state estimates of opioid use disorder in the past year have been published by SAMHSA.

[23] Claritas is a market research firm headquartered in Cincinnati, Ohio (see https://claritas.com/).

Food and Nutrition Service. Also, the Census Bureau's 2015-2019 American Community Survey (ACS) 5-year demographic and socioeconomic variables at the tract level and poverty variable at the county level were used (https://www.census.gov/programs-surveys/acs/).

- *Federal Bureau of Investigation (FBI)*. Uniform Crime Report (UCR) arrest totals were obtained from https://www.icpsr.umich.edu/icpsrweb/NACJD/series/57. The most current data used are from 2016 for most counties, with prior years' data substituted in a few cases.
- *Bureau of Labor Statistics (BLS)*. The 2021 county-level unemployment estimates were used (https://www.bls.gov/lau/tables.htm). The BLS uses results from the Current Population Survey (CPS) to provide county-level unemployment estimates. The CPS is a monthly survey of households conducted by the Census Bureau for the BLS.
- *Bureau of Economic Analysis (BEA)*. The 2020 county-level per capita income estimates were used (https://www.bea.gov/data/income-saving/personal-income-county-metro-and-other-areas). These county-level per capita income estimates are produced by the Regional Income Division of the BEA.
- *National Center for Health Statistics (NCHS)*. Mortality data using International Classification of Diseases, 10th revision (ICD-10), 2012-2017, were used. The ICD-10 death data are from the NCHS at the Centers for Disease Control and Prevention.
- *Substance Abuse and Mental Health Services Administration (SAMHSA), Center for Behavioral Health Statistics and Quality (CBHSQ; formerly the Office of Applied Studies [OAS])*. Data were used from the National Survey of Substance Abuse Treatment Services (N-SSATS). The 2017 and 2019 data on drug and alcohol treatment were obtained. Most recent data available on maintenance of effort expenditures, block grant awards, cost of services, and total taxable resources data were also used.

Data sources, along with the description of potential predictor variables obtained from each source, are provided in the following lists.

Claritas Data (Description)	*Claritas Data* (Level)
% Population Aged 0 to 19 in Block Group	Block Group
% Population Aged 20 to 24 in Block Group	Block Group
% Population Aged 25 to 34 in Block Group	Block Group
% Population Aged 35 to 44 in Block Group	Block Group
% Population Aged 45 to 54 in Block Group	Block Group
% Population Aged 55 to 64 in Block Group	Block Group
% Population Aged 65 or Older in Block Group	Block Group
% Non-Hispanic Blacks in Block Group	Block Group
% Hispanics in Block Group	Block Group
% Non-Hispanic Other Races in Block Group	Block Group
% Non-Hispanic Whites in Block Group	Block Group
% Males in Block Group	Block Group
% American Indians, Eskimos, Aleuts in Tract	Tract
% Asians, Pacific Islanders in Tract	Tract
% Population Aged 0 to 19 in Tract	Tract
% Population Aged 20 to 24 in Tract	Tract
% Population Aged 25 to 34 in Tract	Tract
% Population Aged 35 to 44 in Tract	Tract
% Population Aged 45 to 54 in Tract	Tract
% Population Aged 55 to 64 in Tract	Tract
% Population Aged 65 or Older in Tract	Tract
% Non-Hispanic Blacks in Tract	Tract
% Hispanics in Tract	Tract
% Non-Hispanic Other Races in Tract	Tract
% Non-Hispanic Whites in Tract	Tract
% Males in Tract	Tract
% Population Aged 0 to 19 in County	County
% Population Aged 20 to 24 in County	County
% Population Aged 25 to 34 in County	County
% Population Aged 35 to 44 in County	County
% Population Aged 45 to 54 in County	County
% Population Aged 55 to 64 in County	County
% Population Aged 65 or Older in County	County
% Non-Hispanic Blacks in County	County
% Hispanics in County	County
% Non-Hispanic Other Races in County	County
% Non-Hispanic Whites in County	County
% Males in County	County

American Community Survey (ACS) (Description)	*ACS Data* (Level)
% Population Who Dropped Out of High School	Tract
% Housing Units Built in 1940 to 1949	Tract
% Females 16 Years or Older in Labor Force	Tract
% Females Never Married	Tract
% Females Separated, Divorced, Widowed, or Other	Tract

American Community Survey (ACS) (Description)	*ACS Data* (Level)
% One-Person Households	Tract
% Males 16 Years or Older in Labor Force	Tract
% Males Never Married	Tract
% Males Separated, Divorced, Widowed, or Other	Tract
% Housing Units Built in 1939 or Earlier	Tract
Average Number of Persons per Room	Tract
% Families below Poverty Level	Tract
% Households with Public Assistance Income	Tract
% Housing Units Rented	Tract
% Population with 9 to 12 Years of School, No High School Diploma	Tract
% Population with 0 to 8 Years of School	Tract
% Population with Associate's Degree	Tract
% Population with Some College and No Degree	Tract
% Population with Bachelor's, Graduate, Professional Degree	Tract
% Housing Units with No Telephone Service Available	Tract
% Households with No Vehicle Available	Tract
% Population with No Health Insurance	Tract
Median Rents for Rental Units	Tract
Median Value of Owner-Occupied Housing Units	Tract
Median Household Income	Tract
% Families below the Poverty Level	County

Uniform Crime Report (UCR) Data (Description)	*UCR Data* (Level)
Drug Possession Arrest Rate	County
Drug Sale or Manufacture Arrest Rate	County
Drug Violations' Arrest Rate	County
Marijuana Possession Arrest Rate	County
Marijuana Sale or Manufacture Arrest Rate	County
Opium or Cocaine Possession Arrest Rate	County
Opium or Cocaine Sale or Manufacture Arrest Rate	County
Other Drug Possession Arrest Rate	County
Other Dangerous Non-Narcotics Arrest Rate	County
Serious Crime Arrest Rate	County
Violent Crime Arrest Rate	County
Driving under Influence Arrest Rate	County

Other Categorical Data (Description)	*Other Categorical Data* (Source)	*Other Categorical Data* (Level)
= 1 if Hispanic, = 0 Otherwise	National Survey on Drug Use and Health (NSDUH) Sample	Person
= 1 if Non-Hispanic Black, = 0 Otherwise	NSDUH Sample	Person
= 1 if Non-Hispanic Other, = 0 Otherwise	NSDUH Sample	Person
= 1 if Male, = 0 if Female	NSDUH Sample	Person
= 1 if Metropolitan Statistical Area (MSA) with $\geq$ 1 Million, = 0 Otherwise	2010 Census	County

Other Categorical Data (Description)	*Other Categorical Data* (Source)	*Other Categorical Data* (Level)
= 1 if MSA with < 1 Million, = 0 Otherwise	2010 Census	County
= 1 if Non-MSA Urban, = 0 Otherwise	2010 Census	Tract
= 1 if Urban Area, = 0 if Rural Area	2010 Census	Tract
= 1 if No Cubans in Tract, = 0 Otherwise	2010 Census	Tract
= 1 if No Arrests for Dangerous Non-Narcotics, = 0 Otherwise	Uniform Crime Report (UCR)	County
= 1 if No Arrests for Opium or Cocaine Possession, = 0 Otherwise	UCR	County
= 1 if No Housing Units Built in 1939 or Earlier, = 0 Otherwise	American Community Survey (ACS)	Tract
= 1 if No Housing Units Built in 1940 to 1949, = 0 Otherwise	ACS	Tract
= 1 if No Households with Public Assistance Income, = 0 Otherwise	ACS	Tract

