

Methodological Considerations in Estimating Adolescent Substance Use*

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Abstract

The Federal government relies primarily on three major national surveys in tracking adolescents' use of alcohol, tobacco, and illicit drugs. The National Survey on Drug Use and Health (NSDUH), Monitoring the Future Study (MTF), and the national Youth Risk Behavior Survey (YRBS) have shown similar trends in substance use over the past decade, but the surveys show significant differences in the levels of use of some substances. The school-based surveys (MTF and YRBS) generally report higher rates of use than the household survey (NSDUH). Prior methodological research has explored how various design features such as mode, setting, privacy, question wording, and coverage may affect substance use estimates from the surveys. This paper explores these factors based on new analyses of combined 2002-2008 data from the surveys. The findings will aid policymakers, program officials, and researchers in understanding and interpreting data from these surveys, and will also be useful to survey statisticians planning designs for other studies of adolescent behavior.

Keywords: Substance use, adolescents, surveys, mode, setting, coverage

1. Introduction

The Federal government relies primarily on three major national surveys in tracking adolescents' use of alcohol, tobacco, and illicit drugs: The National Survey on Drug Use and Health (NSDUH), Monitoring the Future Study (MTF), and the national Youth Risk Behavior Survey (YRBS). NSDUH is an in-person survey conducted principally in households. The other two surveys are in-school surveys. School-based surveys such as MTF and YRBS have typically yielded higher estimates of substance use compared with surveys conducted in household settings (Gfroerer, Wright, & Kopstein, 1997; Kann et al., 2002; Office of Applied Studies [OAS], 2009). Brener et al. (2006) randomly assigned high school students in grades 9 and 11 to school-based and household survey settings and found that the odds of reporting most substance use behaviors (adjusted for gender, race/ethnicity, and age) were significantly greater for surveys administered in the school setting than for those conducted in the home setting; however, significant differences by survey setting were not observed for lifetime or current (i.e., past 30 day) use of cigarettes, current use of cigars, or lifetime use of "Ecstasy" (MDMA). Griesler, Kandel, Schaffran, Hu, and Davies (2008) examined data

* This report is released to inform interested parties of (ongoing) research and to encourage discussion (of work in progress). Any views expressed on (statistical, methodological, technical, or operational) issues are those of the author(s) and not necessarily those of the authors' organizations.

on inconsistent reporting of cigarette use among students in grades 7 through 12 who were initially surveyed in schools between September 1994 and April 1995 and then were followed up in households in Wave I (April to December 1995) of the National Longitudinal Survey of Adolescent Health ("Add Health"). The authors reported that among youths in the school-based interviews who reported smoking cigarettes in the past 12 months, 8.6 percent reported having never smoked cigarettes on follow-up in the household interviews. In particular, younger adolescents were more likely than older adolescents and those who were black or Hispanic were more likely than whites to give these inconsistent reports in the household setting.

It has been suggested that adolescents—particularly younger adolescents and members of racial or ethnic minorities—may underreport sensitive behaviors such as substance use in household surveys out of concerns about privacy and the confidentiality of their answers, especially if a parent may be present nearby (Brener et al., 2006; Fendrich & Johnson, 2001; Gfroerer et al., 1997; Griesler et al., 2008; Johnson & Bowman, 2003; Kann et al., 2002). However, Fendrich and Johnson (2001) suggested that privacy issues did not completely explain the differences in adolescent substance use estimates between the school-based and household surveys that they compared. Other factors that can contribute to differences in estimates between surveys include differences in procedures for obtaining parental permission and assent from adolescents, sponsor and content of survey, question wording, mode of administration, procedures for handling missing or inconsistent data, and differences in nonresponse bias.

In addition, the phenomenon that Griesler et al. (2008) referred to as "inconsistent reporting" has been referred to elsewhere as "recanting" in longitudinal studies (Fendrich, 2005; Fendrich & Rosenbaum, 2003). This occurs when respondents report use of a particular substance in an earlier survey wave and then deny having ever used that substance in one or more subsequent waves. This phenomenon is not unique to whether respondents were surveyed in schools in an earlier wave and administered follow-up surveys in household settings in subsequent waves.

With adolescents, two factors that may contribute to differences in estimates of substance use within a longitudinal survey at different points in time or between two separate surveys that cover the same period are underreporting and overreporting. Underreporting could occur if youths perceive substance use in general or use of a specific substance to be socially undesirable behavior, or if they have concerns that parents or teachers might later find out how the survey questions were answered. If youths in "Survey A" who have used a given substance are less comfortable than those in "Survey B" in reporting their use, then Survey A may yield a lower estimate. Underreporting of use also could account for situations in which youths reported use in an earlier interview but subsequently deny use in a later interview because of their recognition that the substance use was socially undesirable behavior.

