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Declines in Prevalence of Adolescent Substance Use Disorders and Delinquent Behaviors in the United States: A Unitary Trend?

Richard A. Grucza, Ph.D.[1], **Robert F. Krueger, Ph. D.**[2], **Arpana Agrawal, Ph.D.**[1], **Andrew D. Plunk, Ph. D.**[3], **Melissa J. Krauss, M.P.H.**[1], **Jahnavi Bongu, M.P.H.**[1], **Patricia A. Cavazos-Rehg, Ph.D.**[1], and **Laura J. Bierut, M.D.**[1]

[1]Department of Psychiatry, Washington University School of Medicine, St. Louis, MO, USA.

[2]Department of Psychology, University of Minnesota, Minneapolis, MN, USA.

[3]Department of Pediatrics, Eastern Virginia Medical School, Norfolk VA; USA.

Abstract

Background: Downward trends in a number of adolescent risk behaviors including violence, crime, and drug use have been observed in the United States in recent years. It is unknown whether these are separate trends or whether they might relate to a general reduction in propensity to engage in such behaviors. Our objectives were to quantify trends in substance use disorders and delinquent behaviors over the 2003–2014 period and to determine whether they might reflect a single trend in an Externalizing-like trait.

Methods: We analyzed data from 12–17 year old participants from the National Survey on Drug Use and Health, a representative survey of the household dwelling population of the United States, across the 2003–2014 period (N=210,599). Outcomes included past-year prevalence of 6 categories of substance use disorder and 6 categories of delinquent behavior.

Results: Trend analysis suggested a net decline of 49% in mean number of substance use disorders and a 34% decline in delinquent behaviors over the twelve-year period. Item Response Theory models were consistent with the interpretation that that declines in each set of outcomes could be attributed to changes in mean levels of a latent, Externalizing-like trait.

Conclusions: Our findings suggest that declines in substance use disorders and some delinquent behaviors reflect a single trend related to an Externalizing-like trait. Identifying the factors contributing to this trend may facilitate continued improvement across a spectrum of adolescent risk behaviors.

Keywords

Juvenile delinquency; substance use disorder; epidemiology; structural models; trends

Address for Correspondence: Richard A. Grucza, Ph.D. Department of Psychiatry, Washington University School of Medicine, 660 South Euclid Avenue, Box 8134, St. Louis, Missouri 63110. Phone: 314-362-6535. gruczar@psychiatry.wustl.edu.

Introduction

Downward trends in a number of adolescent health risk behaviors have been observed over the past 15 or more years in the United States. For example, arrest rates for both assault and theft dropped by 75% between 1992 and 2010, and this trend is consistent with those based on results from crime victimization surveys (Child Trends Data Bank, 2015; Finkelhor et al., 2014; Morgan et al., 2015; Office of Juvenile Justice and Delinquency Prevention, 2015; Robers, 2010; White and Lauritsen, 2012). Self-reported survey measurements also indicate declines in problem behaviors including bullying and fighting, binge drinking, cigarette smoking, use of most classes of illicit drugs, and early sexual involvement (Abma et al., 2010; Finkelhor, 2013; Johnston et al., 2013; Perlus et al., 2014).

The phenomenon of reduced rates for a broad array of risk behaviors raises an important question: Have these changes resulted from separate trends across multiple domains of behavior, or are they better described by a single trend that involves predisposition to risk-taking behaviors more generally? The answer to this question has important implications. Separate trends suggest behavior-specific causes. For example, state policies implemented since the late 1990s may have led to a reduction in bullying and other types of violence (Hatzenbuehler et al., 2015), but there is no *a priori* reason to think that these policies would have direct effects on substance use behaviors or on non-violent crime. Similarly, policies adopted to restrict access to alcohol and tobacco by minors at the state and municipal levels in recent years have likely had their intended effects (Farrelly et al., 2013; Grucza et al., 2013; Gruenewald, 2011). But any “spillover” effects on violent behaviors and other crime would presumably be indirect and smaller in magnitude.

In contrast, if we were to discover that these individual trends were manifestations of a more far-reaching underlying trend, we would think differently about the potential causes. Rather than asking why teenagers are smoking less or drinking less, etc., we might ask why adolescents seem less disposed toward risk behaviors more generally. Several lines of research suggest that much of variation in proclivity to engage in different problem behaviors stems from an underlying latent characteristic. For example, results from developmental studies based on Problem Behavior Theory suggested that adolescent risk behaviors including substance use, precocious sexual involvement, and delinquency is linked to an underlying behavioral syndrome that was subsequently labeled “risk behavior syndrome” (Donovan and Jessor, 1985; Jessor, 1991; Jessor and Jessor, 1977). More recently, psychopathology-focused studies have suggested that conduct disorder, alcohol and drug use disorders, and impulsivity share common etiologies and represent a core “externalizing” or “disinhibition” factor (Dick et al., 2005; Hicks et al., 2004; Kendler et al., 2003; Krueger et al., 2002; Krueger and South, 2009; McGue et al., 2001; Young et al., 2000). These earlier lines of research characterized variation in risk behaviors within cohorts, but no research to date has examined whether the population-level mean values of these traits might change over time.