Miscellaneous Data (Description)	*Miscellaneous Data* (Source)	*Miscellaneous Data* (Level)
Alcohol Death Rate, Underlying Cause	National Center for Health Statistics' International Classification of Diseases, 10th revision (NCHS-ICD-10)	County
Cigarette Death Rate, Underlying Cause	NCHS-ICD-10	County
Drug Death Rate, Underlying Cause	NCHS-ICD-10	County
Alcohol Treatment Rate	National Survey of Substance Abuse Treatment Services (N-SSATS)	County
Alcohol and Drug Treatment Rate	N-SSATS	County
Drug Treatment Rate	N-SSATS	County
Unemployment Rate	Bureau of Labor Statistics (BLS)	County
Per Capita Income (in Thousands)	Bureau of Economic Analysis (BEA)	County
Average Suicide Rate (per 10,000)	NCHS-ICD-10	County
Food Stamp Participation Rate	Census Bureau	County
Single State Agency Maintenance of Effort	National Association of State Alcohol and Drug Abuse Directors (NASADAD)	State
Block Grant Awards	Substance Abuse and Mental Health Services Administration (SAMHSA)	State
Cost of Services Factor Index	SAMHSA	State
Total Taxable Resources per Capita Index	U.S. Department of Treasury	State
% Hispanics Who Are Cuban	2010 Census	Tract

The predictor variables used in the SAE models were selected from the set of potential predictors given above using the method described in Section B.4.

B.4 Selection of Predictor Variables for the SAE Models

Predictor variable selection was done using the 2021 data for all measures, using the following multistep process:

1. For each measure, age group–specific[24] SAS® stepwise logistic regression models were fit using the sample data (SAS Institute Inc., 2017). The input list to these models included all linear polynomials (constructed from continuous predictor variables) and other categorical or indicator variables given in Section B.3. All significant[25] predictors were input to step 2, given as follows.
2. Using the sample, all significant predictors from step 1 then were input to PROC HPSPLIT to identify significant complex (at most three-way) interaction terms. PROC HPSPLIT is a SAS procedure that uses decision-tree algorithms to build classification systems. The exhaustive chi-squared automatic interaction detector (CHAID) algorithm was used to create the trees.
3. All the significant variables from step 1, along with their corresponding higher-order polynomials (quadratic and cubic), interaction of gender and race, and the significant interactions detected by PROC HPSPLIT in step 2 then were input to SAS stepwise logistic regression models. All predictors that remained significant[26] then were input to step 4 of variable selection.
4. All significant variables from step 3 were input to fit SUDAAN (RTI International, 2013) logistic regression models, and predictors that remained significant[27] were used in the SAE models described in Section B.1. The race and gender predictors were forced in most of the models.

B.5 Benchmarking the Age Group–Specific Small Area Estimates

The self-calibration built into the survey-weighted hierarchical Bayes (SWHB) solution ensures the population-weighted average of the state small area estimates will closely match the national design-based estimates. The national design-based estimates in NSDUH are based entirely on survey-weighted data using a direct estimation approach, whereas the state and census region estimates are model based. Given the self-calibration ensured by the SWHB method, for state reports prior to 2002, the standard Bayes prescription was followed; specifically, the posterior mean was used for the point estimate, and the tail percentiles of the posterior distribution were used for the Bayesian confidence interval limits.

Singh and Folsom (2001) extended Ghosh's (1992) results on constrained Bayes estimation to include exact benchmarking to design-based national estimates. In the simplest version of this constrained Bayes solution where only the design-based mean is imposed as a benchmarking constraint, each of the 2021 state-by-age group small area estimates is adjusted by

[24] Generally, age groups are 12 to 17, 18 to 25, 26 to 34, and 35 or older. For underage alcohol and binge alcohol use, the age group is 12 to 20.
[25] Depending on the measure and age group, significance levels were 1, 3, 5, or 10 percent.
[26] Depending on the measure and age group, significance levels were 1, 3, or 5 percent.
[27] Depending on the measure and age group, significance levels were 0.5, 1, 3, 5, or 10 percent.

adding the common factor $\Delta_a = (D_a - P_a)$, where D_a is the design-based national estimate and P_a is the population-weighted mean of the state small area estimates (P_{sa}) for age group-*a*. The exactly benchmarked state-*s* and age group-*a* small area estimates then are given by $\theta_{sa} = P_{sa} + \Delta_a$. Experience with such additive adjustments suggests that the resulting exactly benchmarked state small area estimates will always be between 0 and 100 percent because the SWHB self-calibration ensures the adjustment factor is small relative to the size of the state-level small area estimates.

Relative to the Bayes posterior mean, these benchmark-constrained state small area estimates are biased by the common additive adjustment factor. Therefore, the posterior mean squared error (MSE) for each benchmarked state small area estimate has the square of this adjustment factor added to its posterior variance. To achieve the desirable feature of exact benchmarking, this constrained Bayes adjustment factor was implemented for the state-by-age group small area estimates. The associated Bayesian confidence (credible) intervals can be recentered at the benchmarked small area estimates on the logit scale with the symmetric interval end points based on the posterior root mean squared errors (RMSEs). The adjusted 95 percent Bayesian confidence intervals $(Lower_{sa}, Upper_{sa})$ are defined as follows:

$$Lower_{sa} = \exp(L_{sa}) / [1 + \exp(L_{sa})] \text{ and } Upper_{sa} = \exp(U_{sa}) / [1 + \exp(U_{sa})],$$

where

$$L_{sa} = \ln[\theta_{sa} / (1 - \theta_{sa})] - 1.96 * \sqrt{MSE_{sa}},$$

$$U_{sa} = \ln[\theta_{sa} / (1 - \theta_{sa})] + 1.96 * \sqrt{MSE_{sa}}, \text{ and}$$

$$MSE_{sa} = (\ln[P_{sa} / (1 - P_{sa})] - \ln[\theta_{sa} / (1 - \theta_{sa})])^2 + \text{posterior variance of } \ln[P_{sa} / (1 - P_{sa})].$$

The associated posterior coverage probabilities for these benchmarked intervals are very close to the prescribed 0.95 value because the state small area estimates have posterior distributions that can be approximated exceptionally well by a Gaussian distribution after the logit transformation.

B.6 Calculation of Estimated Number of Individuals Associated with Each Outcome

Tables 1 to 35 of *2021 National Survey on Drug Use and Health: Model-Based Estimated Totals (in Thousands) (50 States and the District of Columbia)* (CBHSQ, forthcoming b) show the estimated numbers of individuals associated with each of the 34 measures of interest. To calculate these numbers, the benchmarked small area estimates and associated 95 percent Bayesian confidence intervals are multiplied by the 2021 population count of the state by the age group of interest (Tables C.1 to C.3 of this methodology document).

For example, past month use of alcohol among 18- to 25-year-olds in Alabama was 39.69 percent in 2021.[28] The corresponding Bayesian confidence intervals ranged from 33.62 to 46.10 percent. The population count for 18- to 25-year-olds for 2021 in Alabama was 508,027 (see Table C.2 in Section C of this methodology document). Hence, the estimated number of 18- to 25-year-olds using alcohol in the past month in Alabama was 0.3969 × 508,027, which is 201,636.[29] The associated Bayesian confidence intervals ranged from 0.3362 × 508,027 (i.e., 170,799) to 0.4610 × 508,027 (i.e., 234,200). Note that when estimates of the number of individuals are calculated for Tables 1 to 35 in 2021 Model-Based Estimated Totals (CBHSQ, forthcoming b), the unrounded percentages and population counts are used, then the numbers are reported to the nearest thousand. Hence, the number obtained by multiplying the published estimate with the published population estimate may not exactly match the counts published in these tables because of rounding differences.