Differences in substance use estimates between surveys could also occur because of overreporting of use. That is, some youths may report use, or more recent use, even though they never used a substance or did not use it recently (e.g., in the past year or past month). Youths who have not used a substance may report use if they misunderstand the question or if they are motivated to report use because their peers view the behavior as "cool." These kinds of reporting errors would presumably be more likely to occur in a classroom setting if students believed their peers could see their responses, than in a home setting, and among younger adolescents. As they mature, youths may provide more accurate answers (i.e., no use) in a subsequent interview (Fendrich & Rosenbaum, 2003).

As the lead Federal entity with the responsibility for collecting substance use data, the Center for Behavioral Health Statistics and Quality (CBHSQ), within the Substance Abuse and Mental Health Services Administration (SAMHSA) also has the

responsibility to provide appropriate context and information to users of NSDUH and other youth substance use data. Specifically, CBHSQ working in conjunction with other federally-funded sources of adolescent substance use can provide information on possible reasons for any differences in estimates between the surveys, how to interpret trends and patterns in substance use, and how to best analyze these data. This paper describes a series of analyses undertaken to accomplish this goal. Most of the results described in this paper are from a more detailed report, which includes complete descriptions of the methods (SAMHSA, forthcoming). Policymakers need to understand the implications of the differences in estimates and potential sources of error or bias when interpreting findings from these surveys. Understanding sources of measurement error or bias also is critical for identifying ways to reduce these sources of error.

2. Data Sources Used in this Study

A summary comparison of the design features of the three surveys is shown in Table 1 and discussed in the sections below. As is evident from the table, there are important differences between these surveys for every one of the design characteristics listed.

2.1 National Survey on Drug Use and Health (NSDUH)

NSDUH is the primary source of statistical information on the use of illegal drugs by the U.S. population. Conducted by the Federal Government since 1971, the survey collects data by administering questionnaires to a representative sample of the population through face-to-face interviews at the respondent's place of residence. The survey is sponsored by SAMHSA, U.S. Department of Health and Human Services, and is planned and managed by CBHSQ. Data collection and analysis are conducted under contract with RTI International, Research Triangle Park, North Carolina.[†]

NSDUH collects information from residents of households and noninstitutional group quarters (e.g., shelters, rooming houses, dormitories) and from civilians living on military bases. The survey excludes homeless persons who do not use shelters, military personnel on active duty, and residents of institutional group quarters, such as jails and hospitals. The 2002 to 2008 NSDUHs used a State-based design with an independent, multistage area probability sample within each State and the District of Columbia. Dwelling units were selected within clusters of census blocks called area segments (for 2002 to 2004) or within census tracts (for 2005 to 2008), and zero, one, or two persons aged 12 or older were selected for the interview within dwelling units. A representative sample of segments was selected each quarter. The design oversampled adolescents aged 12 to 17 and young adults aged 18 to 25.

Since 1999, the NSDUH interview has been carried out in English or Spanish using computer-assisted interviewing (CAI). Most of the questions are administered with audio computer-assisted self-interviewing (ACASI). Less sensitive items are administered by interviewers using computer-assisted personal interviewing (CAPI). Since 2002, respondents have been given \$30 for completing the interview.

Data from the 2002 to 2008 NSDUHs for this analysis contained 220,955 completed interviews from persons aged 12 to 20; including 158,995 interviews from youths aged 12 to 17 and 61,960 interviews from young adults aged 18 to 20. In addition, the subset of respondents aged 12 to 20 in the 2002 to 2008 NSDUHs who were interviewed in January through June and reported being enrolled in 8th through 12th

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

grades was relevant for comparison of NSDUH estimates with corresponding estimates from MTF or YRBS, which are administered in schools in the spring.

Table 1. Design Features of NSDUH, MTF, and YRBS.

