ORIGINAL ARTICLE

Use and Abuse of Alcohol and Illicit Drugs in US Adolescents

Results of the National Comorbidity Survey–Adolescent Supplement

Joel Swendsen, PhD; Marcy Burstein, PhD; Brady Case, MD; Kevin P. Conway, PhD; Lisa Dierker, PhD; Jianping He, MS; Kathleen R. Merikangas, PhD

Context: Comprehensive descriptions of substance use and abuse trajectories have been lacking in nationally representative samples of adolescents.

Objective: To examine the prevalence, age at onset, and sociodemographic correlates of alcohol and illicit drug use and abuse among US adolescents.

Design: Cross-sectional survey of adolescents using a modified version of the Composite International Diagnostic Interview.

Setting: Combined household and school adolescent samples.

Participants: Nationally representative sample of 10 123 adolescents aged 13 to 18 years.

Main Outcome Measures: Lifetime estimates of alcohol and illicit substance use and *DSM-IV* diagnoses of abuse, with or without dependence.

Results: By late adolescence, 78.2% of US adolescents had consumed alcohol, 47.1% had reached regular drinking levels defined by at least 12 drinks within a given year, and 15.1% met criteria for lifetime abuse. The opportunity to use illicit drugs was reported by 81.4% of the oldest adolescents, drug use by 42.5%, and drug abuse by 16.4%. The median age at onset was 14 years for alcohol abuse with or without dependence, 14 years for drug abuse with dependence, and 15 years for drug abuse without dependence. The associations observed by age, sex, and race/ethnicity often varied significantly by previous stage of use.

Conclusions: Alcohol and drug use is common in US adolescents, and the findings of this study indicate that most cases of abuse have their initial onset in this important period of development. Prevention and treatment efforts would benefit from careful attention to the correlates and risk factors that are specific to the stage of substance use in adolescents.

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Author Affiliations: University of Bordeaux, National Center for Scientific Research (CNRS 5287), Bordeaux, France (Dr Swendsen); Genetic Epidemiology Research Branch, Intramural Research Program, National Institute of Mental Health, Bethesda, Maryland (Drs Burstein and Merikangas and Ms He); Health Services Research Program, Emma Pendleton Bradley Hospital, East Providence, Rhode Island (Dr Case); Division of Epidemiology, Services, and Prevention Research, National Institute on Drug Abuse, National Institutes of Health, Rockville, Maryland (Dr Conway); and Department of Psychology, Wesleyan University, Middletown, Connecticut (Dr Dierker).

THE PATTERNS OF ALCOHOL and drug use that emerge during adolescence are increasingly recognized as important determinants of later substance use behavior and associated disorders.[1-9] Estimates from major surveys in the United States, including the National Survey on Drug Use and Health (NSDUH),[10] the National Health and Nutrition Examination Surveys (NHANES),[11] and the Monitoring the Future study,[12] indicate that by 17 years of age most adolescents (59% to 71%) had consumed alcohol, 31% to 44% had tried cannabis, and 4% to 6% had tried cocaine. Although each of these investigations provides information on the prevalence of alcohol or drug use among adolescents, only the NSDUH examined substance use disorders, and the assessments were limited to symptoms experienced during the previous 12 months. The only national survey to use direct diagnostic interviews regarding both current and lifetime substance use among US adolescents recently described large increases in the cumulative incidence of substance use disorders between 13 and 18 years of age[13] and an overall lifetime prevalence that approaches that of adult samples.[14-17] Nationally representative data concerning the full trajectory of substance use and associated disorders in adolescence have been lacking and are necessary for attaining further progress in prevention and public health objectives.[18]

In addition to more complete descriptions of substance use trajectories in adolescents, assessment of factors associated with the development of substance use disorders in nationally representative samples is crucial. Epidemiologic investigations of adults have consistently demonstrated a higher prevalence of abuse and dependence among males,[14-20] as well as decreased prevalence of these disorders

among certain minority ethnic subgroups.[14-17,21] Despite the marked increase in the prevalence of substance use disorders from early to late adolescence,[13] it is uncertain to what degree these sociodemographic differences may characterize recent adolescent cohorts. For example, no salient sex differences were observed for initial alcohol or illicit drug use in NHANES between 1999 and 2004, and ethnic differences for illicit substances in this investigation were at times contrary to the adult literature.[11] An additional rationale for understanding sociodemographic variation is the need for information concerning the timing of their influence across the substance use trajectory. Recent analyses of population-based surveys have shown that the magnitude and even direction of associations observed for many sociodemographic variables are specific to stages of use.[16,17,22,23] Analyses of sociodemographic factors conditioned on stage of previous use are currently lacking in US adolescent samples, and little is known about the timing of their expression during this key stage of development.

The present investigation examines these issues in the National Comorbidity Survey–Adolescent Supplement (NCS-A), a nationally representative survey that used direct diagnostic interviews with youth aged 13 to 18 years. The goals of this report are to (1) describe the prevalence of 4 lifetime stages of alcohol use (use, regular use, abuse without dependence, and abuse with dependence) and 4 lifetime stages of illicit drug use (opportunity to use, first drug use, drug abuse without dependence, and drug abuse with dependence); (2) estimate the prevalence of these stages by age, sex, and race/ethnicity; and (3) examine the association of these sociodemographic variables with the risk of transition among stages.

METHODS

SAMPLE AND PROCEDURE

The NCS-A is a nationally representative, face-to-face survey of 10 123 adolescents aged 13 to 18 years in the continental United States conducted between February 1, 2001, and January 30, 2004.[24] The survey was administered by the professional interview staff of the Institute for Social Research at the University of Michigan, Ann Arbor. There were 197 interviewers supervised by a team of 18 experienced regional supervisors. A study manager located at the central facility in Michigan oversaw the work of the supervisors and their staff. The NCS-A was performed in a dual-frame sample that included a household subsample and a school subsample.[24-27] The overall NCS-A response rate combining the 2 subsamples was 82.9%. Comparisons of sample and population distributions on US Census sociodemographic variables, and in the school sample on school characteristics, documented only minor differences, which were corrected with poststratification weighting. The recruitment and consent procedures were approved by the Human Subjects Committees of both Harvard Medical School and the University of Michigan. On making in-person contact, the interviewer answered questions before obtaining written informed consent from the parent and then written informed assent from the adolescent. Once the survey was completed, cases were weighted for variation in within-household probability of selection (in the household subsample) and for residual discrepancies between the sample and the US population on the basis of sociodemographic and geographic variables. These weighting procedures are discussed in more detail elsewhere.[26,27] Sociodemographic variables examined in this report include age (in years), sex, and self-described race/ethnicity. Approximately half the sample was male (51.3%) and the mean age was 15.2 years, with a larger proportion of adolescents aged 13 to 14 years (36.2%) and approximately equal distributions of adolescents aged 15 to 16 and 17 to 18 years. The sample was composed of 65.6% non-Hispanic whites, 15.1% non-Hispanic blacks, and 14.4% Hispanics.