The only exception to this calculation is the production of the estimated numbers of marijuana initiates. Those estimates cannot be directly calculated as the product of the percentage estimate of first use of marijuana and the population counts available in Section C. That is because the denominator of that percentage estimate is defined as the number of person-years at risk for marijuana initiation, which is a combination of individuals who never used marijuana and one half of the individuals who initiated in the past 24 months (see Section B.8 for more details).

B.7 Calculation of Aggregate Age Group Estimates and Limitations

Tables 1 to 35 of 2021 Model-Based Prevalence Estimates (CBHSQ, 2022c) show estimates for the following age groups: 12 to 17, 18 to 25, 26 or older, 18 or older, and 12 or older. If a user was interested in producing aggregated estimates, such as for those aged 12 to 25, the aggregated estimates could be calculated using prevalence estimates along with the population totals shown in Section C of this document. However, with the information provided in the tables, the confidence intervals cannot be calculated. Below is an example of the calculation of aggregated estimate for a given state.

In 2021, past month use of alcohol in Alabama among youths aged 12 to 17 was 5.96 percent, and among young adults aged 18 to 25 it was 39.69 percent.[30] The population counts for 12- to 17-year-olds and 18- to 25-year-olds in 2021 in Alabama were 395,422 and 508,027, respectively (see Table C.2 in Section C of this methodology document). Hence, one would calculate the estimate for people aged 12 to 25 by first finding the number of users aged 12 to 25, which is 225,203 ([0.0596 × 395,422] + [0.3969 × 508,027]), then dividing that number by the population aged 12 to 25, which results in a rate of 24.93 percent (225,203 / [395,422 + 508,027]).

[28] See Table 14 in *2021 National Survey of Drug Use and Health: Model-Based Prevalence Estimates (50 States and the District of Columbia)* (CBHSQ, 2022c).

[29] See Table 14 in 2021 NSDUH: Model-Based Estimated Totals (CBHSQ, forthcoming b).

[30] See Table 14 in 2021 NSDUH: Model-Based Prevalence Estimates (CBHSQ, 2022c).

B.8 Calculation of Initiation of Marijuana Use

Initiation[31] rates typically are calculated as the number of new initiates of a substance during a period of time (such as in the past year) divided by an estimate of the number of person-years of exposure (in thousands). The initiation definition used here employs a simpler form of the at-risk population based on the model-based methodology. This model-based initiation rate (i.e., first use of marijuana in the past year among people at risk for initiation of marijuana use) is defined as follows:

$$Average\ annual\ rate = 100 * \{[X_1 \div (0.5 * X_1 + X_2)] \div 2\},$$

where X_1 is the number of marijuana initiates in the past 24 months, and X_2 is the number of persons who never used marijuana.

The initiation rate is expressed as a percentage or rate per 100 person-years of exposure. Note that this estimate uses a 2-year time period to accumulate initiation cases from the annual survey. By assuming further that the distribution of first use for the initiation cases is uniform across the 2-year interval, the total number of person-years of exposure is 1 year on average for the initiation cases plus 2 years for all the "never users" at the end of the time period. This approximation to the person-years of exposure permits one to recast the initiation rate as a function of two population prevalence rates—namely, the fraction of people who first used marijuana in the past 2 years and the fraction who had never used marijuana. Both of these prevalence estimates were estimated using the SWHB estimation approach. Note that only initiation rates for marijuana use are provided here.

B.9 Underage Drinking

To obtain small area estimates for people aged 12 to 20 for past month alcohol and binge alcohol use, a separate set of SAE models with predictors selected for the age groups 12 to 17, 18 to 20, 21 to 34, and 35 or older were used. Model-based estimates for people aged 12 to 20 were produced by taking the population-weighted average of the individual age group (12 to 17 and 18 to 20) estimates. Estimates for underage drinking for past month alcohol and binge alcohol use were benchmarked to match national design-based estimates for that age group using the process described in Section B.5.

B.10 Marijuana Use

In the 2021 NSDUH, questions about vaping marijuana were added to the emerging issues section of the questionnaire. Respondents who reported that they vaped anything were asked whether they ever vaped marijuana with a vaping device. Additionally, respondents who answered "yes" to ever vaping marijuana were then asked how long it had been since they last vaped marijuana with a vaping device.

[31] In NSDUH SAE documents prior to 2016-2017, the term "initiation" was referred to as "incidence."

To maintain consistent measures across years where possible, a general principle of editing is not to edit across interview sections (except in situations where answers to questions in a previous section govern skip logic in a later section). However, the introduction to the marijuana section of the interview did not mention the use of marijuana with a vaping device as one of the ways people could use marijuana. Therefore, respondents might not have thought about vaping marijuana when they answered the earlier marijuana questions. For this reason, data from these marijuana vaping questions were incorporated into the marijuana use measures and related measures that include marijuana beginning with the 2021 NSDUH. If respondents reported that they did not use marijuana in the marijuana section of the questionnaire, but they later reported that they vaped marijuana, they were considered to have used marijuana in their lifetime and in the applicable recency period.

For details on marijuana vaping, please refer to Section 3.4.10.3 of CBHSQ (2022b).

B.11 Substance Use Disorder (SUD)

The NSDUH questionnaire includes questions to measure SUD for alcohol and drugs. SUD estimates for drugs and alcohol in the 2021 NSDUH were based on the criteria in the *Diagnostic and Statistical Manual of Mental Disorders*, 5th edition (DSM-5; American Psychiatric Association [APA], 2013). Respondents were asked SUD questions separately for any drugs or alcohol they used in the 12 months prior to the survey.[32]

Drugs included marijuana, cocaine (including crack), heroin, hallucinogens, inhalants, methamphetamine, and *any* use of prescription pain relievers, tranquilizers, stimulants, or sedatives. Beginning in 2021, NSDUH respondents who reported *any* use of prescription psychotherapeutic drugs (i.e., pain relievers, tranquilizers, stimulants, or sedatives) in the past year (i.e., not just misuse of prescription drugs) were asked the respective SUD questions for that category of prescription drugs.

DSM-5 includes the following SUD criteria (as measured in the 2021 NSDUH):

1. The substance is often taken in larger amounts or over a longer period than intended.
2. There is a persistent desire or unsuccessful efforts to cut down or control substance use.
3. A great deal of time is spent in activities necessary to obtain the substance, use the substance, or recover from its effects.
4. There is craving, or a strong desire or urge, to use the substance.
5. There is recurrent substance use resulting in a failure to fulfill major role obligations at work, school, or home.
6. There is continued substance use despite having persistent or recurrent social or interpersonal problems caused by or exacerbated by the effects of the substance.

[32] NSDUH respondents in 2021 were asked the respective questions for alcohol use disorder or marijuana use disorder if they reported use of these substances on 6 or more days in the past year.