Design Characteristic	NSDUH	MTF	YRBS
<i>Population Covered</i>	Ages 12 and older (youth: 12-17)	8 th , 10 th and 12 th graders	9 th through 12 th graders
<i>Sample size (2009)</i>	Total: 68,700 12-17: 22,626	46,097 students (in 389 schools)	16,410 students (in 158 schools)
<i>Design effect (2009, current marijuana use)</i>	1.9 for 12-17	8.1 for 12 th 4.7 for 10 th 4.3 for 8 th	5.5 for combined 9 th -12 th
<i>Response Rate (youth, 2009)</i>	Household: 89% Interview: 86% Overall: 76%	School: 54% Student: 86% Overall: 46%	School: 81% Student: 88% Overall: 71%
<i>Follow up of initial nonrespondents</i>	Yes	No	Yes (absentees)
<i>Period of collection</i>	January-December	Spring	Spring
<i>Setting</i>	Household	Classroom	Classroom
<i>Mode</i>	ACASI	Self Admin PAPI	Self Admin PAPI
<i>Primary content</i>	Substance Use	Substance Use	Risk Behaviors
<i>Question wording for current use of marijuana</i>	Have you ever, even once, used marijuana or hashish? <i>If yes, then:</i> How long has it been since you last used marijuana or hashish? 1- Within the past 30 days 2- More than 30 days ago but within the past 12 months 3- More than 12 months ago	On how many occasions (if any) have you used marijuana (grass, pot) or hashish (hash, hash oil) during the last 30 days? A. 0 occasions B. 1-2 occasions C. 3-5 occasions D. 6-9 occasions E. 10-19 occasions F. 20-39 occasions G. 40 or more occasions	During the past 30 days, how many times did you use marijuana? A. 0 times B. 1 or 2 times C. 3 to 9 times D. 10 to 19 times E. 20 to 39 times F. 40 or more times

2.2 Monitoring the Future (MTF)

MTF is an ongoing study of substance use trends and related attitudes among America's secondary school students, college students, and adults through the age of 50. The study is conducted annually by the Institute for Social Research at the University of Michigan through grants awarded by the National Institute on Drug Abuse (NIDA). MTF and NSDUH are the Federal Government's largest and primary tools for tracking youth substance use. The MTF comprises three substudies: (1) an annual survey of high school seniors that was initiated in 1975; (2) ongoing panel studies of representative samples from each graduating class that have been conducted by mail since 1976; and (3) annual surveys of 8th and 10th graders that were initiated in 1991. In the spring, students

complete a self-administered, machine-readable paper-and-pencil questionnaire during a regular class period. The survey annually samples an average of about 400 public and private schools and about 50,000 students.

The 2002 to 2008 MTF public use data for 8th, 10th, and 12th graders include a final sample size of 333,837. For additional details about MTF, see the MTF website at <http://www.monitoringthefuture.org/>.

2.3 Youth Risk Behavior Survey (YRBS)

The national YRBS is a component of CDC's Youth Risk Behavior Surveillance System (YRBSS), which measures the prevalence of six priority health risk behavior categories: (1) behaviors that contribute to unintentional injuries and violence; (2) tobacco use; (3) alcohol and other drug use; (4) sexual behaviors that contribute to unintended pregnancy and sexually transmitted diseases, including human immunodeficiency virus infection; (5) unhealthy dietary behaviors; and (6) physical inactivity, plus asthma and obesity. YRBSS includes national, State, territorial, and local school-based surveys of high school students conducted every 2 years. The national YRBS, which was used for this study, uses a three-stage cluster sample design to produce a nationally representative sample of students in grades 9 through 12 who attend public and private schools. Schools are selected with probability proportional to enrollment size in grades 9 through 12, and black and Hispanic students are oversampled. Classes are selected randomly within schools. The national YRBS has been conducted during the spring of every odd-numbered year since 1991, with students completing a self-administered, machine-readable paper-and-pencil questionnaire during a regular class period. Schools are given \$500 for agreeing to participate.

The 2003, 2005, and 2007 YRBS public use data included a final sample of 43,172. For further details about YRBS, see the CDC website at <http://www.cdc.gov/HealthyYouth/yrebs/>.

3. Measures of Substance Use

NSDUH, MTF, and YRBS include questions to measure adolescents' use of cigarettes and other tobacco products, alcohol, and illicit drugs, including marijuana, cocaine, heroin, Ecstasy (MDMA), and inhalants. These surveys measure use in one or more of the following periods: (1) at any point in a person's lifetime, (2) in the 12-month period prior to taking the survey (i.e., past year use), or (3) in the 30-day period prior to taking the survey (i.e., past month use).

Although all three surveys may report estimates on a similar measure (e.g., past month cigarette use), the surveys do not measure these behaviors identically. In particular, NSDUH respondents first are asked whether they ever used specific substances in their lifetime. Those who report lifetime use of a given substance are asked more detailed questions about use of that substance. In NSDUH, past year and past month users are identified through questions on when they last used a substance. Because the computer-assisted logic in NSDUH skips respondents out of additional questions about a given substance if they do not report lifetime use, NSDUH respondents cannot report use of a substance in the past year or past month without also reporting lifetime use. In contrast, the paper-and-pencil administration for MTF and YRBS can allow respondents to leave a question blank for lifetime use but to report more recent use. In addition, MTF and YRBS estimate use of most substances from questions about the number of "occasions" (MTF) or "times" (YRBS) that respondents used a substance in the period of interest; respondents who report use on one or more occasions/times in that period are defined as users.