Much of the research on externalizing and related constructs has emerged from the behavior genetics literature and these latent factors have been shown to be highly heritable. However, this does not mean that externalizing-like traits are unmodifiable by the environment.

Biometrical modeling studies suggest significant influence for environmental factors that are shared by siblings and those that are unique to the individual environment (see Burt, 2009 for a review and meta-analysis). There are also examples of specific environmental factors that may influence externalizing. For example, Hicks and his colleagues (2009) showed that the heritability of externalizing was modified by the environment such that heritability was higher in the presence of multiple risk factors such as antisocial peer affiliations and stressful life events. This suggests an important role for the environment in modulating risk for multiple externalizing outcomes. Relatedly, Verona and Sachs-Ericsson (2005) showed that the transmission of externalizing from parent to offspring was mediated by physical and sexual abuse, again suggesting this highly heritable trait is substantially modifiable by the environment. Notably, several indicators suggest declines in child abuse and neglect in recent decades, including physical and sexual abuse (Board on Children, Youth, and Families, 2012). This provides us with at least one example of a societal-level environmental change that could influence risk for multiple externalizing outcomes.

Given the possibility that environmental change can lead to reductions in multiple adverse outcomes, it is essential to know the degree to which observed reductions in externalizing (or “problem”) behaviors reflect a single, multi-faceted trend in these behaviors as a behavioral syndrome as opposed to multiple, separate but concurrent trends. Distinguishing between these possibilities requires multivariate analysis. It is not sufficient to merely examine whether these declines are occurring in parallel. Rather, we need to know whether a reduction in risk for any one outcome for a given individual corresponds to reductions in risk of comparable magnitude for other outcomes for that same individual.

Addressing these questions requires historical data, and no single series of U.S. youth behavioral health surveys has measured all behaviors of interest. Therefore, this report focuses outcomes related to externalizing that have been regularly assessed in the National Survey on Drug Use and Health (NSDUH). Externalizing outcomes include substance use disorders (SUDs) and disruptive behaviors (Krueger, 1999; Krueger et al., 2002). The NSDUH is annually administered to a cross-section of the population (i.e., a new sample every year) and is the only U.S. national survey that regularly assesses SUDs among adolescents. The NSDUH does not formally assess disruptive behavior disorders, but queries several delinquent behaviors that partially overlap with conduct disorder (Lahey, 2008). Our first objective was to describe trends in all outcomes using conventional univariate methods. We then employed Item Response Theory models (IRT) to first determine whether trends in various SUDs among adolescents could be attributed to a single trend in a latent trait or factor conferring liability to all SUD outcomes, then whether trends in different delinquent behaviors could similarly be attributed to a trend in an underlying latent trait for delinquency, and finally whether trends in both SUDs and delinquent behaviors were consistent with a trend in a single Externalizing-like trait. Our analyses were motivated by our previous work in which we suggested that trends in delinquency were related to the recent decline in the prevalence of marijuana use disorder among adolescents (Grucza et al., 2016). However, formal modeling of the co-occurrence between delinquent behaviors and marijuana use disorder was beyond the scope of that work. (Nor did that work examine other SUDs). The work described here constitutes the first comprehensive and multivariate examination of recent trends in adolescent SUDs and delinquent behaviors. Further, despite

several decades of research indicating that a full understanding of these behaviors requires multivariate analysis, we are unaware of prior studies that have used such methods to examine population-level trends in any set of adolescent risk behaviors.

Methods

Survey Overview and Sample.

We utilized data from the adolescent sample (ages 12–17) of the National Survey on Drug Use and Health (NSDUH), a yearly survey of the non-institutionalized, civilian population of the United States, overseen by the Substance Abuse and Mental Health Services Administration (SAMHSA). The NSDUH utilizes household-based multistage probability sampling from all 50 states and the District of Columbia, and includes those living in group-quarters. Consistent sampling and recruitment methods have been employed since 2002, rendering the data comparable from year-to-year on most measures. Interviews are conducted in dwelling units; behavioral questions are administered by audio-computer assisted self-interview to maximize privacy and confidentiality. Detailed methods are available through SAMHSA (Substance Abuse and Mental Health Services Administration, 2015). Because of slight changes to items assessing delinquency in 2003, our analyses cover the period 2003 through 2014, the most recent year for which data was available. Weighted adolescent response rates for that period range from 80–87% (SAMHSA, 2014). Public use NSDUH files were obtained from the Interuniversity Consortium for Social and Political Research (ICPSR, 2015). Annual sample sizes ranged from 13,409 to 18,518. After removing 2,144 subjects with missing data, the final combined sample size was 210,599.