OUTCOME MEASURES

Adolescents were administered a modified version (version 3.0) of the World Health Organization Composite International Diagnostic Interview (CIDI), a fully structured interview administered by trained lay interviewers to generate *DSM-IV* diagnoses.[28] The modifications to the CIDI were conducted following a standard 4-step process of instrument development proposed by experts in survey methods.[24] First, diagnostic sections of the adult CIDI were reviewed to determine whether assessment for particular disorders should be removed based on low presumed prevalence in adolescents. Second, the language in the remaining CIDI sections was modified to enhance comprehension with adolescents using an iterative process. Third, CIDI modules were modified in content to make them more germane to the contexts and experiences of adolescents. The most common change of this type required altering references from adult contexts (eg, work life and parenting) to adolescent contexts (eg, school life and peer relationships). Fourth, the finalized revision of each diagnostic module was reviewed for meaning, logic, and comparability to the adult version. Each diagnostic section was then systematically piloted to test the flow and timing among adolescents, with subsequent modifications to reduce the length of the diagnostic sections. Lifetime substance use disorders assessed in the CIDI included alcohol and drug abuse, and individuals fulfilling abuse criteria were administered questions concerning dependence criteria. This report therefore presents both categories of abuse (with or without dependence). In light of differences in the pertinence of diagnostic categories for nicotine, trajectories for this substance will be addressed in a separate manuscript. In addition to *DSM-IV* diagnoses, all respondents were asked about the use of diverse substances and their age at which specific stages of use first occurred. For alcohol, the lifetime use question concerned age at which respondents first (if ever) had a drink with alcohol, specified as beer, wine, wine coolers, and hard liquor (eg, vodka, gin, whiskey, and mixed drinks). First regular use of alcohol was defined as the age at which the respondent first had at least 12 drinks within a single year. For illicit drugs, participants were asked their age at which they had first (if ever) consumed a range of specific substances, including marijuana or hashish; cocaine in any form (eg, powder, crack, freebase, coca leaves, or paste); tranquilizers, stimulants, pain killers, or other prescription drugs either without the recommendation of a health professional or for any reason other than a health professional said they should be used; and heroin, opium, glue, lysergic acid diethylamide, peyote, or any other drug. Participants were also asked about the first time they had an opportunity to drink alcohol or use drugs, regardless of whether they used them. Opportunity to use was defined as when someone either offered them alcohol or drugs or when the individual was present when others were using and could have used if he or she wanted to. The age at first opportunity to use substances was recorded separately for alcohol and drugs. In light of the high availability of legal substances, such as alcohol, only opportunity to use illicit drugs is examined in this investigation.

Table 1. Lifetime Prevalence of Alcohol Use Stages in 10 123 US Adolescents in the National Comorbidity Survey–Adolescent Supplement

Group	Lifetime Prevalence, No. (%) [SE]				Conditional Prevalence, No. (%) [SE]		
	Any Alcohol Use	Regular Alcohol Use	Abuse Without Dependence	Abuse With Dependence	Regular Use Given Any Use	Abuse Without Dependence Given Regular Use	Abuse With Dependence Given Regular Use
All Adolescents							
Total	5866 (59.8) [1.4]	2441 (25.2) [1.2]	560 (5.2) [0.4]	112 (1.3) [0.1]	2441 (42.2) [1.6]	560 (20.8) [1.2]	112 (5.1) [0.5]
Age group, y							
13-14	1598 (42.5) [1.6]	328 (9.7) [0.9]	37 (0.7) [0.2]	13 (0.6) [0.2]	328 (22.8) [1.8]	37 (7.2) [1.7]	13 (6.0) [2.2]
15-16	2459 (64.9) [1.7]	1033 (27.1) [1.1]	205 (5.3) [0.5]	35 (1.1) [0.3]	1033 (41.7) [1.6]	205 (19.7) [1.7]	35 (4.2) [0.9]
17-18	1809 (78.2) [1.5]	1080 (47.1) [2.5]	318 (12.4) [1.1]	64 (2.7) [0.4]	1080 (60.2) [2.6]	318 (26.4) [1.7]	64 (5.7) [0.8]
Sex							
Female	2952 (60.1) [1.7]	1140 (23.7) [1.3]	242 (4.7) [0.5]	48 (1.1) [0.2]	1140 (39.4) [1.9]	242 (20.0) [1.6]	48 (4.6) [0.7]
Male	2914 (59.4) [1.3]	1301 (26.7) [1.3]	318 (5.7) [0.5]	64 (1.5) [0.2]	1301 (44.9) [1.8]	318 (21.4) [1.6]	64 (5.5) [0.9]
Race/ethnicity							
Hispanic	1156 (63.4) [3.3]	504 (27.3) [2.7]	122 (5.8) [0.9]	23 (1.0) [0.4]	504 (43.1) [2.8]	122 (21.2) [3.1]	23 (3.5) [1.2]
Non-Hispanic black	910 (49.3) [2.0]	258 (12.8) [1.3]	37 (1.7) [0.3]	6 (0.5) [0.2]	258 (25.9) [2.9]	37 (13.1) [2.7]	6 (4.3) [1.9]
Other	329 (50.2) [3.5]	116 (17.0) [2.1]	28 (2.2) [0.7]	8 (0.7) [0.4]	116 (33.9) [2.6]	28 (13.1) [3.9]	8 (4.2) [2.4]
Non-Hispanic white	3471 (62.1) [1.5]	1563 (28.3) [1.6]	373 (6.2) [0.5]	75 (1.6) [0.2]	1563 (45.5) [2.0]	373 (21.8) [1.4]	75 (5.5) [0.7]
13- to 14-Year-Olds							
Sex							
Female	785 (43.0) [2.1]	153 (10.2) [1.8]	17 (0.6) [0.2]	8 (1.0) [0.4]	153 (23.7) [3.6]	17 (6.3) [2.3]	8 (9.6) [4.2]
Male	813 (42.1) [1.6]	175 (9.2) [1.0]	20 (0.8) [0.3]	5 (0.2) [0.1]	175 (21.9) [2.3]	20 (8.1) [2.5]	5 (2.5) [1.3]
Race/ethnicity							
Hispanic	341 (48.4) [4.0]	90 (16.7) [3.1]	14 (2.1) [0.7]	2 (0.0) [0.0]	90 (34.5) [5.2]	14 (12.6) [4.2]	2 (0.2) [0.2]
Non-Hispanic black	265 (34.8) [2.3]	50 (5.7) [1.3]	1 (0.2) [0.2]	1 (0.2) [0.2]	50 (16.3) [3.8]	1 (2.8) [2.6]	1 (4.3) [4.3]
Other	101 (33.8) [4.7]	15 (3.9) [1.7]	2 (0.3) [0.2]	0 (0.0) [0.0]	15 (11.5) [4.5]	2 (7.0) [5.2]	0 (0.0) [0.0]
Non-Hispanic white	891 (44.0) [1.9]	173 (9.5) [1.0]	20 (0.5) [0.2]	10 (0.9) [0.4]	173 (21.6) [1.9]	20 (5.5) [1.7]	10 (9.1) [4.0]
15- to 16-Year-Olds							
Sex							
Female	1266 (64.5) [1.9]	518 (26.2) [1.6]	106 (5.6) [0.8]	14 (0.7) [0.3]	518 (40.6) [2.3]	106 (21.4) [2.3]	14 (2.8) [1.0]
Male	1193 (65.4) [2.3]	515 (28.0) [1.7]	99 (5.1) [0.6]	21 (1.6) [0.5]	515 (42.9) [2.1]	99 (18.1) [2.4]	21 (5.6) [1.7]
Race/ethnicity							
Hispanic	447 (70.6) [4.2]	195 (29.8) [3.7]	46 (5.2) [0.9]	10 (1.4) [0.9]	195 (42.2) [3.6]	46 (17.4) [3.3]	10 (4.8) [2.7]
Non-Hispanic black	380 (54.8) [3.4]	119 (15.5) [1.6]	14 (1.8) [0.4]	2 (0.2) [0.2]	119 (28.4) [3.1]	14 (11.7) [2.6]	2 (1.4) [1.3]
Other	128 (57.0) [5.1]	52 (21.7) [3.1]	13 (2.9) [1.1]	2 (1.3) [1.1]	52 (38.1) [4.5]	13 (13.3) [4.6]	2 (6.0) [4.9]
Non-Hispanic white	1504 (66.5) [1.7]	667 (29.3) [1.4]	132 (6.2) [0.7]	21 (1.3) [0.4]	667 (44.1) [2.0]	132 (21.3) [2.3]	21 (4.3) [1.2]
17- to 18-Year-Olds							
Sex							
Female	901 (78.1) [2.3]	469 (39.9) [2.6]	119 (9.4) [1.3]	26 (1.9) [0.5]	469 (51.1) [3.0]	119 (23.7) [2.4]	26 (4.9) [1.3]
Male	908 (78.2) [1.8]	611 (53.7) [3.0]	199 (15.2) [1.4]	38 (3.4) [0.6]	611 (68.6) [3.3]	199 (28.3) [2.6]	38 (6.3) [1.1]
Race/ethnicity							
Hispanic	368 (78.1) [4.0]	219 (41.8) [3.5]	62 (13.0) [2.0]	11 (1.9) [0.8]	219 (53.5) [2.7]	62 (31.1) [5.1]	11 (4.5) [1.8]
Non-Hispanic black	265 (67.0) [3.2]	89 (21.4) [4.8]	22 (4.4) [1.3]	3 (1.8) [1.0]	89 (31.9) [7.0]	22 (20.3) [5.7]	3 (8.3) [4.7]
Other	100 (71.4) [6.1]	49 (35.1) [5.6]	13 (5.0) [2.1]	6 (1.2) [0.7]	49 (49.2) [5.4]	13 (14.1) [6.0]	6 (3.5) [2.2]
Non-Hispanic white	1076 (81.1) [1.7]	723 (54.7) [2.9]	221 (14.6) [1.3]	44 (3.2) [0.5]	723 (67.4) [2.8]	221 (26.7) [1.9]	44 (5.8) [0.9]