7. Important social, occupational, or recreational activities are given up or reduced because of substance use.
8. There is recurrent substance use in situations in which it is physically hazardous.
9. Substance use is continued despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance.
10. There is a need for markedly increased amounts of the substance to achieve intoxication or the desired effect, or markedly diminished effect with continued use of the same amount of the substance (i.e., tolerance).
11. There are two components of withdrawal symptoms, either of which meet the overall criterion for withdrawal symptoms:
    a. There is a required number of withdrawal symptoms that occur when substance use is cut back or stopped following a period of prolonged use.[33]
    b. The substance or a related substance is used to get over or avoid withdrawal symptoms.[34]

For alcohol, marijuana, cocaine, heroin, and methamphetamine, respondents were classified as having an SUD if they had at least 2 of the 11 criteria in a 12-month period. However, respondents were classified as having a hallucinogen use disorder or an inhalant use disorder if they had at least 2 of the first 10 criteria in the past 12 months; the withdrawal criterion does not apply to hallucinogens and inhalants.

For use or misuse of prescription drugs, the applicable DSM-5 criteria for classifying respondents as having a prescription drug use disorder depends on whether respondents misused prescription drugs or used but did not misuse prescription drugs in the past year. If respondents misused prescription drugs in the past year, they were classified as having a prescription drug use disorder if they had at least 2 of the 11 criteria shown. However, if respondents used but did not misuse prescription drugs in the past year, they were classified as having a prescription drug use disorder if they had at least two of the first *nine* criteria shown above. Criteria 10 (tolerance) and 11 (withdrawal) do not apply to respondents who used but did not misuse these prescription drugs in the past year; tolerance and withdrawal can occur as normal physiological adaptations when people use these prescription drugs appropriately under medical supervision (Hasin et al., 2015).

The following lists the substances and types of use or misuse that are included in the 2021 NSDUH state SAEs:

[33] For alcohol, for example, withdrawal symptoms include (but are not limited to) trouble sleeping, hands trembling, hallucinations (seeing, feeling, or hearing things that are not really there), or feeling anxious.

[34] For alcohol use disorder, for example, this criterion involves the use of alcohol, sedatives, or tranquilizers to get over or avoid alcohol withdrawal symptoms.

- Any SUD in the past year includes data from past year users of alcohol, marijuana,[35] cocaine (including crack), heroin, hallucinogens, inhalants, and methamphetamine, and *any* past year users of prescription psychotherapeutic drugs.
- Alcohol use disorder includes only data from past year users of alcohol.
- Pain reliever use disorder includes data from *any* past year users of prescription pain relievers.
- Drug use disorder includes data from past year users of marijuana, cocaine, heroin, hallucinogens, inhalants, and methamphetamine, and *any* past year users of prescription psychotherapeutic drugs. It does not include people who had an alcohol use disorder in the past year.
- Opioid use disorder includes data from past year users of heroin and *any* past year users of prescription pain relievers.

Illicit drug or alcohol use disorder includes data from past year users of alcohol, marijuana, cocaine, heroin, hallucinogens, inhalants, and methamphetamine, and past year *misusers* of prescription psychotherapeutic drugs. SAEs for this illicit drug or alcohol use disorder measure are not shown; however, it is relevant to the definition for the need for substance use treatment described in Section B.12.

For more information about the SUD definitions based on criteria from DSM-5, see Section 3.4.3.2 of CBHSQ (2022b).

B.12 Needing But Not Receiving Treatment

The 2021 NSDUH included a series of questions designed to measure treatment need for an alcohol or illicit drug use problem and to determine people needing but not receiving treatment. Respondents were classified as needing substance use treatment in the past year if they met either of the following criteria:

1. presence of an illicit drug or alcohol use disorder in the past year (see Section B.11 of this report or Section 3.4.3 of CBHSQ [2022b]), or
2. receipt of treatment at a specialty facility (i.e., drug and alcohol rehabilitation facility [inpatient or outpatient], hospital [inpatient only], or mental health center) in the past year for the use of alcohol or illicit drugs (or both).

For additional details on how respondents were classified as needing substance use treatment, see Section 3.4.4.1 of CBHSQ (2022b).

[35] NSDUH respondents in 2021 were asked the respective questions for alcohol use disorder or marijuana use disorder only if they reported use of these substances on 6 or more days in the past year.

B.13 Mental Health Measures

This section provides a summary of the measurement issues associated with six mental health outcome variables such as mental illness, depression, and suicidal thoughts and behaviors. Additional details can be found in Sections 3.4.6, 3.4.7, and 3.4.14 of CBHSQ (2022b).

B.13.1 Mental Illness

In the 2000-2001 and 2002-2003 NSDUH state SAE reports (Wright, 2003a, 2003b; Wright & Sathe, 2005), the Kessler-6 (K6) distress scale was used to measure SMI (Kessler et al., 2003). However, SAMHSA discontinued producing state-level SMI estimates beginning with the release of the 2003-2004 state report (Wright & Sathe, 2006) because of concerns about the validity of using only the K6 distress scale without an impairment scale; see Section B.4.4 in Appendix B of the 2004 NSDUH national findings report (OAS, 2005). The use of the K6 distress scale continued in the 2003-2004 and the 2004-2005 state reports (Wright & Sathe, 2006; Wright et al., 2007), not as a measure of SMI but as a measure of serious psychological distress (SPD) because it was determined that the K6 scale measured only SPD and merely contributed to measuring SMI and AMI (see the details that follow).

In December 2006, a new technical advisory group was convened by SAMHSA's OAS (which later became CBHSQ) and the Center for Mental Health Services to solicit recommendations for data collection strategies to address SAMHSA's legislative requirements. Although the technical advisory group recognized the ideal way to estimate SMI in NSDUH would be to administer a clinical diagnostic interview annually to all 45,000 adult respondents, this approach was not feasible because of constraints on the interview time and the need for trained mental health clinicians to conduct the interviews. Therefore, the approach recommended by the technical advisory group and adopted by SAMHSA for NSDUH was to use short scales in the NSDUH interview that separately measure psychological distress and functional impairment for use in a statistical model that predicts whether a respondent had mental illness.

To accomplish this, SAMHSA's CBHSQ initiated a Mental Health Surveillance Study (MHSS) in 2008 as part of NSDUH to develop and implement methods to estimate SMI. Models using the short scales for psychological distress and impairment to predict mental illness status were developed from a subsample of adult respondents who had completed the NSDUH interview and were administered a clinical psychological diagnostic interview soon afterward. For the clinical interview data, people were classified as having SMI if they had a diagnosable mental, behavioral, or emotional disorder in the past 12 months, other than a developmental disorder or SUD, that met the 4th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) criteria (APA, 1994) and resulted in substantial functional impairment. This estimation methodology was implemented in the 2008 NSDUH (for details on the 2008 model, see Section 3.4.7.2 of CBHSQ [2021b]).

Based on recommendations from this panel, estimates of SMI were presented based on a revised methodology; thus, they were not comparable with estimates for SMI or SPD shown in NSDUH state reports prior to 2009. However, in 2013, another revision to the methodology for creating SMI estimates was made, and the estimates presented for 2011 and 2012 were based on this revised methodology (and therefore are not comparable with previously published estimates

of SMI). Thus, the 2008-2009, 2009-2010, and 2010-2011 SMI estimates were reproduced using the new 2013 methodology. The 2013 methodology refers to the 2012 model described as follows.

Clinical Measurement of Mental Illness. Mental illness was measured in the MHSS clinical interviews using an adapted version of the *Structured Clinical Interview for the DSM-IV-TR Axis I Disorders, Research Version, Non-patient Edition* (SCID) (First et al., 2002) and was differentiated by the level of functional impairment based on the Global Assessment of Functioning (GAF) scale (Endicott et al., 1976).[36] Past year disorders assessed through the SCID included mood disorders (e.g., MDE, manic episode), anxiety disorders (e.g., panic disorder, generalized anxiety disorder, posttraumatic stress disorder), eating disorders (e.g., anorexia nervosa), intermittent explosive disorder, and adjustment disorder. In addition, the presence of psychotic symptoms was assessed. SUDs also were assessed, although these disorders were not used to produce estimates of mental illness.