Outcome Measures.

Main outcomes were measures of past-year delinquent behaviors and substance use disorders (SUDs). Frequencies of engaging in six delinquent behaviors were assessed: participation in a serious fight, involvement in a group fight, attacking a person with intent to injure, stealing an item worth $50 or more, selling drugs, and handgun carrying. NSDUH SUD assessments for alcohol and 8 classes of drugs—including prescription drugs used non-medically—are based on DSM-IV abuse and dependence criteria covering the past 12 months. We analyzed six SUD outcomes related to alcohol, nicotine, marijuana, prescription opioids, other non-prescription illicit drugs, and other (non-opioid) prescription drugs. The two “other” categories were created because several of the specific SUD diagnoses were rare. The NSDUH does not assess DSM-IV nicotine dependence, but includes both the Fagerström test for Nicotine Dependence (FTND) and the Nicotine Dependence Syndrome Scale (NDSS; Heatherton et al., 1991) Participants who met criteria using either of those measures were counted as nicotine dependent. For other substances, SUD was defined as meeting criteria for DSM-IV abuse or dependence.

Our primary outcomes were the mean counts of (i) past-year delinquent behaviors reported and (ii) SUD categories for which past-year diagnostic criteria were met. In order to derive summary statistics to describe the overall trends in these variables for the entire observation period—as opposed to year-to-year differences that might fluctuate over time—we used regression methods to model each variable as a function of year (described below). This also

allowed for adjustment for demographic covariates that might also change over time. We also examined trends in individual delinquent behaviors and SUDs

Demographic variables.

Sex, age, race/ethnicity, population density (urban/rural status) and poverty status were used as stratification variables in descriptive analyses and covariates in adjusted trend analyses. Age was categorized into three groups: 12–13, 14–15 and 16–17. Race/ethnicity was recoded into six groups: White, Black, Hispanic, Asian, multiple reported races, and Other. The population density variable was recoded to indicate whether or not the respondent lived in a core-based statistical area (CBSA) with a population of 10,000 or more, or whether they lived outside of a CBSA (labeled “non-rural” and “rural, respectively). A poverty variable, derived from the ratio of total family income to the federal poverty level, included the following categories: family incomes below the federal poverty threshold (FPT), below 200% FPT, and equal to or above 200% FPT.

Statistical Analysis.

Stata version 14 was used for descriptive statistics and regression analyses. For dichotomous outcomes, we modeled each dependent variable as a function of year using log-binomial regression. The exponent of the regression coefficient yields the risk ratio (RR) associated with year. For example an RR of 0.9 would correspond to a 10% reduction in risk per year. We report the average annual relative change in prevalence, which is equivalent to the average annual relative change in risk, calculated as −100*(1-RR). For count variables (number of delinquent behaviors and number of SUDs), we proceeded in a similar manner except using negative binomial regression. In this case, the exponent of the regression coefficient yields the “rate ratio” associated with year, which can be interpreted similarly; i.e., a ratio of 0.9 would mean a reduction in count of 10% per year. As with the dichotomous outcomes, we report the average annual change, or −100*(1-Rate Ratio). To account for the complex design of the surveys, all analyses were conducted using Stata algorithms that incorporate survey design variables and utilize robust variance estimation procedures.

Structural Analyses: Item Response Theory (IRT) Modeling.

IRT analyses were conducted to examine whether changes in each set of outcomes could be attributed to changes in underlying latent traits, which we label DQ (delinquency) and SUD respectively. Development of 2-parameter logistic (2PL) IRT models for single-factor DQ and SUD models are described in the Supplementary Material; 2PL models yield estimates of item discrimination coefficients(a) and item difficulty (b). For the two single-factor models, we analyzed 6 delinquent behaviors and 6 SUDs, respectively, as indicators of the underlying unidimensional factor. We then examined measurement invariance (MI) of each unidimensional model across survey years. This was done by estimating a series of models: (1.) A model in which the discrimination coefficients and difficulty parameters were allowed to vary across years—typically called a configural model; factor means and variances are fixed at 0 and 1, respectively, for model identification. (2.) A model in which discrimination coefficients and difficulty parameters were held constant across years, but factor means and variances were estimated separately for each year—typically called a scalar model. (3.)

Model 2, with variances held constant (at 1) for each year but factor means estimated separately for each year. (4.) Model 2 with means held constant and variances estimated separately for each year and (5.) Model 2 with both factor means and variances held constant across years. Superiority of the scalar model (2) over the configural model (1) is evidence of MI and justifies constraining of the discrimination coefficients and item difficulty parameters to be constant over time, indicating that the relations between the manifest indicators and the latent factor means remain constant over time, such that changes in indicator values can be interpreted as changes in the distribution of the underlying latent traits rather than temporal differences in model properties (e.g, Eaton et al., 2012). Superiority of Model 3 would further indicate that the variance of the underlying factor remained constant and that changes in indicator values reflect changes in the mean levels of the latent trait. Models 4 and 5 were estimated to rule-out alternative hypotheses that changes stemmed from changes in variance only, or that the distribution of the latent factor remained relatively constant over time.