STATISTICAL ANALYSIS

Cross-tabulations were used to calculate the prevalence of the 4 stages of alcohol and drug use by demographic characteristics. Conditional prevalence estimates for each alcohol or drug use stage were also calculated among those who had reached the earlier stage of use. Estimated projections of the cumulative probability of stages of alcohol or drug use as of the age of 18 years were obtained by the actuarial method implemented in PROC LIFETEST in SAS statistical software (version 9.2; SAS Institute, Inc). The associations of age, sex, and race/ethnicity with the stages of alcohol or drug use were examined using multiple logistic regression analysis. Because the NCS-A data are both clustered and weighted, the Taylor series linearization method implemented in SUDAAN (version 10; Research Triangle Institute) was used to estimate standard errors of logistic regression coefficients. The coefficients and standard errors were exponentiated to produce odds ratios and 95% CIs. Significance of predictor sets was evaluated using Wald *F* tests based on design-adjusted coefficient variance-covariance matrices. Statistical significance was consistently evaluated using 2-sided tests with a .05 significance level.

RESULTS

PREVALENCE AND SOCIODEMOGRAPHIC VARIATION IN ALCOHOL USE STAGES

Alcohol use, regular use, and abuse were highly prevalent among US adolescents (**Table 1**). Most of the sample (59.8%) reported alcohol use at some point in their lifetime, ranging from 42.5% for adolescents aged 13 to 14 years to 78.2% for adolescents aged 17 to 18 years. Nearly 1 in 10 adolescents reported regular alcohol use in the 13- to 14-year age cohort, a figure that increased to nearly half (47.1%) of adolescents aged 17 to 18 years. Concerning alcohol use disorders, 5.2% of all US adolescents met *DSM-IV* criteria for alcohol abuse without dependence and 1.3% for alcohol abuse with dependence. The prevalence of alcohol abuse with or without dependence ranged from 1.3% for the youngest cohort to 15.1% for adolescents 17 to 18 years old. The cumulative prevalence of alcohol use stages by age is presented in **Figure 1**. The median age at onset of each category was 13 years for first alcohol use and 14 years for regular use or abuse (with or without dependence).

Male and female adolescents had essentially equivalent rates of any alcohol use, but male adolescents demonstrated slightly higher rates of regular use and abuse. These sex differences were larger in individuals aged 17 to 18 years than in the 2 younger cohorts. Black and other racial/ethnic groups generally reported lower rates of alcohol use, regular use, and abuse than either Hispanic or white adolescents. These racial differences were observed for each age cohort.

The conditional prevalence rates presented in Table 1 demonstrate salient effects for age in transitions among the stages of alcohol use. Only a few (22.8%) of the youngest users progressed to regular alcohol use, and 13.2% of this latter group developed abuse with or without dependence. By comparison, most adolescents (60.2%) 17 to 18 years old who used alcohol later reported regular alcohol use, and nearly 1 in 3 regular users (32.1%) in this age cohort met criteria for lifetime alcohol abuse with or without dependence. Regarding sex differences, male adolescents were more likely to make transitions among the stages, especially among the oldest adolescents. In addition, generally robust racial/ethnic differences were observed in the proportion of individuals making transitions from one alcohol stage to another. The percentage of individuals at each stage making transitions to the next was generally lowest for the black and other ethnic groups and was observable across all age cohorts.