- Respondents were classified as having *any mental illness* (AMI) if they were determined to have any of the mental health disorders assessed in the SCID (not including SUDs), regardless of the level of functional impairment.
- Respondents were classified as having *serious mental illness* (SMI) if they had any of the mental health disorders assessed in the SCID (not including SUDs), and these disorders resulted in substantial impairment in carrying out major life activities, based on GAF scores of 50 or below. The SMI diagnosis was used as the response variable in the 2012 prediction models.

The SCID and the GAF in combination were considered to be the "gold standard" for measuring mental illness.

The 2012 SMI Model. The 2012 SMI prediction model was fit with data from 4,912 MHSS respondents from 2008 through 2012. For more information about the instruments and items used to measure the variables employed in the 2012 model, see Sections 3.4.6.4 through 3.4.6.6 of CBHSQ (2022b). Specifically, in CBHSQ (2022b), the instrument used to measure mental illness in the clinical interviews is described, followed by descriptions of the scales and items in the main NSDUH interviews that were used as predictor variables in the model (i.e., the K6 and World Health Organization Disability Assessment Schedule [WHODAS] total scores, age, MDE, and suicidal thoughts). The response variable Y equaled 1 when an SMI diagnosis was positive based on the clinical interview; otherwise, Y was 0. Letting $\mathbf{X}$ be a vector of characteristics attached to a NSDUH respondent and letting the probability that this respondent had SMI be $\pi = \Pr(Y = 1 | \mathbf{X})$, the 2012 SMI prediction model was

[36] The GAF is a numeric scale used by mental health clinicians to quantify the severity of mental disorders and the extent to which mental disorders negatively affected a person's daily functioning. In the MHSS, GAF scores were assigned by clinical interviewers at the end of each SCID interview based on information gathered throughout the interview about symptoms of mental disorders and related impairment. This procedure differs from use of the WHODAS in NSDUH, which relies on respondents' (rather than clinicians') perceptions of the extent to which their symptoms of psychological distress affected their day-to-day functioning.

$$\text{logit}(\hat{\pi}) = \log[\hat{\pi} / (1 - \hat{\pi})] = -5.972664 + 0.0873416X_k + 0.3385193X_w + 1.9552664X_s + 1.1267330\,X_m + 0.1059137X_a \quad (1)$$

or

$$\hat{\pi} = \frac{1}{1 + \exp[-(-5.972664 + 0.0873416X_k + 0.3385193X_w + 1.9552664X_s + 1.1267330\,X_m + 0.1059137X_a)]},$$

where $\hat{\pi}$ refers to an estimate of the SMI response probability π.

The covariates in equation (1) came from the main NSDUH interview data:

- X_k = *Alternative Past Year K6 Score*: Past year K6 score of less than 8 recoded as 0; past year K6 score of 8 to 24 recoded as 1 to 17.
- X_w = *Alternative WHODAS Score*: WHODAS item score of less than 2 recoded as 0; WHODAS item score of 2 to 3 recoded as 1, then summed for a score ranging from 0 to 8.
- X_s = *Serious Thoughts of Suicide in the Past Year*: Coded as 1 if "yes"; coded as 0 otherwise.
- X_m = *Past Year MDE*: Coded as 1 if criteria for past year MDE were met (see Section B.13.2); coded as 0 otherwise.
- X_a = *Adjusted Age*: Coded as age minus 18 if aged 18 to 30; coded as 12 otherwise.

A cut point probability π_0 was determined, so that if $\hat{\pi} \geq \pi_0$ for a particular respondent, then the respondent was *predicted* to be SMI positive; otherwise, the respondent was predicted to be SMI negative. The cut point (0.260573529) was chosen so that the weighted number of false positives and false negatives in the MHSS dataset were as close to equal as possible. To produce state estimates for SMI, the predicted SMI status for all adult NSDUH respondents was used in SAE modeling as the dependent variables.

A second cut point probability (0.0192519810) was determined so that any respondent with an SMI probability greater than or equal to the cut point was predicted to be positive for AMI, and the remaining respondents were predicted to be negative for AMI. The second cut point was chosen so that the weighted numbers of AMI false positives and false negatives were as close to equal as possible.

Starting in 2021, the measures used in the mental illness models were all imputed. Therefore, the source variables to create the measures of AMI and SMI had no missing data.

B.13.2 Major Depressive Episode (Depression)

Two sections related to MDE were included in the 2021 questionnaire: an adult depression section and an adolescent depression section. These sections were originally derived

from DSM-IV criteria for MDE. Consistent with the more recent criteria in DSM-5, NSDUH does not exclude MDEs occurring exclusively in the context of bereavement.

Questions on depression permit estimates of MDE to be calculated. Separate sections were administered to adults aged 18 or older and youths aged 12 to 17. The adult questions were adapted from the depression section of the National Comorbidity Survey Replication (NCS-R), and the questions for youths were adapted from the depression section of the National Comorbidity Survey Replication Adolescent Supplement (NCS-A) (see https://www.hcp.med.harvard.edu/ncs/). To make the sections developmentally appropriate for youths, there are minor wording differences in a few questions between the adult and youth sections. Revisions to the questions in both sections were made primarily to reduce the length and to modify the NCS questions, which are interviewer administered, for self-administration in NSDUH.

According to DSM-5, a person is classified as having had an MDE[37] in their lifetime if they had at least five or more of the following nine symptoms nearly every day (except where noted) in the same 2-week period, where at least one of the symptoms is a depressed mood or loss of interest or pleasure in daily activities: (1) depressed mood most of the day; (2) markedly diminished interest or pleasure in all or almost all activities most of the day; (3) significant weight loss when not sick or dieting, or weight gain when not pregnant or growing, or decrease or increase in appetite; (4) insomnia or hypersomnia; (5) psychomotor agitation or retardation at a level observable by others; (6) fatigue or loss of energy; (7) feelings of worthlessness or excessive or inappropriate guilt; (8) diminished ability to think or concentrate or indecisiveness; and (9) recurrent thoughts of death or suicidality (i.e., recurrent suicidal ideation without a specific plan, making a specific plan, or making an attempt). Unlike the other symptoms listed previously, recurrent thoughts of death or suicidality did not need to have occurred nearly every day (APA, 2013).

Respondents who have had an MDE in their lifetime are asked if, during the past 12 months, they had a period of depression lasting 2 weeks or longer while also having some of the other symptoms mentioned. Respondents reporting experiences consistent with them having had an MDE in the past year are asked questions from the SDS to measure the level of functional impairment in major life activities reported to be caused by the MDE in the past 12 months (Leon et al., 1997).

Starting in 2021, the variables for MDE among adults were statistically imputed. MDE variables were not statistically imputed for youths aged 12 to 17.

B.13.3 Suicidal Thoughts and Behavior

The 2021 NSDUH included sets of questions asking adults aged 18 or older whether they had serious thoughts of suicide, made any suicide plans, or had attempted suicide in the past 12 months. All adult respondents in 2021 were asked whether they made a suicide plan or attempted suicide regardless of whether they reported that they had serious thoughts of suicide in the past

[37] "An MDE" refers to the occurrence of at least one MDE, rather than only one MDE. Similarly, reference to "the MDE" in a given period (e.g., the past 12 months) does not mean an individual had only one MDE in that period.