We compared models using the Bayesian Information Criterion (BIC; Schwarz, 1978). The BIC is derived from maximum likelihood estimation and is an indicator of the likelihood that the model is correct based on goodness of fit and model parsimony (lower values indicate preferred models). To ensure our results were not dependent on a particular estimator or fit statistic, we also report the comparative fit index (CFI), which is a parsimony-weighted fit index derived from weighted-least squares estimation. The CFI ranges from 0 to 1, with higher values suggesting a better model (Cheung and Rensvold, 2002). All multivariate analyses were conducted in MPlus utilizing either the ‘MLR’ estimator (maximum-likelihood with robust standard errors) or the ‘WLSMV’ (weighted least squares with mean and variance adjusted chi-square statistic) estimator (Muthén and Muthén, 1998).

After establishing that the single-factor models for both DQ and SUD exhibited strong MI across years and that the variance of each factor was constant, we turned to the question of whether changes in mean values for all 6 SUDs and all 6 delinquent behaviors might be related to changes in mean values of a single higher-order externalizing factor (EXT). Ideally, we would estimate a hierarchical model, in which DQ and SUD are sub-factors of EXT, but this model is under-identified (see Supplemental Material, Part II). Therefore, we modeled all indicators as a function of EXT and estimated the series of 5 invariance-testing models described above. Although this model exhibited a suboptimal fit compared with the the single-factor models, we justified the use of a single-factor model by estimating a model in which the two latent DQ and SUD were correlated with each other and demonstrating that this correlation coefficient was relatively high and constant over time (see Supplemental Material, Part II).

Results

Table 1 reports the number of participants in each demographic group and the mean numbers of delinquent behaviors and SUDs per 100 participants, overall and for each demographic group. The means of these quantities for the first and last year of the observation period are listed in the bottom two rows of the table, and a decline in each is readily apparent. Across

the 2003–2014 period, the estimated mean number of delinquent behaviors per 100 persons was 52.5 (95% CI: 52.0 to 53.1) and the mean number of SUDs was 13.5 per 100 (95% CI: 13.2 to 13.8). Because our primary interest was in trends over time, we do not discuss the demographic distribution of these variables further, but interested readers may refer to Table 1 for details.

Results of epidemiological trend analyses are shown in Figures 1 and 2, and Table 2. Panels A and B of Figure 1 plot the yearly prevalence estimates for each of the six delinquent behaviors and for each of the six SUD categories, respectively, while Figure 2 shows the mean number of delinquent behaviors and the mean number of SUDs per 100 persons. Table 2 lists the average annual changes in each outcome; i.e., the average annual relative change in prevalence for dichotomous variables and the average annual relative change in means for count variables. These are derived from regression estimates of risk ratios and rate ratios, respectively, describing the association between the outcome variable and year. These parameters are related to the slopes of the trend lines in Figures 1 and 2. The first column of Table 2 lists the unadjusted estimates of average annual relative change while the second column lists the same parameters adjusted for demographic variables. (Although some trends deviated from the log-linear form, we opted not to introduce quadratic or higher order terms into the trend models so that we could summarize and compare trend magnitudes for all outcomes using the annual average percentage change.)

The top half of Table 2 shows that, with the exception of handgun carrying, the prevalence of each delinquent behavior underwent a significant decrease, with unadjusted rates of decline ranging from 3.0% to 5.0% annually; adjustment for demographics had little impact on these estimates. Based on these rates, overall declines in the prevalence of each behavior (except for handgun carrying) for the 2003–2014 period ranged from 29 to 44%. The annual average decline in the mean number of delinquent behaviors was 3.7%, which corresponds to an overall decline of 34%. The bottom half of Table 2 summarizes changes in the past-year prevalence of the 6 SUD categories; all SUDs underwent significant and substantial decreases in prevalence, with unadjusted average annual reductions ranging from 2.5% for marijuana use disorder to 8.0% for nicotine dependence. These changes correspond to overall declines ranging from 25% to 60% for the 2003–2014 period. The average annual decline in mean number of SUDs per 100 participants was 6.0%, which corresponds to a net decline of 49%.