PREVALENCE AND SOCIODEMOGRAPHIC VARIATION IN OPPORTUNITY TO USE DRUGS AND DRUG USE STAGES

Most US adolescents (60.2%) reported having had the opportunity to use illicit drugs (**Table 2**). This exposure concerned 39.2% of adolescents aged 13 to 14 years and 81.4% of adolescents aged 17 to 18 years, thereby doubling during the adolescent period. The use of illicit drugs for these same cohorts ranged from 9.6% (nearly a quarter of exposed youth aged 13-14 years) to 42.5% of the oldest adolescents (52.2% of those exposed), respectively. Abuse of illicit drugs was slightly more common than the abuse of alcohol, ranging from 3.4% of youth in the 13- to 14-year cohort to 16.4% of adolescents aged 17 to 18 years old. **Figure 2** presents the cumulative prevalence of drug use stages by age. The median ages of onset for each category were 13 years for the first opportunity to use illicit drugs, 14 years for the first illicit drug use, 14 years for drug abuse with dependence, and 15 years for drug abuse without dependence. Similar to the pattern in alcohol use, there was a slight overall male preponderance in prevalence of stages of drug use, which was most pronounced among older adolescents. The same pattern of racial/ethnic differences was observed across the 3 age cohorts, with black and other racial/ethnic groups having typically lower rates than white or Hispanic adolescents. High rates of opportunity to use drugs and drug use were observed among Hispanic adolescents, especially in the youngest age cohort. Concerning conditional prevalence rates, 40.5% of the sample used illicit drugs when given the opportunity, and more than one-third of adolescents who used illicit drugs developed abuse (36.6%). The overall patterns of effects by sex and race/ethnicity in the conditional prevalence rates for drug use stages were highly similar to those observed for alcohol, as demonstrated by increasing male preponderance in transitions among older adolescents and generally lower rates of transitions, particularly among black adolescents. Concerning types of illicit drugs, cannabis was the most frequently used substance in all age cohorts (**Table 3**). The use of each category of illicit substance was again typically lowest for black adolescents and slightly higher for male adolescents compared with female adolescents, with the exception of prescription drug use.

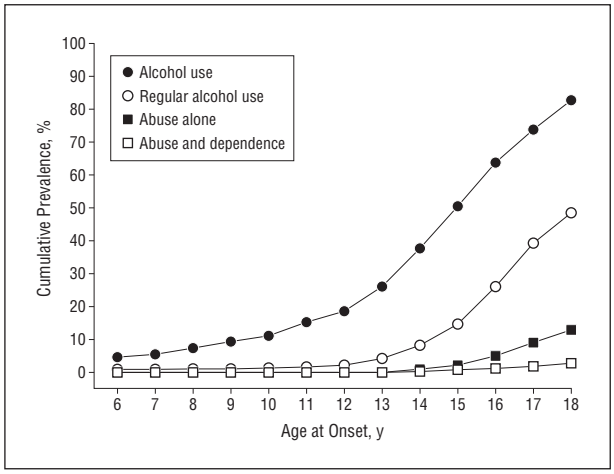

Figure 1. Cumulative prevalence of alcohol use stages in the total sample (N = 10 123).

SOCIODEMOGRAPHIC PREDICTORS OF TRANSITIONS AMONG ALCOHOL AND DRUG USE STAGES

Adolescent age cohort, sex, and race/ethnicity in the risk of transition among the alcohol and drug use stages were examined in multivariate analyses (**Table 4**). For alcohol, the 2 younger age cohorts were less likely than adolescents aged 17 to 18 years to become regular drinkers

Table 2. Lifetime Prevalence of Illicit Drug Use Stages in 10 123 US Adolescents in the National Comorbidity Survey–Adolescent Supplement