12 months. Additionally, beginning in 2021, the variables for suicidal thoughts and behaviors among adults were statistically imputed, so these variables had no missing data for 2021.

Section C: Sample Sizes, Response Rates, and Population Estimates

Table C.1 Sample Sizes, Weighted Screening and Interview Response Rates, and Population Estimates; by State, for Persons Aged 12 or Older: 2021

State	Total Selected DUs	Total Eligible DUs	Total Completed Screeners	Weighted DU Screening Response Rate	Total Selected People	Total Respondents	Population Estimate	Weighted Interview Response Rate	Weighted Overall Response Rate
Total U.S.	1,138,830	1,021,720	220,740	22.21%	152,220	69,850	279,843,944	46.24%	10.27%
Northeast	219,370	197,530	39,510	19.13%	26,410	11,850	48,930,520	46.81%	8.95%
Midwest	265,410	239,590	58,010	25.59%	39,120	17,820	58,022,805	45.58%	11.66%
South	393,790	347,940	72,890	21.51%	48,810	23,470	106,587,154	48.25%	10.38%
West	260,260	236,660	50,330	22.49%	37,870	16,720	66,303,465	43.16%	9.71%
Alabama	17,460	15,560	4,600	32.05%	2,940	1,160	4,242,820	40.38%	12.94%
Alaska	16,680	14,040	2,910	19.40%	2,050	980	585,924	48.29%	9.37%
Arizona	18,390	15,980	3,180	19.11%	2,310	970	6,155,311	42.49%	8.12%
Arkansas	17,150	14,090	3,000	22.41%	2,000	890	2,525,675	47.35%	10.61%
California	60,030	57,390	11,530	21.32%	9,730	4,080	33,100,274	41.59%	8.87%
Colorado	17,010	14,980	3,810	25.72%	2,670	1,170	4,925,859	46.95%	12.08%
Connecticut	17,140	16,100	2,980	19.31%	2,020	860	3,106,746	46.04%	8.89%
Delaware	16,560	14,390	3,330	23.59%	2,010	950	854,842	47.68%	11.25%
District of Columbia	19,060	17,200	3,580	23.03%	1,340	770	569,400	60.05%	13.83%
Florida	53,970	46,780	8,870	20.42%	5,730	2,620	18,725,406	46.87%	9.57%
Georgia	23,370	21,710	4,870	22.93%	3,910	1,870	9,002,387	46.22%	10.60%
Hawaii	18,810	17,150	3,810	21.96%	2,800	1,070	1,183,093	38.42%	8.44%
Idaho	15,500	13,670	2,670	18.57%	1,890	870	1,583,643	48.27%	8.96%
Illinois	40,010	37,410	6,990	19.76%	5,170	2,080	10,711,240	39.18%	7.74%
Indiana	16,730	14,940	3,590	26.38%	2,610	1,250	5,693,016	49.18%	12.98%
Iowa	16,510	15,150	3,570	27.61%	2,310	1,070	2,682,262	46.23%	12.76%
Kansas	16,460	14,960	4,780	35.29%	3,650	1,670	2,422,699	43.18%	15.24%
Kentucky	18,950	16,570	3,720	24.81%	2,240	1,120	3,772,667	51.47%	12.77%
Louisiana	17,530	14,790	3,510	25.28%	2,460	1,060	3,822,416	42.72%	10.80%
Maine	16,400	13,640	3,790	26.49%	2,110	960	1,200,075	51.13%	13.55%
Maryland	19,430	18,250	4,390	26.52%	2,980	1,500	5,187,063	46.95%	12.45%
Massachusetts	18,430	17,190	3,150	20.47%	2,150	920	6,050,007	43.48%	8.90%
Michigan	41,490	37,110	9,880	28.43%	6,220	2,920	8,576,889	49.58%	14.10%
Minnesota	15,770	14,540	3,030	20.87%	1,900	860	4,804,648	45.98%	9.60%
Mississippi	17,350	14,930	2,660	19.23%	1,870	1,000	2,449,265	53.02%	10.20%

See notes at end of table.

(continued)

Table C.1 Sample Sizes, Weighted Screening and Interview Response Rates, and Population Estimates; by State, for Persons Aged 12 or Older: 2021 (continued)

State	Total Selected DUs	Total Eligible DUs	Total Completed Screeners	Weighted DU Screening Response Rate	Total Selected People	Total Respondents	Population Estimate	Weighted Interview Response Rate	Weighted Overall Response Rate
Missouri	16,460	14,240	3,100	22.96%	1,870	860	5,181,361	47.46%	10.90%
Montana	15,490	13,480	2,410	16.77%	1,450	690	939,222	53.48%	8.97%
Nebraska	15,210	13,680	3,280	25.55%	2,400	1,140	1,622,425	46.28%	11.83%
Nevada	18,250	17,240	3,120	19.28%	2,480	1,160	2,657,845	47.59%	9.17%
New Hampshire	15,480	13,750	3,400	26.69%	2,260	990	1,214,720	47.04%	12.55%
New Jersey	26,630	24,450	4,230	16.28%	3,190	1,280	7,869,140	43.72%	7.12%
New Mexico	15,260	13,430	2,580	20.00%	1,970	1,020	1,780,887	50.33%	10.07%
New York	50,790	46,140	7,530	18.00%	5,700	2,700	16,916,914	47.99%	8.64%
North Carolina	26,290	23,660	4,170	17.75%	2,580	1,320	8,880,603	50.02%	8.88%
North Dakota	14,150	12,390	2,830	22.75%	1,900	920	634,226	46.99%	10.69%
Ohio	40,990	37,900	9,810	25.72%	6,320	2,730	9,939,581	42.69%	10.98%
Oklahoma	16,930	15,140	2,930	19.38%	2,080	970	3,287,372	50.95%	9.87%
Oregon	16,390	15,290	4,800	33.63%	3,010	1,280	3,658,684	41.53%	13.97%
Pennsylvania	40,940	38,040	7,070	19.38%	4,590	2,080	11,058,561	48.17%	9.33%
Rhode Island	17,180	14,320	2,410	18.46%	1,520	690	947,403	48.13%	8.88%
South Carolina	17,680	15,170	2,490	16.87%	1,580	840	4,391,328	56.27%	9.49%
South Dakota	15,350	13,060	2,430	19.15%	1,730	840	734,115	47.50%	9.09%
Tennessee	18,080	16,120	2,780	18.93%	1,850	860	5,877,872	51.17%	9.69%
Texas	51,070	45,760	8,140	18.22%	6,810	3,140	24,239,644	47.23%	8.60%
Utah	16,610	15,110	3,850	24.61%	3,690	1,830	2,707,190	53.06%	13.06%
Vermont	16,380	13,910	4,960	34.05%	2,890	1,380	566,956	54.70%	18.63%
Virginia	26,470	23,390	6,600	29.25%	4,570	2,470	7,229,456	52.42%	15.33%
Washington	16,350	15,060	3,690	26.89%	2,580	940	6,539,450	38.71%	10.41%
West Virginia	16,440	14,440	3,250	23.93%	1,870	940	1,528,938	44.30%	10.60%
Wisconsin	16,280	14,210	4,740	34.47%	3,060	1,490	5,020,343	51.93%	17.90%
Wyoming	15,500	13,850	1,980	12.64%	1,260	670	486,083	57.37%	7.25%

DU = dwelling unit.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2021.