Results of analyses of structural relationships among individual delinquent behaviors and individual SUDs are described in the Supplementary Material and below. Development of the one-factor models for DQ and SUD are provided in the Supplementary Material, Part I with results in Tables S1-S3. Model fit statistics (BIC and CFI) from Measurement Invariance analyses of the single-factor models are shown the first two sections of Table 3. In both cases, the models with parameters constrained to be equivalent across years (scalar models) yielded lower BIC and higher CFI values than the unconstrained models, and further constaining the variance to be constant across years resulted in further improvements in those parameters. These results indicate that both the DQ and SUD measurement models exhibit measurement invariance across survey years and that there was little change in the variance of the corresponding latent traits over time. Finally, we estimated the model in

which all 12 behaviors linked by a single factor labeled EXT. This model also exhibited strong measurement invariance and constant factor variance across years. Final models are diagrammed in Figure 3. Supplementary Material Part III describes estimation of the mean values the latent DQ, SUD, and EXT factors; these estimates are plotted in Figure S2. The plot illustrates that mean values of all three factors declined by about 0.3 to 0.4 standard deviations during the period under study.

Discussion

Over the years 2003–2014, we estimate a 34% decline in the number of delinquent behaviors reported by 12–17 year olds, and a 49% decline in the number of substance use disorders. Results of multivariate modeling analyses are consistent with the interpretation that these declines reflect a trend in an underlying Externalizing-like trait rather than multiple trends in specific behaviors or specific types of substance use disorder. In the first stage of modeling, single-factor models for delinquent behaviors (DQ) and substance use disorders (SUD) both exhibited consistent measurement properties from year to year, supporting the interpretation that prevalence declines in each set of outcomes can be attributed to declines in mean levels of the hypothesized underlying traits. We then demonstrated that the latent DQ and SUD traits were strongly correlated with each other (R=0.74), and that the magnitude of that correlation was invariant over time. This justified estimation of a single-factor externalizing model summarizing both delinquent behaviors and SUDs. This model also exhibited consistent measurement properties and constant variance over time suggesting that declines in all manifest variables are largely due to declines in mean levels of an Externalizing-like trait.

We do not discount the possibility that outcome-specific factors—such as alcohol or tobacco policies—may have had some influence on trends in individual outcomes. In fact, this may be particularly true in the case of gun-carrying, which is the only delinquent behavior that did not undergo an appreciable or even statistically significant decline—an observation that is consistent with the findings of at least one other report (Webster et al., 2014). What this means in terms of manifest behavior is that the prevalence of gun-carrying in the context of other delinquent behaviors likely declined whereas the prevalence of gun-carrying as a standalone behavior likely increased. This is explored further in the Supplementary Material (Part IV and Figure S3). Nonetheless, our modelling results suggest that the bulk of change in prevalence in SUDs and delinquent behaviors can be attributed to a trend in a common factor.

The main implication of our findings is that the primary causal factors for the trends we observed probably influence individual characteristics, such as disinhibition or risk-preferences, rather than impacting risk for specific outcomes. Given the fairly sharp decline in the prevalence of behaviors we examined, the potential causes are likely to be environmental factors that have undergone relatively rapid changes in recent years. There are a large number of such factors, but at least two have been nominated by other investigators as potential causes of reductions in delinquency and other risk behaviors that could be considered as part of the externalizing spectrum. Several investigators have suggested that reductions in childhood lead exposure may be linked to declining rates of delinquency,

unwed pregnancy, low IQ, violent crime and other problems (e.g.; Dietrich et al., 2001; Lane et al., 2008; Nevin, 2000; Reyes, 2007; Stretesky and Lynch, 2001). Environmental lead levels dropped precipitously during the 1970s and 1980s and the drop in preschool blood lead levels continued even as the rate of decline in environmental lead asymptotically slowed (Centers for Disease Control and Prevention, 2013; Nevin, 2007). More recently, Finkelhor and Johnson (2015) proposed that the decline in juvenile delinquency may be related to increased rates of psychotropic medication utilization in pediatric populations. This seems particularly plausible in the case of stimulant medications, which are known to reduce aggression in school-aged children and criminal behavior among adults (Hinshaw, 1991; Lichtenstein et al., 2012; Sinzig et al., 2007). Use of these medications was relatively rare prior to the mid-1990s but prescribing rates have increased dramatically since then (Diller, 1996; Olfson et al., 2015; Zuvekas and Vitiello, 2012). We also noted the declining rates of child maltreatment in recent years (see Introduction). Maltreatment has similarly been linked to multiple externalizing-related outcomes and so this is another factor that could be contributing to the trends observed here (Heim et al., 2010; Hicks et al., 2009; Teicher et al., 2003). These factors do not comprise an exhaustive list of candidates and the trends we observe are likely to be multi-causal in nature. But our results underscore the need to consider a broad spectrum of behaviors in examining potential causes for these trends and to utilize multivariate approaches when possible.

Some caveats and limitations to our findings must be enumerated. As noted earlier, there have been reductions in several domains of adolescent risk behaviors over the past 15 or more years, including specific crimes and sexual-risk taking. Our interpretation that trends are a result of a trend in an underlying trait is limited to trends in the outcomes and the time-period studied here. A final noteworthy limitation is that we cannot evaluate or rule out the possibility of causal relationships among our outcomes; for example, alcohol use is likely to influence violent behavior, notwithstanding the likelihood of those behaviors sharing common etiologies. Finally, standard limitations associated with observational studies and self-reported outcomes should be kept in mind.