4. Measures of Demographic Characteristics

This section describes key measures of demographic characteristics that were used in this study. For analyses comparing NSDUH estimates for persons in school with corresponding estimates from MTF or YRBS, NSDUH respondents' current (or upcoming) grade in school was defined according to (1) their report that they were currently enrolled in school (or were on break but intended to return to school when their break was over) and (2) their current grade in school (or the grade they would be in when they returned following their break). NSDUH respondents who had missing data for their school enrollment or current grade were excluded from these analyses.

Analyses comparing NSDUH and YRBS estimates and those conducted only with NSDUH data are presented for racial/ethnic groups based on current guidelines for collecting and reporting race and ethnicity data (Office of Management and Budget [OMB], 1997). The "two or more races" category includes persons who reported more than one category among the basic groups listed in the survey question (white, black or African American, American Indian or Alaska Native, Native Hawaiian, other Pacific Islander, Asian, other). Except for the "Hispanic or Latino" group, the racial/ethnic groups for NSDUH and YRBS include only non-Hispanics. The category "Hispanic or Latino" includes Hispanics of any race.

For analyses comparing NSDUH and MTF estimates by race/ethnicity, data are presented for the following groups: white, black, and Hispanic. Because of changes to the MTF questionnaire in 2005, MTF estimates for Hispanics are based on data only from the 2005 through 2008 surveys. MTF estimates for persons classified as white or black in 2002 through 2004 may include persons in these groups who were of Hispanic origin. NSDUH estimates for persons who were white or black exclude persons who were Hispanic or who reported two or more races. However, overall NSDUH estimates for youths aged 12 to 20 or within a given grade include members of other racial/ethnic groups (see previous paragraph) in addition to persons who were non-Hispanic white, non-Hispanic black, or Hispanic.

5. Analysis Plan

The study can be divided into three main parts. The first part examined estimates of substance use from NSDUH with estimates from MTF and YRBS. Differences in levels of use, demographic patterns of use, and trends in use were examined. These comparisons were made within specific grades. The NSDUH data for comparisons with MTF and YRBS were limited to enrolled students and data that were collected between January and June. The second part used NSDUH data to examine the potential effects on substance use estimates because of school dropouts and youths who were absent from school. The third part examined relationships between the privacy of NSDUH interviews and substance use estimates. Estimates for NSDUH and MTF are based on combined data from the respective 2002 through 2008 surveys. YRBS estimates are based on combined data from the 2003, 2005, and 2007 surveys.

Weighted estimates and the associated standard errors (SEs), were computed using the SUDAAN[®] Software for Statistical Analysis of Correlated Data. SUDAAN also was used to conduct tests of statistical significance between estimates within a given survey (e.g., NSDUH) or between surveys (e.g., NSDUH vs. MTF). Differences were defined as being statistically significant at the .05 level of significance. Terms in this paper such as "higher than" or "more likely than" denote statistical significance.

For significance testing within NSDUH, SUDAAN produced t statistics that accounted for the degrees of freedom because the variance structure was known. The Z statistic was used for testing within MTF and YRBS and for testing between surveys (e.g., between NSDUH and MTF) because the degrees of freedom were not known for MTF and YRBS. Given the large sample sizes for the combined data for MTF and YRBS, however, the degrees of freedom for the other two surveys were assumed to be large enough for the two statistics to be equivalent.

6. Key Results

6.1 Comparison of Prevalence Rates

In most cases, NSDUH estimates of substance use for students in school were lower than corresponding estimates from MTF and YRBS. In addition, YRBS estimates for 10th and 12th graders tended to be higher than MTF estimates (Table 2). Examples include the following:

- Among 12th graders, the prevalence of current (i.e., past month) alcohol use was 53.9 percent for YRBS, 46.3 percent for MTF, and 38.8 percent for NSDUH. The prevalence of current marijuana use among 12th graders was 24.6 percent for YRBS, 19.9 percent for MTF, and 15.7 percent for NSDUH.
- An exception to this general pattern was observed for current cigarette use. The NSDUH estimate similar to the corresponding MTF estimate and lower than the YRBS estimate for 10th graders. However, the NSDUH estimate of current cigarette use in the 12th grade (25.5 percent) was comparable to the YRBS estimate (26.7 percent) and higher than the MTF estimate (23.2 percent).