Group	Lifetime Prevalence, No. (%) [SE]				Conditional Prevalence, No. (%) [SE]		
	Opportunity to Use Illicit Drugs	Use of Illicit Drugs	Abuse Without Dependence	Abuse With Dependence	Use Given Opportunity	Abuse Without Dependence Given Use	Abuse With Dependence Given Use
All Adolescents							
Total	5970 (60.2) [1.6]	2380 (24.4) [1.5]	683 (7.1) [0.5]	186 (1.8) [0.2]	2380 (40.5) [1.7]	683 (29.0) [1.0]	186 (7.6) [0.7]
Age group, y							
13-14	1448 (39.2) [1.8]	348 (9.6) [0.7]	82 (2.4) [0.4]	19 (1.0) [0.4]	348 (24.5) [1.7]	82 (25.0) [4.0]	19 (10.5) [4.2]
15-16	2614 (67.1) [2.0]	1036 (27.5) [1.8]	291 (8.1) [0.7]	67 (1.6) [0.3]	1036 (41.1) [1.9]	291 (29.6) [1.5]	67 (5.7) [1.1]
17-18	1908 (81.4) [1.8]	996 (42.5) [2.6]	310 (12.7) [1.1]	100 (3.7) [0.7]	996 (52.2) [2.6]	310 (29.9) [1.7]	100 (8.7) [1.4]
Sex							
Female	2925 (58.6) [1.8]	1108 (23.3) [1.5]	279 (6.2) [0.5]	86 (1.8) [0.3]	1108 (39.7) [2.1]	279 (26.7) [1.3]	86 (7.8) [1.2]
Male	3045 (61.7) [1.8]	1272 (25.5) [1.7]	404 (7.9) [0.6]	100 (1.9) [0.3]	1272 (41.3) [2.1]	404 (31.1) [1.7]	100 (7.4) [0.9]
Race/ethnicity							
Hispanic	1222 (66.9) [2.8]	510 (27.7) [3.5]	156 (8.2) [1.3]	45 (2.4) [0.9]	510 (41.3) [4.0]	156 (29.6) [3.0]	45 (8.9) [3.0]
Non-Hispanic black	1131 (60.7) [2.5]	363 (19.5) [2.0]	72 (3.3) [0.5]	13 (1.1) [0.4]	363 (32.1) [2.5]	72 (16.9) [2.2]	13 (5.7) [1.6]
Other	334 (50.5) [4.0]	140 (19.2) [3.0]	38 (5.5) [1.4]	18 (3.0) [0.6]	140 (38.0) [4.4]	38 (28.8) [5.3]	18 (15.6) [2.2]
Non-Hispanic white	3283 (59.3) [1.9]	1367 (25.2) [1.6]	417 (7.8) [0.6]	110 (1.8) [0.3]	1367 (42.4) [1.8]	417 (31.1) [1.4]	110 (7.2) [1.0]
13- to 14-Year-Olds							
Sex							
Female	694 (38.0) [2.0]	162 (9.6) [1.0]	36 (2.4) [0.6]	9 (1.3) [0.8]	162 (25.2) [2.2]	36 (25.2) [5.9]	9 (13.7) [7.2]
Male	754 (40.3) [2.1]	186 (9.7) [1.0]	46 (2.4) [0.6]	10 (0.8) [0.3]	186 (24.0) [2.4]	46 (24.7) [4.9]	10 (7.9) [2.9]
Race/ethnicity							
Hispanic	348 (52.6) [2.8]	88 (14.3) [2.4]	19 (3.5) [1.3]	4 (2.3) [2.1]	88 (27.1) [4.3]	19 (24.5) [9.9]	4 (15.8) [13.0]
Non-Hispanic black	328 (43.2) [2.5]	67 (7.8) [1.5]	14 (1.3) [0.5]	2 (0.7) [0.5]	67 (18.0) [3.0]	14 (17.1) [6.1]	2 (9.0) [5.3]
Other	95 (32.8) [5.6]	22 (8.7) [2.8]	7 (1.7) [0.9]	3 (3.2) [1.9]	22 (26.5) [6.5]	7 (19.5) [7.2]	3 (37.0) [16.7]
Non-Hispanic white	677 (35.3) [2.2]	171 (9.0) [0.9]	42 (2.5) [0.6]	10 (0.6) [0.2]	171 (25.5) [2.1]	42 (27.5) [5.1]	10 (6.2) [2.5]
15- to 16-Year-Olds							
Sex							
Female	1307 (64.3) [2.7]	500 (26.4) [2.0]	126 (7.5) [1.0]	31 (1.2) [0.5]	500 (41.1) [2.5]	126 (28.5) [2.7]	31 (4.7) [1.8]
Male	1307 (70.0) [2.1]	536 (28.7) [2.4]	165 (8.8) [0.9]	36 (2.0) [0.5]	536 (41.0) [2.6]	165 (30.5) [2.6]	36 (6.8) [1.4]
Race/ethnicity							
Hispanic	476 (71.2) [4.8]	206 (33.4) [4.6]	62 (9.4) [1.5]	18 (1.5) [0.7]	206 (46.9) [3.9]	62 (28.3) [2.7]	18 (4.6) [1.6]
Non-Hispanic black	476 (68.4) [3.0]	158 (24.1) [3.1]	30 (3.5) [0.8]	4 (1.7) [1.1]	158 (35.2) [3.7]	30 (14.7) [2.9]	4 (6.9) [4.3]
Other	140 (65.2) [5.1]	65 (26.6) [5.0]	11 (7.2) [3.3]	8 (3.3) [1.3]	65 (40.9) [5.9]	11 (27.1) [10.8]	8 (12.5) [4.9]
Non-Hispanic white	1522 (66.1) [2.1]	607 (27.2) [1.7]	188 (8.9) [0.9]	37 (1.5) [0.4]	607 (41.2) [2.0]	188 (32.7) [2.2]	37 (5.4) [1.4]
17- to 18-Year-Olds							
Sex							
Female	924 (79.5) [2.0]	446 (38.4) [3.0]	117 (9.5) [1.2]	46 (3.8) [0.8]	446 (48.3) [3.3]	117 (24.7) [3.1]	46 (9.9) [1.6]
Male	984 (83.1) [2.0]	550 (46.2) [2.9]	193 (15.7) [1.4]	54 (3.6) [0.8]	550 (55.7) [2.8]	193 (33.9) [2.4]	54 (7.8) [1.6]
Race/ethnicity							
Hispanic	398 (84.9) [3.3]	216 (41.8) [6.3]	75 (14.3) [2.4]	23 (4.2) [1.0]	216 (49.2) [6.3]	75 (34.3) [3.4]	23 (10.0) [2.4]
Non-Hispanic black	327 (80.3) [3.2]	138 (33.7) [4.3]	28 (6.7) [1.4]	7 (0.9) [0.4]	138 (42.0) [4.6]	28 (19.8) [4.3]	7 (2.6) [1.4]
Other	99 (63.1) [6.3]	53 (28.4) [4.1]	20 (10.4) [3.5]	7 (2.1) [0.9]	53 (45.0) [5.3]	20 (36.6) [9.5]	7 (7.4) [3.2]
Non-Hispanic white	1084 (82.2) [2.0]	589 (45.6) [2.7]	187 (13.8) [1.4]	63 (4.3) [1.0]	589 (55.5) [2.6]	187 (30.3) [2.5]	63 (9.5) [1.9]

if they had already consumed this substance and less likely to develop abuse (without dependence) if they had reached regular use levels. Female adolescents were also less likely to make the transition from any alcohol use to regular use, as were adolescents who were black or members of other racial/ethnic groups compared with white adolescents. However, the patterns observed for drug use categories were more complex in the multivariate analyses than those observed for alcohol. The 2 younger cohorts were less likely than older adolescents to use drugs when given the opportunity, but no significant sex differences were observed in the risk of transition among drug use stages. Black adolescents were less likely than white adolescents to use drugs when given the opportunity and less likely to abuse drugs (without dependence) if they were drug users. Conversely, ado-

lescents of other racial/ethnic groups were more likely than whites to develop abuse with dependence if they were already drug users.

COMMENT

Knowledge of the developmental trajectories of alcohol and illicit drug use among US adolescents has relied on retrospective reports from nationally representative adult samples and on prospective observation of clinical cohorts and local community youth samples. The purposes of the present investigation were to estimate in a nationally representative sample of adolescents the prevalence of multiple states of alcohol and illicit drug use and abuse and to examine the association of sociodemographic variables with transitions across these substance use categories.

The present study reports several novel findings concerning the incidence and prevalence of alcohol and drug abuse among US youth. Although the NSDUH has shown that the rates of abuse with or without dependence of alcohol or illicit drugs have converged during the past several years among adolescents aged 12 to 17 years, we found greater rates for drug abuse (8.9%) than alcohol abuse (6.5%) among adolescents. Our conditional analyses also revealed high rates of regular use and abuse in adolescent substance users. Among alcohol users, 42.2% reported regular use, and 25.9% of these regular drinkers met criteria for abuse with or without dependence. For illicit substances, 40.5% reported using drugs after having had the opportunity to do so, and nearly 36.6% of drug users met criteria for abuse with or without dependence. These conditional rates are higher than base (unconditional) rates reported by prior surveys of youth and therefore provide additional information concerning risk of substance abuse after initial use during adolescence. The risk of drug abuse among adolescent users is of concern considering the recent findings from the Monitoring the Future and NSDUH, which show a resurgence of marijuana use among adolescents, even surpassing use of nicotine, a finding that may reflect increasingly tolerant attitudes concerning the use of illicit drugs.[10,12]

The median age at onset of alcohol abuse with or without dependence was 14 years, with 15.1% meeting diagnostic criteria by 18 years of age. Drug abuse was characterized by a similarly young median age at onset and with a prevalence of 16.4% among the oldest adolescents. These adolescent lifetime prevalence estimates for abuse can be compared with adult prevalences observed in the National Comorbidity Survey–Replication, a study that used parallel methods and was conducted concurrently with the NCS-A. Lifetime prevalence of alcohol abuse in the adult survey (18.6%) was only marginally higher than the adolescent prevalence we observed, whereas the prevalence of drug abuse among adults (11.1% overall and 15.1% for the youngest cohort aged 19-30) was actually lower than the adolescent prevalences we estimated.[16,17]