While the full explanation for recent trends in SUDs and delinquent behaviors is almost certainly multicausal, the analyses presented here provides some clues into their etiology by showing that they appear to reflect an overall trend in an externalizing-like trait. Future research should characterize this phenomenon in greater detail by investigating what other behaviors have been influenced by this trend and identifying which segments of the population have been most affected. This could provide further clues into the contributing causes to this phenomenon, elucidation of which would be invaluable toward facilitating continuation of these improvements in adolescent health as far into the future and across as much of the adolescent population as possible.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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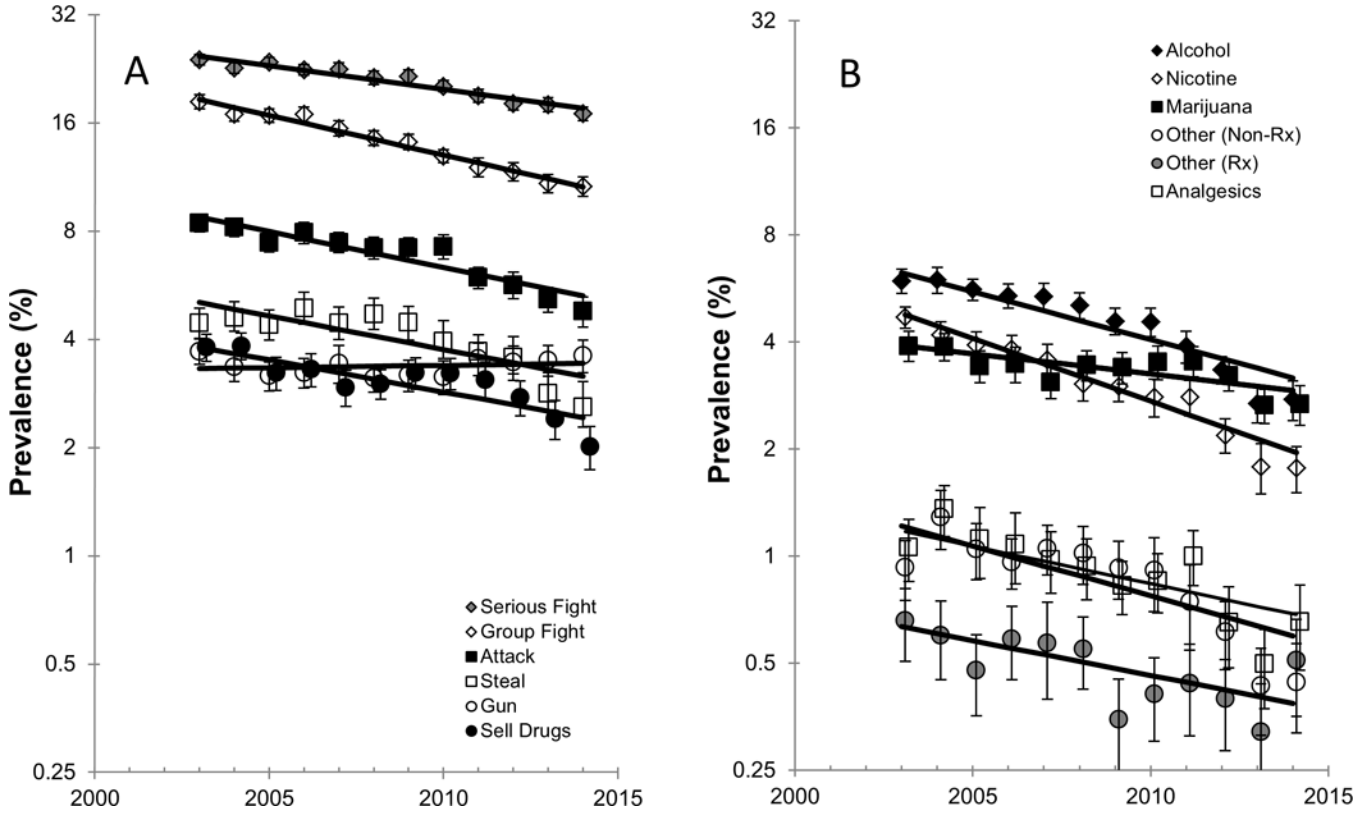

Figure 1:

Prevalence by year for each of 6 delinquent behaviors A), and each of SUD categories (B). Trend lines represent fits to log-binomial models of each variable as a function of year. Error bars represent 95% confidence intervals. Y-axes are logarithmically scaled.