Table C.2 Sample Sizes, Weighted Interview Response Rates, and Population Estimates; by State and Three Age Groups: 2021

State	12-17 Total Selected People	12-17 Total Respondents	12-17 Population Estimate	12-17 Weighted Interview Response Rate	18-25 Total Selected People	18-25 Total Respondents	18-25 Population Estimate	18-25 Weighted Interview Response Rate	26+ Total Selected People	26+ Total Respondents	26+ Population Estimate	26+ Weighted Interview Response Rate
Total U.S.	35,430	13,270	26,019,281	38.40%	37,180	16,540	33,458,433	43.01%	79,610	40,040	220,366,229	47.63%
Northeast	5,950	2,120	4,144,411	34.44%	6,400	2,710	5,724,517	42.10%	14,060	7,020	39,061,593	48.76%
Midwest	8,980	3,140	5,482,975	36.86%	9,750	4,330	7,102,761	41.54%	20,400	10,350	45,437,069	47.27%
South	11,850	4,890	10,151,564	42.14%	11,760	5,590	12,696,092	46.49%	25,210	12,980	83,739,498	49.24%
West	8,660	3,120	6,240,332	36.29%	9,280	3,910	7,935,064	39.40%	19,930	9,690	52,128,069	44.53%
Alabama	700	240	395,422	38.51%	760	310	508,027	38.64%	1,470	610	3,339,372	40.88%
Alaska	500	190	59,073	34.56%	480	230	65,965	47.52%	1,080	570	460,886	50.14%
Arizona	530	210	581,282	38.11%	580	230	759,837	37.10%	1,190	530	4,814,192	43.72%
Arkansas	420	120	248,172	25.30%	550	240	309,645	43.32%	1,030	520	1,967,858	50.90%
California	2,220	830	3,110,181	38.04%	2,320	950	3,976,766	39.42%	5,190	2,300	26,013,327	42.34%
Colorado	570	190	446,231	33.37%	740	300	587,055	40.27%	1,350	680	3,892,572	49.51%
Connecticut	490	160	272,723	28.61%	410	160	378,772	37.45%	1,120	540	2,455,251	49.26%
Delaware	450	180	73,577	35.30%	590	260	92,181	44.50%	970	500	689,084	49.61%
District of Columbia	350	150	33,728	44.53%	330	210	76,598	69.14%	660	410	459,074	59.72%
Florida	1,340	530	1,515,024	41.09%	1,350	640	1,926,018	47.66%	3,040	1,450	15,284,364	47.31%
Georgia	890	420	913,170	45.96%	960	470	1,118,065	51.00%	2,060	990	6,971,153	45.54%
Hawaii	580	170	97,954	33.46%	640	250	117,389	38.48%	1,590	650	967,749	38.88%
Idaho	570	190	170,496	33.37%	370	160	194,262	43.12%	950	520	1,218,885	51.37%
Illinois	1,190	350	1,010,183	32.40%	1,260	470	1,275,485	33.86%	2,720	1,270	8,425,572	40.78%
Indiana	550	230	560,432	47.08%	680	310	735,781	47.67%	1,380	710	4,396,803	49.68%
Iowa	610	220	260,546	34.20%	480	230	352,606	42.98%	1,220	620	2,069,110	48.12%
Kansas	770	310	248,490	41.15%	980	430	318,285	38.36%	1,900	940	1,855,924	44.33%
Kentucky	550	220	355,789	47.12%	570	270	457,909	46.67%	1,130	630	2,958,969	52.72%
Louisiana	570	220	374,804	41.52%	550	220	453,214	36.20%	1,340	620	2,994,399	43.87%
Maine	500	180	92,597	35.99%	520	210	121,056	43.71%	1,080	560	986,422	53.57%
Maryland	750	340	476,715	40.81%	730	350	586,757	46.07%	1,500	810	4,123,592	47.80%
Massachusetts	430	120	489,322	29.34%	550	220	774,583	41.07%	1,170	580	4,786,102	45.26%
Michigan	1,510	570	770,114	36.06%	1,450	640	1,046,218	43.95%	3,270	1,710	6,760,557	52.09%
Minnesota	480	150	463,273	33.40%	430	200	563,299	43.15%	1,000	520	3,778,076	47.90%
Mississippi	490	230	251,241	46.26%	380	190	303,082	48.23%	1,010	580	1,894,942	54.58%

See notes at end of table.

(continued)

Table C.2 Sample Sizes, Weighted Interview Response Rates, and Population Estimates; by State and Three Age Groups: 2021 (continued)

State	12-17 Total Selected People	12-17 Total Respondents	12-17 Population Estimate	12-17 Weighted Interview Response Rate	18-25 Total Selected People	18-25 Total Respondents	18-25 Population Estimate	18-25 Weighted Interview Response Rate	26+ Total Selected People	26+ Total Respondents	26+ Population Estimate	26+ Weighted Interview Response Rate
Missouri	440	140	486,555	38.16%	460	210	621,371	46.49%	960	510	4,073,435	48.78%
Montana	370	110	83,053	31.96%	350	140	111,204	37.19%	730	440	744,965	58.44%
Nebraska	520	170	167,182	34.51%	610	300	212,264	45.43%	1,270	670	1,242,979	47.96%
Nevada	570	230	246,567	45.27%	620	280	284,837	42.71%	1,290	640	2,126,441	48.52%
New Hampshire	510	190	95,411	41.38%	550	220	138,311	43.83%	1,190	570	980,998	48.02%
New Jersey	840	270	719,971	30.39%	870	350	872,319	40.15%	1,480	660	6,276,850	45.78%
New Mexico	440	200	172,756	39.36%	510	240	214,873	43.83%	1,020	580	1,393,259	52.55%
New York	1,140	440	1,407,192	38.11%	1,350	660	1,975,502	46.90%	3,210	1,600	13,534,221	49.11%
North Carolina	680	290	823,515	45.43%	540	270	1,059,223	44.65%	1,370	760	6,997,864	51.29%
North Dakota	430	140	60,339	34.11%	460	230	90,326	50.09%	1,010	550	483,561	47.91%
Ohio	1,450	500	919,931	35.74%	1,650	690	1,182,393	36.73%	3,220	1,540	7,837,257	44.42%
Oklahoma	550	210	334,862	35.05%	510	210	420,050	45.25%	1,020	550	2,532,461	54.30%
Oregon	620	210	308,408	30.30%	830	330	407,507	40.46%	1,560	740	2,942,769	42.84%
Pennsylvania	1,040	380	949,324	35.65%	1,160	460	1,267,925	37.60%	2,390	1,230	8,841,312	51.05%
Rhode Island	350	100	74,798	29.68%	320	130	122,791	43.35%	850	460	749,814	50.39%
South Carolina	380	160	399,457	43.04%	390	200	502,860	56.94%	810	480	3,489,012	57.60%
South Dakota	410	130	74,669	36.47%	440	220	91,353	43.36%	890	500	568,093	49.78%
Tennessee	490	170	542,631	35.79%	470	230	689,135	48.28%	890	470	4,646,107	53.41%
Texas	1,590	650	2,625,037	41.96%	1,610	730	3,151,861	44.25%	3,600	1,760	18,462,746	48.51%
Utah	880	360	337,975	42.07%	850	390	428,034	45.56%	1,960	1,080	1,941,181	56.75%
Vermont	650	270	43,072	42.41%	660	290	73,259	44.33%	1,580	830	450,625	57.47%
Virginia	1,140	580	659,759	50.18%	1,080	590	869,866	50.21%	2,340	1,310	5,699,831	52.98%
Washington	570	140	578,426	24.67%	640	210	730,514	31.78%	1,370	590	5,230,511	41.28%
West Virginia	500	210	128,663	45.76%	420	220	171,603	51.22%	950	510	1,228,673	43.14%
Wisconsin	620	250	461,262	39.96%	870	420	613,380	46.87%	1,570	820	3,945,702	54.20%
Wyoming	250	<100	47,929	41.78%	360	200	56,821	53.63%	650	380	381,333	59.89%

NOTE: Computations in this table are based on a respondent's age at screening. Thus, the data in the Total Respondents column(s) could differ from data in other National Survey on Drug Use and Health tables that use the respondent's age recorded during the interview.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2021.