Taken together, these findings suggest greater incidence risk and lifetime prevalence of substance abuse during adolescence than has been estimated from adult samples.[14-17] Such differences are likely to reflect the inclusion of older-onset cases in investigations of adults and increases in retrospective memory biases in these samples. It also remains possible that younger cohorts are more likely to use specific substances or to use them at an earlier age. In this regard, the conditional analyses demonstrate that the risk of abuse among users is particularly high among the youngest adolescents. The conditional rate for abuse with or without dependence among the youngest drug users (13-14 years old) is 10-fold the unconditional rate (35.4% vs 3.4%). By contrast, the conditional rate of abuse with or without dependence among the oldest adolescents is just more than twice the unconditional rate (38.6% vs 16.4%). Although high conditional rates in younger adolescents may be partly attributable to the low unconditional prevalences, they nonetheless pinpoint early adolescence as a period of heightened risk for substance use and abuse.[29,30] The elevated rate and risk of substance use and abuse among youth should be considered relative to neuroimaging data that demonstrate the occurrence of important maturational changes in the brain during adolescence, particularly in regions associated with regulatory control and decision making. Such normative developmental processes may be substantially compromised by substance use.[31-35]

Although probability of each stage of alcohol and drug use increased with age, rates were almost always lowest for black and other racial/ethnic groups compared with white or Hispanic adolescents. These findings may contradict common assumptions but are consistent with previous investigations in adult and adolescent samples.[10,11] No salient sex differences were observed in lifetime alcohol use, whereas minor differences were observed for all other stages of alcohol or drug use among adolescents aged 13 to 16 years. However, for those 17 to 18 years of age, male adolescents had notably higher rates for most stages of alcohol or drug use. These findings are globally consistent with previous reports of the associations between sociodemographic characteristics and substance use and substance use disorders[11,12,14,16-21,29] and indicate that sex differences in substance use behavior

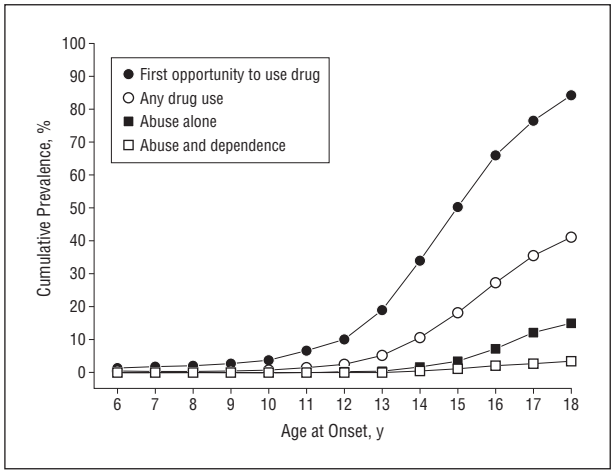

Figure 2. Cumulative prevalence of drug use stages in the total sample (N = 10 123).

Table 3. Lifetime Prevalence of Illicit Drug Use by Substance Category

Group	Type of Drug, No. (%) [SE]			
	Cannabis	Cocaine	Prescription Drugs	Other Drugs
Total	2281 (23.3) [1.5]	240 (2.3) [0.3]	493 (5.4) [0.4]	312 (3.2) [0.4]
Age group, y				
13-14	318 (8.9) [0.7]	15 (0.6) [0.2]	54 (1.3) [0.3]	27 (0.8) [0.2]
15-16	988 (26.3) [1.8]	84 (2.3) [0.4]	212 (6.1) [0.6]	109 (3.2) [0.5]
17-18	975 (41.2) [2.7]	141 (5.1) [0.8]	227 (10.5) [1.2]	176 (7.3) [1.2]
Sex				
Female	1057 (22.3) [1.5]	116 (2.2) [0.3]	261 (5.8) [0.6]	151 (3.0) [0.4]
Male	1224 (24.3) [1.8]	124 (2.4) [0.5]	232 (5.0) [0.6]	161 (3.4) [0.6]
Race/ethnicity				
Hispanic	487 (26.5) [3.4]	77 (4.7) [1.6]	93 (4.6) [1.0]	60 (2.6) [0.8]
Non-Hispanic black	348 (18.4) [2.0]	5 (0.2) [0.1]	28 (2.1) [0.5]	11 (0.3) [0.1]
Other	132 (17.7) [2.7]	17 (2.0) [0.8]	32 (4.7) [1.4]	18 (3.5) [0.9]
Non-Hispanic white	1314 (24.2) [1.6]	141 (2.3) [0.3]	340 (6.3) [0.6]	223 (4.0) [0.5]

Table 4. Sociodemographic Predictors of Any Alcohol or Illicit Drug Use and Transitions From Stages of Substance Use (Person-Level Data Analysis)

Predictor	Adjusted OR (95% CI)							
	Alcohol Stages				Illicit Drug Stages			
	Any Alcohol Use (n=10 123)	Regular Use Among Any Users (n=5866)	Abuse Without Dependence Among Regular Users (n=2441)	Abuse and Dependence Among Regular Users (n=2441)	First Opportunity to Use (n=10 123)	Use Among Those Having Opportunity (n=5970)	Abuse Without Dependence Among Users (n=2380)	Abuse and Dependence Among Users (n=2380)
Age, y								
13-14	0.21 (0.16-0.26)	0.16 (0.12-0.22)	0.15 (0.09-0.26)	0.71 (0.25-2.04)	0.14 (0.11-0.19)	0.21 (0.16-0.27)	0.60 (0.37-0.96)	0.70 (0.24-2.05)
15-16	0.51 (0.41-0.64)	0.43 (0.34-0.54)	0.61 (0.46-0.80)	0.62 (0.33-1.18)	0.47 (0.39-0.56)	0.54 (0.44-0.65)	0.90 (0.70-1.16)	0.48 (0.26-0.92)
17-18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
χ^2_2 (*P* value)	202.7 (<.001)	126.5 (<.001)	63.1 (<.001)	2.7 (.26)	201.7 (<.001)	145.4 (<.001)	4.7 (.09)	5.4 (.07)
Sex								
Female	1.01 (0.89-1.16)	0.80 (0.67-0.94)	0.99 (0.77-1.27)	0.89 (0.51-1.58)	0.83 (0.71-0.96)	1.01 (0.83-1.23)	0.83 (0.67-1.03)	1.34 (0.85-2.11)
Male	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
χ^2_1 (*P* value)	0.0 (.86)	7.3 (.007)	0.0 (.93)	0.2 (.69)	6.7 (.01)	0.0 (.93)	3.0 (.08)	1.6 (.20)
Race/ethnicity								
Hispanic	1.13 (0.85-1.50)	0.97 (0.73-1.27)	1.10 (0.78-1.56)	0.61 (0.23-1.58)	1.57 (1.19-2.09)	1.02 (0.76-1.38)	0.88 (0.65-1.18)	1.11 (0.43-2.86)
Non-Hispanic black	0.61 (0.52-0.71)	0.41 (0.29-0.58)	0.54 (0.30-0.95)	0.68 (0.22-2.08)	1.19 (0.96-1.48)	0.65 (0.49-0.84)	0.40 (0.28-0.58)	0.68 (0.31-1.48)
Other	0.64 (0.49-0.85)	0.58 (0.41-0.81)	0.54 (0.26-1.09)	0.79 (0.23-2.76)	0.76 (0.53-1.08)	0.83 (0.55-1.24)	0.86 (0.49-1.49)	2.30 (1.35-3.94)
Non-Hispanic white	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
χ^2_3 (*P* value)	62.7 (<.001)	35.3 (<.001)	7.3 (.06)	1.2 (.76)	14.6 (.002)	17.2 (.001)	28.3 (<.001)	13.9 (.003)