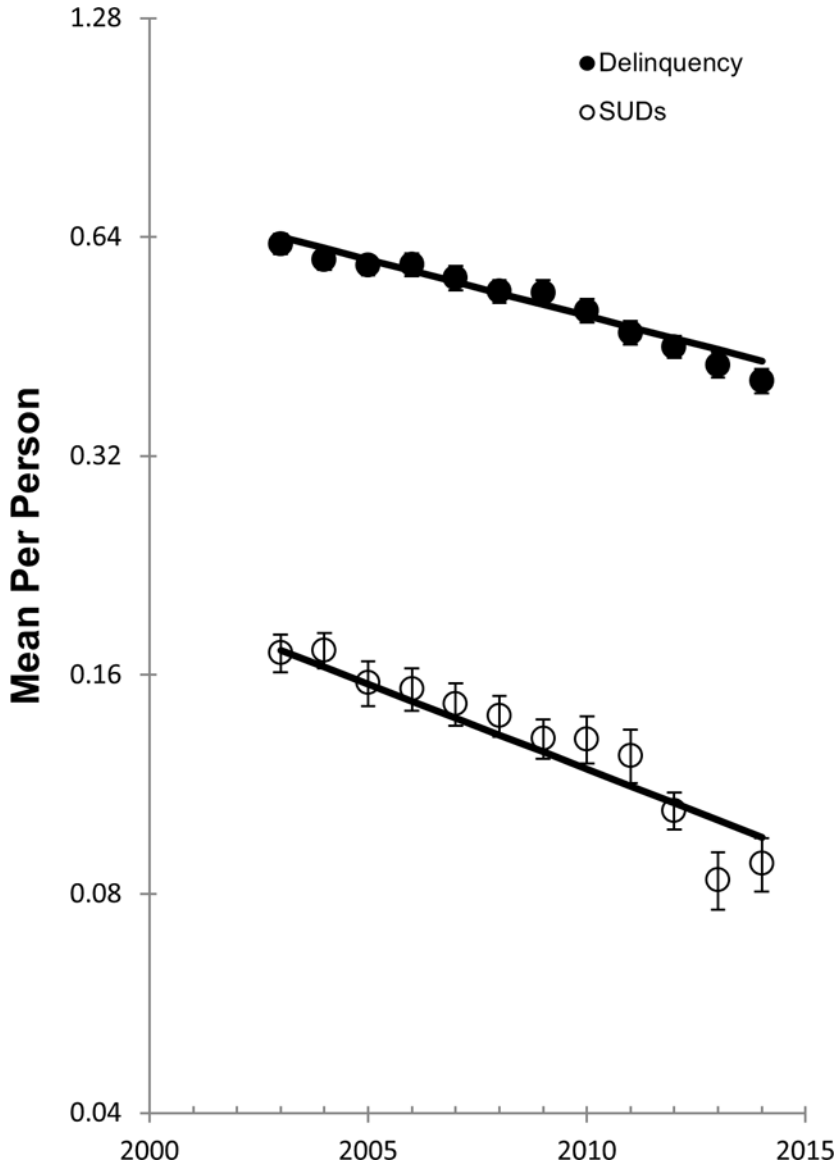

Figure 2:

Mean by year for average number of delinquent behaviors and SUDs per person. Trend lines represent fits to log-binomial model. Error bars represent 95% confidence intervals. Y-axis is logarithmically scaled.