Table 2. Substance Use Estimates (Percentages), by Grade and Survey: 2002-2008

Substance Use	10 th Grade Prevalences (SEs)			12th Grade Prevalences (SEs)		
	NSDUH	MTF	YRBS	NSDUH	MTF	YRBS
Cigarettes, Past Month	15.4 (.40)	15.1 (.29)	20.9 (.88)	25.5 (.54)	23.2 (.36)	26.7 (1.08)
Alcohol, Past Month	23.5 (.47)	33.8 (.38)	42.5 (1.11)	38.8 (.63)	46.3 (.42)	53.9 (1.28)
Marijuana, Past Month	10.4 (.35)	15.5 (.27)	20.5 (.81)	15.7 (.45)	19.9 (.42)	24.6 (.97)
Inhalants, Lifetime	11.6 (.38)	13.1 (.26)	12.9 (.51)	10.4 (.36)	10.9 (.35)	10.7 (.55)
Cocaine, Lifetime	3.1 (.20)	5.3 (.19)	7.6 (.41)	6.8 (.35)	7.9 (.25)	9.6 (.51)
Heroin, Lifetime	0.4 (.07)	1.5 (.05)	2.4 (.22)	0.6 (.10)	1.5 (.06)	2.5 (.24)

6.2 Demographic Correlates

In general, these three surveys show similar findings on which subgroups of adolescents have relatively higher or lower substance use estimates. Examples include the following:

- In all three surveys, males in the 12th grade were more likely than females in this grade to be current users of cigarettes, marijuana, and cocaine. For example, the

12th grade prevalence of current marijuana use in NSDUH was 18.7 percent for males and 12.4 percent for females; in MTF, it was 22.9 percent for males and 16.4 percent for females and in YRBS, it was 28.0 percent for males and 21.2 percent for females.

- In two of the three surveys (NSDUH and MTF but not YRBS), males in the 12th grade were more likely than their female counterparts to be current alcohol users (NSDUH: 42.1 vs. 35.2 percent; MTF: 49.3 vs. 43.3 percent; YRBS: 54.5 vs. 53.1 percent).
- In all three surveys, whites in the 12th grade were more likely than blacks in this grade to be current cigarette users, current alcohol users, or current cocaine users. In NSDUH and MTF, but not YRBS, whites in the 12th grade also were more likely than 12th grade Hispanics to be current cigarette users. For example, the prevalence of current cigarette use in NSDUH among 12th graders was 29.3 percent for whites, 22.0 percent for Hispanics, and 15.1 percent for blacks. In MTF, 26.9 percent of 12th grade whites, 15.4 percent of 12th grade Hispanics, and 10.4 percent of blacks in this grade were current cigarette users. Among 12th graders in YRBS, 30.5 percent of whites and 14.4 percent of blacks were current cigarette users.
- Two of the three surveys (NSDUH and MTF) also indicated that whites in the 12th grade were more likely than Hispanics to be current marijuana users. In NSDUH, the prevalence of current marijuana use among 12th graders was 17.1 percent for whites and 13.5 percent for Hispanics. For 12th graders in MTF, 21.3 percent of whites and 15.6 percent of Hispanics were current marijuana users. The YRBS estimates were 24.5 percent for whites and 24.9 percent for Hispanics.

6.3 Trend Measurement

NSDUH and MTF, which are conducted annually, generally provide similar findings about changes over time (i.e., trends) in the prevalence of use of cigarettes, alcohol, and marijuana among 12th graders. Examples include the following:

- Both surveys indicated that a lower percentage of 12th graders in 2008 had ever tried a cigarette (NSDUH: 45.2 percent; MTF: 44.7 percent) than in 2002 (NSDUH: 61.3 percent; MTF: 57.2 percent). The surveys also showed that the prevalence of current cigarette use among 12th graders was lower in 2008 (NSDUH: 23.4 percent; MTF: 20.4 percent) than in 2002 (NSDUH: 28.2 percent; MTF: 26.7 percent).
- The prevalence of current alcohol use among 12th graders in NSDUH decreased from 38.7 percent in 2002 to 36.6 percent in 2008. For MTF, the prevalence decreased from 48.6 percent in 2002 to 43.1 percent in 2008.
- In NSDUH, the prevalence of current marijuana use among 12th graders decreased from 18.2 percent in 2002 to 13.6 percent in 2008. However, the prevalence did not decrease significantly for MTF over this period (21.5 percent in 2002 and 19.4 percent in 2008).