Abbreviation: OR, odds ratio.

are most visible after 15 years of age. In conditional analyses, male alcohol users were significantly more likely to transition to regular alcohol use, whereas no sex differences were associated with drug use transitions. Reduced risk for black adolescents was significant only in transitions from alcohol use to regular use, from having the opportunity to use drugs to drug use, and from drug use to drug abuse without dependence. Despite lower rates of drug use among other racial/ethnic groups, these adolescents were more likely than white adolescents to transition from use to abuse with dependence. These findings are concordant with previous studies[16,17,22,29] demonstrating that stage of previous substance use moderates the role of sociodemographic factors.

The principal strengths of this study include its use of a nationally representative adolescent sample with direct diagnostic interviews and the assessment of multiple stages of alcohol and drug use. Study limitations include its cross-sectional design, retrospective reporting for age at onset information, and the lack of assessment of alcohol or drug dependence without a history of abuse. However, although we would expect that only a small proportion of youth would be excluded in this latter reason, the conclusions are limited to the categories examined and may not be generalizable outside of the US adolescent population. Caution is also warranted in drawing parallels to findings from retrospective estimates in adult samples because such interviews may underestimate rates

due to forgetting or other memory biases and may increase biases in estimates of age of disorder onset due to the longer period of recall.[36]

In addition, the use of the term *lifetime* to describe the prevalence of substance use disorders in adolescence does not necessarily indicate the persistence of these disorders in the long term, in particular because individuals may "mature out" of harmful substance use as they progress into adulthood or begin to assume adult responsibilities.[37,38] A final limitation of the present investigation is that it cannot account for societal factors that vary over time and that affect prevalence rates, such as the degree of tolerance for specific illicit substances or their availability. It is important to consider that psychoactive substances are implicated in more than 12% of mortality worldwide and their use constitutes the leading cause of preventable death.[39,40] Because the early onset of substance use is a significant predictor of substance use behavior and disorders in a lifespan,[1-9] the public health implications of the current findings are far reaching. The prevention of both alcohol and illicit drug abuse requires strategies that target early adolescence and take into account the highly differential influence that population-based factors may exert by stage of substance use. The lack of information concerning the precise stage of alcohol or drug use most associated with sociodemographic factors may partly explain the modest success observed for certain prevention strategies.[41-43] An additional challenge for national policy concerns the emergence of drug instrumentalization models that emphasize the adaptive role that psychoactive substances may play in the daily lives of nondependent individuals.[44] The critical evaluation of such perspectives and the development of appropriate national policy on alcohol and drug use can only be achieved through empirical data describing the nature of harm or risk posed by alcohol and drugs.

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Correspondence: Kathleen R. Merikangas, PhD, Genetic Epidemiology Research Branch, Intramural Research Program, National Institute of Mental Health, 35 Convent Dr, MSC 3720, Bethesda, MD 20892-3720 (merikank@mail.nih.gov).
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REFERENCES

1. Anthony JC, Petronis KR. Early-onset drug use and risk of later drug problems. *Drug Alcohol Depend*. 1995;40(1):9-15.
2. Behrendt S, Wittchen HU, Höfler M, Lieb R, Beesdo K. Transitions from first substance use to substance use disorders in adolescence: is early onset associated with a rapid escalation? *Drug Alcohol Depend*. 2009;99(1-3):68-78.
3. Chen CY, O'Brien MS, Anthony JC. Who becomes cannabis dependent soon after onset of use? epidemiological evidence from the United States: 2000-2001. *Drug Alcohol Depend*. 2005;79(1):11-22.
4. Grant BF, Dawson DA. Age at onset of alcohol use and its association with *DSM-IV* alcohol abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *J Subst Abuse*. 1997;9:103-110.
5. Grant BF, Stinson FS, Harford TC. Age at onset of alcohol use and *DSM-IV* alcohol abuse and dependence: a 12-year follow-up. *J Subst Abuse*. 2001;13(4):493-504.
6. Grant BF, Dawson DA. Age of onset of drug use and its association with *DSM-IV* drug abuse and dependence: results from the National Longitudinal Alcohol Epidemiologic Survey. *J Subst Abuse*. 1998;10(2):163-173.
7. Hasin DS, Glick H. Severity of *DSM-III-R* alcohol dependence: United States, 1988. *Br J Addict*. 1992;87(12):1725-1730.
8. Perkonigg A, Pfister H, Hofler M, Frohlich C, Zimmermann P, Lieb R, Wittchen HU. Substance use and substance use disorders in a community sample of adolescents and young adults: incidence, age effects and patterns of use. *Eur Addict Res*. 2006;12(4):187-196.
9. Pitkänen T, Lyyra AL, Pulkkinen L. Age of onset of drinking and the use of alcohol in adulthood: a follow-up study from age 8-42 for females and males. *Addiction*. 2005;100(5):652-661.
10. Substance Abuse and Mental Health Services Administration, Office of Applied Studies. Detailed tables, 2009 National Survey on Drug Use & Health. http://oas.samhsa.gov/NSDUH/2k9NSDUH/tabs/TOC.htm. Accessed October 3, 2010.
11. Fryar CD, Merino MC, Hirsch R, Porter KS. *Smoking, Alcohol Use, and Illicit Drug Use Reported by Adolescents Aged 12-17 Years: United States, 1999-2004*. National Health Statistics Report 15. Washington, DC: US Dept of Health and Human Services; May 20, 2009.
12. Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE. *Marijuana Use Is Rising; Ecstasy Use Is Beginning to Rise; and Alcohol Use Is Declining Among US Teens*. Ann Arbor: University of Michigan News Service; December 14, 2010. http://www.monitoringthefuture.org. Accessed October 3, 2010.
13. Merikangas KR, He JP, Burstein M, Swanson SA, Avenevoli S, Cui L, Benjet C, Georgiades K, Swendsen J. Lifetime prevalence of mental disorders in US adolescents: results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A) [published online July 31, 2010]. *J Am Acad Child Adolesc Psychiatry*. 2010;49(10):980-989. doi:10.1016/j.jaac.2010.05.017.
14. Compton WM, Thomas YF, Stinson FS, Grant BF. Prevalence, correlates, disability, and comorbidity of *DSM-IV* drug abuse and dependence in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry*. 2007;64(5):566-576.
15. Hasin DS, Stinson FS, Ogburn E, Grant BF. Prevalence, correlates, disability, and comorbidity of *DSM-IV* alcohol abuse and dependence in the United States: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry*. 2007;64(7):830-842.
16. Kalaydjian A, Swendsen J, Chiu WT, Dierker L, Degenhardt L, Glantz M, Merikangas KR, Sampson N, Kessler R. Sociodemographic predictors of transitions across stages of alcohol use, disorders, and remission in the National Comorbidity Survey Replication. *Compr Psychiatry*. 2009;50(4):299-306.
17. Swendsen J, Anthony JC, Conway KP, Degenhardt L, Dierker L, Glantz M, He J, Kalaydjian A, Kessler RC. Improving targets for the prevention of drug use disorders: sociodemographic predictors of transitions across drug use stages in the National Comorbidity Survey Replication. *Prev Med*. 2008;47(6):629-634.
18. Clark DB. The natural history of adolescent alcohol use disorders. *Addiction*. 2004;99(suppl 2):5-22.
19. Diala CC, Muntaner C, Walrath C. Gender, occupational, and socioeconomic correlates of alcohol and drug abuse among U.S. rural, metropolitan, and urban residents. *Am J Drug Alcohol Abuse*. 2004;30(2):409-428.
20. Warner LA, Kessler RC, Hughes M, Anthony JC, Nelson CB. Prevalence and correlates of drug use and dependence in the United States: results from the National Comorbidity Survey. *Arch Gen Psychiatry*. 1995;52(3):219-229.
21. Degenhardt L, Cheng H, Anthony JC. Assessing cannabis dependence in community surveys: methodological issues. *Int J Methods Psychiatr Res*. 2007;16(2):43-51.
22. Swendsen J, Conway KP, Degenhardt L, Dierker L, Glantz M, Jin R, Merikangas KR, Sampson N, Kessler RC. Socio-demographic risk factors for alcohol and drug dependence: the 10-year follow-up of the National Comorbidity Survey. *Addiction*. 2009;104(8):1346-1355.
23. Swendsen J, Conway KP, Degenhardt L, Glantz M, Jin R, Merikangas KR, Sampson N, Kessler RC. Mental disorders as risk factors for substance use, abuse and dependence: results from the 10-year follow-up of the National Comorbidity Survey. *Addiction*. 2010;105(6):1117-1128.
24. Merikangas K, Avenevoli S, Costello J, Koretz D, Kessler RC. National Comor-