Table C.3 Sample Sizes, Weighted Interview Response Rates, and Population Estimates; by State and Two Age Groups: 2021

State	12-20 Total Selected People	12-20 Total Respondents	12-20 Population Estimate	12-20 Weighted Interview Response Rate	18+ Total Selected People	18+ Total Respondents	18+ Population Estimate	18+ Weighted Interview Response Rate
Total U.S.	48,710	19,030	39,093,526	39.90%	116,790	56,580	253,824,662	47.03%
Northeast	8,270	3,100	6,472,180	37.18%	20,460	9,730	44,786,109	47.93%
Midwest	12,440	4,590	8,144,512	37.66%	30,150	14,670	52,539,830	46.49%
South	16,030	6,850	15,096,995	43.65%	36,970	18,570	96,435,590	48.88%
West	11,960	4,490	9,379,838	37.60%	29,220	13,600	60,063,133	43.86%
Alabama	970	350	588,696	39.18%	2,240	910	3,847,398	40.57%
Alaska	670	270	88,221	40.59%	1,550	790	526,851	49.80%
Arizona	720	270	885,858	38.12%	1,770	770	5,574,029	42.90%
Arkansas	630	210	370,837	30.66%	1,590	770	2,277,503	49.88%
California	3,100	1,220	4,720,697	39.12%	7,510	3,250	29,990,092	41.95%
Colorado	830	290	688,166	35.27%	2,090	980	4,479,628	48.30%
Connecticut	640	210	378,959	29.13%	1,520	700	2,834,023	47.71%
Delaware	680	290	108,581	38.65%	1,560	770	781,265	48.93%
District of Columbia	430	200	54,718	52.84%	990	620	535,672	61.12%
Florida	1,850	780	2,422,602	44.88%	4,390	2,090	17,210,381	47.35%
Georgia	1,240	590	1,390,797	48.88%	3,020	1,460	8,089,218	46.25%
Hawaii	800	260	144,468	36.79%	2,220	900	1,085,138	38.84%
Idaho	700	230	227,513	33.45%	1,320	680	1,413,147	50.20%
Illinois	1,650	500	1,520,941	31.86%	3,980	1,730	9,701,057	39.89%
Indiana	800	330	821,526	45.61%	2,050	1,020	5,132,584	49.40%
Iowa	790	310	410,952	37.82%	1,700	850	2,421,716	47.42%
Kansas	1,120	460	355,573	40.05%	2,880	1,360	2,174,209	43.42%
Kentucky	740	300	536,035	46.20%	1,700	900	3,416,877	51.93%
Louisiana	770	300	556,021	40.82%	1,890	850	3,447,613	42.84%
Maine	700	250	134,837	37.63%	1,600	780	1,107,478	52.45%
Maryland	1,020	460	692,128	43.95%	2,230	1,160	4,710,349	47.57%
Massachusetts	620	190	829,183	32.25%	1,720	790	5,560,684	44.71%
Michigan	2,030	790	1,152,891	38.26%	4,710	2,360	7,806,775	50.95%
Minnesota	660	220	699,739	36.97%	1,420	720	4,341,374	47.28%
Mississippi	630	290	334,606	43.55%	1,380	770	2,198,024	53.75%

See notes at end of table.

(continued)

Table C.3 Sample Sizes, Weighted Interview Response Rates, and Population Estimates; by State and Two Age Groups: 2021 (continued)

State	12-20 Total Selected People	12-20 Total Respondents	12-20 Population Estimate	12-20 Weighted Interview Response Rate	18+ Total Selected People	18+ Total Respondents	18+ Population Estimate	18+ Weighted Interview Response Rate
Missouri	590	200	678,153	39.73%	1,420	720	4,694,806	48.49%
Montana	480	150	115,066	29.23%	1,080	580	856,169	55.51%
Nebraska	730	280	250,908	38.62%	1,880	960	1,455,243	47.58%
Nevada	800	340	365,145	45.57%	1,910	930	2,411,278	47.84%
New Hampshire	720	270	143,496	41.55%	1,750	790	1,119,308	47.51%
New Jersey	1,140	410	1,123,258	36.55%	2,350	1,010	7,149,169	45.08%
New Mexico	620	270	236,762	39.24%	1,530	820	1,608,131	51.43%
New York	1,610	690	2,213,206	41.20%	4,560	2,260	15,509,722	48.85%
North Carolina	840	370	1,114,671	44.18%	1,900	1,030	8,057,088	50.49%
North Dakota	580	210	91,205	38.08%	1,470	780	573,887	48.26%
Ohio	2,030	730	1,390,643	35.59%	4,870	2,230	9,019,650	43.40%
Oklahoma	730	270	470,056	37.67%	1,530	760	2,952,510	52.90%
Oregon	900	330	452,306	34.68%	2,390	1,070	3,350,276	42.56%
Pennsylvania	1,490	560	1,452,682	36.16%	3,550	1,700	10,109,237	49.33%
Rhode Island	460	150	124,350	31.78%	1,170	590	872,604	49.57%
South Carolina	530	230	575,655	45.15%	1,200	680	3,991,871	57.52%
South Dakota	530	180	109,996	39.70%	1,330	720	659,446	48.81%
Tennessee	630	220	776,875	37.05%	1,360	700	5,335,241	52.73%
Texas	2,200	920	3,939,985	42.71%	5,220	2,490	21,614,607	47.87%
Utah	1,170	490	496,773	43.63%	2,810	1,470	2,369,215	54.65%
Vermont	900	380	72,209	42.31%	2,240	1,110	523,883	55.67%
Virginia	1,490	780	975,161	51.78%	3,420	1,890	6,569,697	52.63%
Washington	800	210	888,724	26.91%	2,010	800	5,961,025	40.10%
West Virginia	650	290	189,574	46.84%	1,370	730	1,400,276	44.16%
Wisconsin	930	390	661,986	40.26%	2,430	1,240	4,559,082	53.22%
Wyoming	380	160	70,139	44.96%	1,010	580	438,154	59.02%

NOTE: Computations in this table are based on a respondent's age at screening. Thus, the data in the Total Respondents column(s) could differ from data in other National Survey on Drug Use and Health tables that use the respondent's age recorded during the interview.

Source: SAMHSA, Center for Behavioral Health Statistics and Quality, National Survey on Drug Use and Health, 2021.

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Section E: List of Contributors

This National Survey on Drug Use and Health (NSDUH) document was prepared by the Center for Behavioral Health Statistics and Quality (CBHSQ), Substance Abuse and Mental Health Services Administration (SAMHSA), U.S. Department of Health and Human Services (HHS), and by RTI International, Research Triangle Park, North Carolina. Work by RTI was performed under Contract No. HHSS283201700002C. Marlon Daniel served as government project officer and as the contracting officer representative.

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