6.4 Potential Reporting Anomalies for Inhalants and Heroin

Another characteristic common to these surveys is that all three of them identified the same counterintuitive phenomenon of *decreasing* prevalence of lifetime inhalant use from the lowest to the highest grades. Because the cohort of youths who used

a substance in an earlier grade remains lifetime users in subsequent grades, the lifetime prevalence of use is expected to increase as grade increases. This expected pattern was evident in the data for most other substances. However, a lower prevalence of lifetime inhalant use among 12th graders than among students in the lowest grades was found in all three of these surveys.

In NSDUH, the pattern for lifetime heroin use among students was in the expected direction, with youths in higher grades being more likely than those in lower grades to be lifetime users. Specifically, the prevalence of lifetime heroin use in NSDUH was higher among 12th graders (0.6 percent) than among 8th or 9th graders (0.1 and 0.3 percent, respectively). In contrast, the school-based surveys did not show this pattern of increasing lifetime prevalence of heroin use as the grade increased. For MTF, the estimated lifetime prevalence of heroin use was 1.5 percent among students in the 8th, 10th, and 12th grades. In YRBS, the estimate of lifetime heroin use was 2.4 percent among 10th graders and 2.5 percent among 12th graders; among 11th graders, the rate was lower than the estimate for 9th graders (2.2 vs. 3.0 percent).

These apparent anomalies require further study to more clearly explain the reporting biases associated with these two substances, but they suggest potential underreporting of prior inhalant use by older teens within school-based surveys, and overreporting of heroin use by younger teens. Until these issues can be analyzed more extensively, caution is warranted for the interpretation of patterns of use of heroin and inhalants among youths based on self-report data.

6.5 School Dropouts

School-based surveys such as MTF and YRBS are designed to make inferences only for the population of adolescents who are in school. However, policymakers and others may use data inappropriately from school-based surveys to make inferences about substance use among all adolescents in the United States. The accuracy of inferences about adolescents as a whole based on school-based survey data will depend on the contribution of school dropouts to measurement of adolescent substance use; dropouts generally have a higher prevalence of substance use than youths who are in school.

To assess the effects of dropouts on estimates of adolescent substance use, analyses were conducted on combined 2002 to 2008 NSDUH data, including data collected during all 12 months, for persons aged 12 to 20. For these analyses, dropouts were assumed to be at a particular grade level (i.e., if they had remained in school) based on their current age, the highest school grade they completed, and the age at which they left school. Rates of substance use were generally much higher for dropouts than students at each grade level and for all substances (Table 3). At each grade level, estimates that included dropouts and youths who were in school also were compared with estimates from only the youths who were in school. Examples include the following:

- Because there were so few dropouts at the 8th or 9th grade levels, dropouts had a relatively small effect on the overall percentages of 8th and 9th grade level youths who are estimated to be substance users. At the 8th grade level, for example, inclusion of data from dropouts in addition to data from those who were in school had no effect on estimates to the nearest tenth of a percent for current use of cigarettes (4.9 percent with dropouts or without dropouts), past year use of marijuana (5.7 percent for both estimates), or past year use of cocaine (0.4 percent for both estimates).
- At the 12th grade level, where dropout rates are highest, inclusion of data from dropouts increased overall estimates of current use of substances by varying degrees. For example, estimates that included dropouts were about 1.4 times the

estimates without dropouts for current use of cocaine and Ecstasy and were about 1.3 times the estimate for cigarettes. For cigars, binge alcohol use, and marijuana, the rates were about 1.1 times the estimates without dropouts. The impact was smaller for alcohol, smokeless tobacco, and inhalant use. For heroin, the estimate of lifetime use with dropouts was about 1.7 times the estimate without dropouts.

- Inclusion of data from dropouts at the 12th grade level had a more notable impact on estimates of the numbers of substance users; information on numbers of substance users is important for estimating the size of the adolescent population needing early intervention or treatment services. Specifically, if estimates for all adolescents were desired or needed, exclusion of dropouts at the 12th grade level would miss about 40 percent of the current cigarette users, about 25 percent of the current alcohol users, about 30 percent of the current binge alcohol users, about 30 percent of the current marijuana users, more than half of the past year cocaine users, and more than half of the lifetime Ecstasy users at this grade level.