bidity Survey Replication Adolescent Supplement (NCS-A), I: background and measures. *J Am Acad Child Adolesc Psychiatry*. 2009;48(4):367-369.
25. Kessler RC, Merikangas KR. The National Comorbidity Survey Replication (NCS-R): background and aims. *Int J Methods Psychiatr Res*. 2004;13(2):60-68.
26. Kessler RC, Avenevoli S, Costello EJ, Green JG, Gruber MJ, Heeringa S, Merikangas KR, Pennell BE, Sampson NA, Zaslavsky AM. National Comorbidity Survey Replication Adolescent Supplement (NCS-A), II: overview and design. *J Am Acad Child Adolesc Psychiatry*. 2009;48(4):380-385.
27. Kessler RC, Avenevoli S, Costello EJ, Green JG, Gruber MJ, Heeringa S, Merikangas KR, Pennell BE, Sampson NA, Zaslavsky AM. Design and field procedures in the US National Comorbidity Survey Replication Adolescent Supplement (NCS-A). *Int J Methods Psychiatr Res*. 2009;18(2):69-83.
28. Kessler RC, Ustün TB. The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *Int J Methods Psychiatr Res*. 2004;13(2):93-121.
29. Kandel D, Chen K, Warner LA, Kessler RC, Grant B. Prevalence and demographic correlates of symptoms of last year dependence on alcohol, nicotine, marijuana and cocaine in the U.S. population. *Drug Alcohol Depend*. 1997; 44(1):11-29.
30. Sung M, Erkanli A, Angold A, Costello EJ. Effects of age at first substance use and psychiatric comorbidity on the development of substance use disorders. *Drug Alcohol Depend*. 2004;75(3):287-299.
31. Gogtay N, Giedd JN, Lusk L, Hayashi KM, Greenstein D, Vaituzis AC, Nugent TF III, Herman DH, Clasen LS, Toga AW, Rapoport JL, Thompson PM. Dynamic mapping of human cortical development during childhood through early adulthood. *Proc Natl Acad Sci U S A*. 2004;101(21):8174-8179.
32. Volkow N, Li TK. The neuroscience of addiction. *Nat Neurosci*. 2005;8(11):1429-1430.
33. Volkow ND, Chang L, Wang GJ, Fowler JS, Leonido-Yee M, Franceschi D, Sedler MJ, Gatley SJ, Hitzemann R, Ding YS, Logan J, Wong C, Miller EN. Association of dopamine transporter reduction with psychomotor impairment in methamphetamine abusers. *Am J Psychiatry*. 2001;158(3):377-382.
34. Volkow ND, Fowler JS. Addiction, a disease of compulsion and drive: involvement of the orbitofrontal cortex. *Cereb Cortex*. 2000;10(3):318-325.
35. Clark DB, Thatcher DL, Tapert SF. Alcohol, psychological dysregulation, and adolescent brain development. *Alcohol Clin Exp Res*. 2008;32(3):375-385.
36. Moffitt TE, Caspi A, Taylor A, Kokaua J, Milne BJ, Polanczyk G, Poulton R. How common are common mental disorders? evidence that lifetime prevalence rates are doubled by prospective versus retrospective ascertainment. *Psychol Med*. 2010;40(6):899-909.
37. Littlefield AK, Sher KJ, Wood PK. Do changes in drinking motives mediate the relation between personality change and "maturing out" of problem drinking? *J Abnorm Psychol*. 2010;119(1):93-105.
38. Yamaguchi K, Kandel D. On the resolution of role incompatibility: life event history analysis of family roles and marijuana use. *Am J Sociol*. 1985;90(6):1284-1325.
39. World Health Organization. *Global Health Risks: Mortality and Burden of Diseases Attributable to Selected Major Risks*. Geneva, Switzerland: World Health Organization Press; 2009.
40. World Health Organization. *WHO Report on the Global Tobacco Epidemic, 2009*. Geneva, Switzerland: World Health Organization Press; 2009.
41. Cuijpers P. Three decades of drug prevention research. *Drugs Educ Prev Policy*. 2003;10(1):7-20. doi:10.1080/0968763021000018900.
42. Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: implications for substance abuse prevention. *Psychol Bull*. 1992;112(1):64-105.
43. Toumbourou JW, Stockwell T, Neighbors C, Marlatt GA, Sturge J, Rehm J. Interventions to reduce harm associated with adolescent substance use. *Lancet*. 2007;369(9570):1391-1401.
44. Müller CP, Schumann G. Drugs as instruments: a new framework for non-addictive psychoactive drug use. *Behav Brain Sci*. 2011;34(6):293-347.