Table 3. Percentages Using Substances among Youths Age-appropriate for 12th Grade, by Enrollment Status, 2002-2008

Substance Use	Total	Enrolled	Not Enrolled
Cigarettes, Past Month	31.4 (.36)	24.3 (.37)	55.3 (.88)
Alcohol, Past Month	38.6 (.38)	36.7 (.42)	45.0 (.87)
Marijuana, Past Month	17.1 (.30)	15.2 (.31)	23.4 (.77)
Inhalants, Past Year	3.1 (.13)	3.2 (.15)	2.7 (.29)
Cocaine, Past Year	5.4 (.19)	4.1 (.19)	9.4 (.51)
Heroin, Lifetime	1.0 (.08)	0.6 (.07)	2.5 (.25)

6.6 Absentees

In addition, school-based surveys may miss students who were absent from school on the day of survey administration; if make-up administrations are scheduled, these surveys may miss students who frequently are absent. Students who often are absent from school may be at increased risk of substance use. Therefore, NSDUH data on substance use among youths in school were compared according to the number of days that youths reported being absent from school in the past 30 days to determine whether the exclusion of chronic absentees affected youth substance use estimates.

Frequent absentees in the past 30 days were more likely to be past year or current substance users than their peers who had not been absent from school (Table 4). Examples include the following:

- At each grade, students who missed 6 or more days of school for any reason were more likely than those who did not miss any days of school to be current alcohol users, current binge alcohol users, or current marijuana users. For example, 26.7 percent of 12th graders who missed school on 6 or more days for any reason and 10.9 percent of those who did not miss any days of school were current marijuana users.
- Students in each grade who missed school on 6 or more days for any reason were more likely than those who did not miss any days of school to be past year cocaine users or lifetime Ecstasy users. Among 12th graders, for example, 10.7 percent of those who were absent on 6 or more days for any reason and 3.3 percent for those who did not miss any days of school were lifetime Ecstasy users.

To assess the impact of excluding absentees on school-based substance use estimates, NSDUH data were reweighted to adjust for absentees. Essentially, a student's analysis weight (and therefore contribution to an overall estimate) was decreased according to the number of days that the student reported being absent in the past 30 days. Comparisons of adjusted to unadjusted estimates showed that the sizes of the differences were small. Examples include the following:

- Among 12th graders overall, the unadjusted and adjusted estimates were 23.3 and 22.2 percent for current cigarette use, 37.7 and 36.9 percent for current alcohol use, 25.5 and 24.7 percent for current binge alcohol use, and 14.7 and 14.0 percent for current marijuana use respectively.
- For past year cocaine use, the estimate among 12th graders that was not adjusted for absences was 4.0 percent, and the adjusted estimate was 3.7 percent.

Table 4. Substance Use Prevalence Estimates (Percentages) for 12th Graders by Number of Days Missed School, for All 12th Graders (Unadjusted for Absences) and Adjusted for Absences: 2002-2008, January-June.

Substance Use	Days Missed School in Past Month				All 12th Graders	
	0 Days	1-2 Days	3-5 Days	6+ Days	Unadjusted	Adjusted to Exclude Absentees
Cigarettes, Past Month	17.1 (.77)	21.9 (.98)	31.4 (1.45)	39.5 (1.92)	23.3 (.55)	22.2 (.55)
Alcohol, Past Month	31.1 (.99)	39.2 (1.21)	46.0 (1.54)	46.7 (2.05)	37.7 (.64)	36.9 (.65)
Marijuana, Past Month	10.9 (.66)	13.9 (.81)	18.9 (1.20)	26.7 (1.79)	14.7 (.46)	14.0 (.45)
Cocaine, Past Year	2.2 (.31)	4.2 (.49)	5.5 (.72)	8.3 (1.59)	4.0 (.29)	3.7 (.26)

6.7 Privacy during NSDUH Interviews

NSDUH estimates of substance use among adolescents were compared according to interviewers' ratings of the level of privacy during the interviews. Results generally were consistent with the hypothesis that youths who have used tobacco, alcohol, or other substances will tend to underreport their use in household interview settings if their interviews are not private. Based on NSDUH interviewers' ratings of interview privacy, completely private interviews (i.e., no one else was present during the interview or could overhear) in NSDUH typically yielded the highest prevalence estimates, and those that were least private (i.e., those for which the constant presence of one or more other persons during the interview was reported) typically yielded the lowest estimates. Because interview privacy is associated with age and other factors (e.g., older youths are more likely to be interviewed in private in NSDUH), logistic regression models were run by age, with statistical controls for several other variables, to test whether privacy was independently associated with reported substance use. Even with statistical controls, privacy still was associated with whether substance use was reported (Table 5). For example:

- Interview privacy was significantly associated with lifetime cigarette use in models for youths aged 12 or 13 and those aged 14 or 15 but not for youths aged

16 or 17. Youths in these two youngest age groups who had someone else constantly present during their interviews were less likely to report lifetime cigarette use than their counterparts with completely private interviews.

- Youths aged 12 or 13, those aged 14 or 15, and those aged 16 or 17 who had the least private interviews were less likely than their counterparts with private interviews to report lifetime alcohol use.
- Youths aged 14 or 15 and those aged 16 or 17 who had the least private interviews were less likely than those with completely private interviews to be identified as lifetime marijuana users.

However, interviewers rated more than three fourths of NSDUH interviews with adolescents as being completely private. Consequently, there was little difference between selected substance use estimates based on completely private interviews and corresponding overall estimates for adolescents or subgroups of adolescents.

Table 5. Reporting of Lifetime Substance Use in NSDUH: Adjusted Odds Ratios for Constant Presence of Others vs. Complete Privacy, by Age, 2002-2008

	Age 12-13	Age 14-15	Age 16-17
Cigarettes	0.76*	0.80*	0.90
Alcohol	0.76*	0.79*	0.72*
Marijuana	0.84	0.79*	0.73*

Note: * indicates statistical significance ($p < .05$)

7. Conclusions: Impact of Survey Designs on Estimates

Conducting an interview in an adolescent's home environment could inhibit adolescent substance users' willingness to report use, even if parents or other household members are not in the same room as the adolescent and are not able to see how adolescents are answering the substance use questions. Youths could perceive an interview in a classroom at school to be more private than an interview at home. Another possible explanation that warrants further study is whether the presence of friends in the classroom setting also leads to some overreporting by youths.

Additional factors besides interview privacy could contribute to lower estimates of adolescent substance use in NSDUH than in MTF or YRBS, and lower estimates in MTF than in YRBS. These other factors include the focus of the survey (e.g., primary focus on substance use or on broader health topics), and how prominently substance use is mentioned when a survey is presented to parents and adolescents. The focus on overall health risk behaviors in YRBS could result in less underreporting on the substance use questions in that survey. Assurances of anonymity or confidentiality, the placement and context of substance use questions in the interview, the survey mode (e.g., computer-assisted interviewing with skip patterns or paper-and-pencil questionnaires), and the question structure and wording could all impact reporting levels. For example, NSDUH asks filter questions about lifetime use before asking about other recency and frequency measures. Such a structure could depress reporting of certain behaviors. In addition, some NSDUH respondents may realize early during their interview that if they answer 'no' to the initial gate questions about lifetime substance use, they can avoid having to answer subsequent questions and therefore will finish the interview in less time. The MTF and YRBS questionnaires do not have these kinds of skip patterns. In addition, students taking the MTF or YRBS need to stay until the end of their class period regardless of

when they finish taking the survey. However, the NSDUH interviewer (or respondent, if a second person in the household also is selected for an interview) can leave once the interview is finished. Different designs are also likely to cause differing levels and patterns of coverage and nonresponse bias, which may or may not be alleviated by weighting adjustments or imputation. The survey content and sponsor, procedures for obtaining parental permission for their children to be interviewed, and information on confidentiality protections, and incentive payments are likely to influence response rates at the school or household levels and at the individual respondent level. Several of these design features vary across NSDUH, MTF, and YRBS, potentially leading to different response rates. As seen in Table 2, response rates have been substantially lower in MTF than in NSDUH or YRBS.

Using much larger samples than were used in previous studies, this analysis was able to confirm some previous findings regarding the impact of survey design features on youth substance use estimates. This study also provided a more accurate quantification of these effects, including differential impacts on demographic subgroups and specific drugs. Although this study was not able to determine the specific underlying causes for differences between the survey estimates, it does provide a baseline descriptive analysis that can help guide future research attempting to pinpoint the causes. Major findings are listed below:

- The three surveys have many design differences and produce estimates for different populations, complicating comparisons
- Controlling for grade, time of year, and enrollment, YRBS produces the highest prevalence rates and NSDUH the lowest
- Higher rates of substance use are obtained in school settings than in household settings, which is consistent with prior research
- No clear explanation is apparent for the higher YRBS estimates than in MTF
- Dropouts have substantially higher rates of substance use than students, but for youths younger than the 12th grade level, rates for students are nearly identical to rates for all youths of the same age
- Rates of substance use are positively correlated with frequency of school absence but the impact on overall substance use estimates for students is small
- Youths are most likely to report their substance use in interviews done in complete privacy (i.e., no others nearby) even when controls are applied for other factors that are related to substance use
- Trend results (i.e., comparisons over time) were consistent across NSDUH and MTF.

Although it is necessary to continue efforts to understand how these factors affect adolescents' reporting of substance use, it is also important to recognize the critical contributions each of the surveys make to research and policy development. The differences in the survey designs can be viewed as a strength, in that when all three show the same general conclusions regarding trends or patterns in youth substance use, confidence can be placed in those conclusions.

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