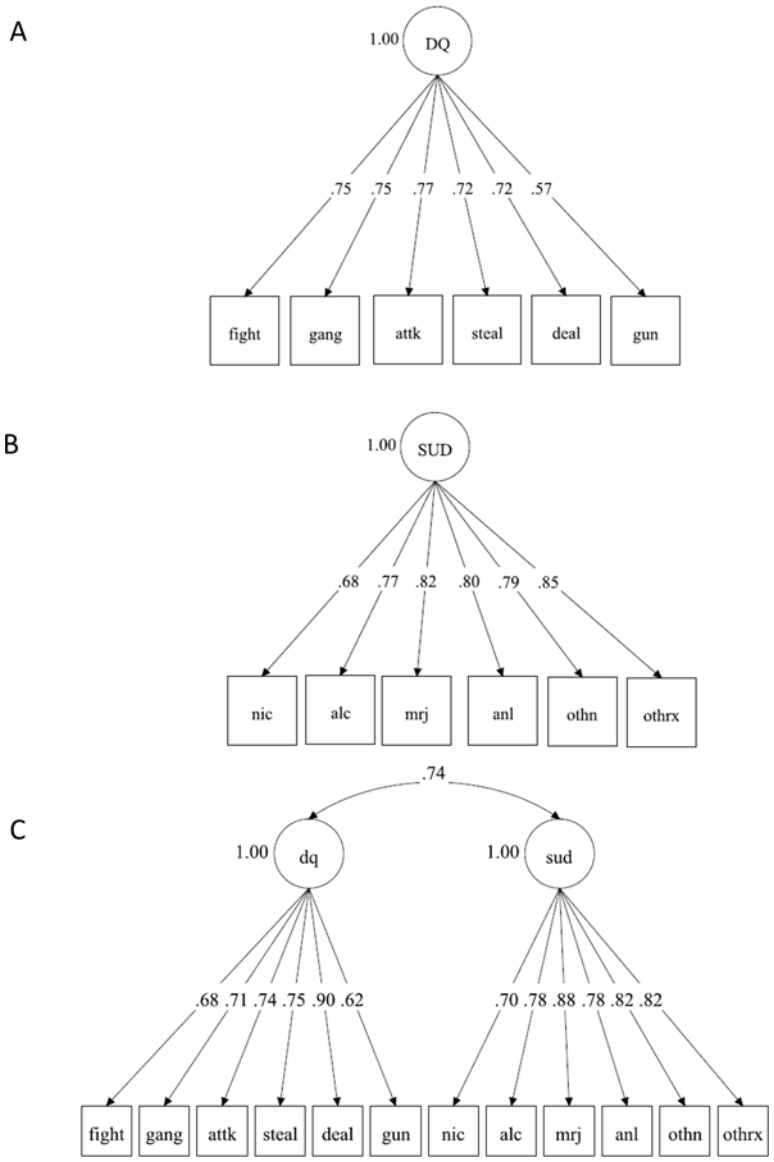

Figure 3:

Structural models for (A.) Delinquency measurement (IRT) model; (B.) Substance use disorders measurement model and (C.) Two-factor model in which DQ and SUD are modeled as correlated factors with the correlation coefficient held fxed across years.

Table 1:

Estimates for mean number of 6 delinquent behaviors and mean number 6 categories of SUDs per 100 persons, by demographic group, for the 2003–2014 NSDUH adolescent samples.

	Unweighted n	Weighted % of Sample	Mean Delinquent Behaviors (95% CI) [Weighted][a]		Mean SUDs (95% CI) [Weighted][a]	
Full sample	210,599	100.0	52.5	(52.0, 53.1)	13.5	(13.2, 13.8)
Sex						
Males	107,232	51.1	63.0	(62.2, 63.8)	13.1	(12.7, 13.5)
Females	103,367	48.9	41.7	(41.0, 42.3)	13.9	(13.5, 14.4)
Age						
12–13	66,984	32.1	48.0	(47.2, 48.8)	2.7	(2.5, 2.8)
14–15	71,207	34.0	55.3	(54.3, 56.3)	12.2	(11.7, 12.6)
16–17	72,408	33.9	54.0	(53.0, 55.1)	25.2	(24.6, 25.8)
Race/ethnicity						
White	125,312	58.4	47.5	(46.9, 48.2)	15.7	(15.3, 15.9)
Black	28,808	14.7	70.5	(69.0, 72.1)	7.7	(7.2, 8.4)
Hispanic	36,775	19.5	56.7	(55.2, 58.1)	12.2	(11.4, 12.9)
Asian	6,687	4.3	31.4	(29.2, 33.5)	4.2	(3.4, 5.1)
Multiple Race	8,854	2.2	63.2	(58.9, 67.5)	16.1	(14.3, 18.1)
Other[b]	4,163	0.9	70.2	(64.7, 75.8)	9.8	(8.9, 10.7)
Population Density						
Non-rural	191,289	91.0	52.2	(51.6, 52.7)	13.2	(12.9, 13.5)
Rural	19,310	9.0	56.3	(54.5, 58.1)	17.2	(16.2, 18.3)
Poverty						
Below FPT[c]	40,692	19.5	67.0	(65.6, 68.4)	14.5	(13.7, 15.3)
1–2x FPT	47,799	22.0	59.2	(58.1, 60.3)	14.4	(13.8, 15.1)
>2x FPT	124,252	58.5	45.2	(44.6, 45.9)	12.8	(12.5, 13.2)
Year						
2003	18,067	8.36	62.6	(60.6, 64.7)	17.1	(16.1, 18.2)
2014	13,409	8.28	40.6	(39.0, 42.2)	8.8	(8.0, 9.6)

[a] Per 100 people; range = 0 to 600.

[b] Includes Native American, Native Hawaiian and other Pacific Islanders; included in main analyses, but not in stratified trend analyses due to small sample size.

[c] FPT=Federal Poverty Threshold

Table 2:

Average annual relative change in the prevalence of each of 6 delinquent behaviors, each of 6 substance use disorders, and the mean numbers of each, as estimated from linear trend models.

	Average Annual Reduction, % (95% CI)	
	Unadjusted[a]	Adjusted[b]
Delinquent Behaviors		
Serious Fight	−3.0 (−3.3, −2.7)	−3.2 (−2.9, −3.5)
Group Fight	−5.0 (−5.4, −4.5)	−5.2 (−4.8, −5.7)
Attack to Injure	−4.5 (−5.1, −3.9)	−4.8 (−4.2, −5.4)
Stealing Item >$50	−4.2 (−4.9, −3.5)	−5.0 (−4.3, −5.7)
Selling Drugs	−4.0 (−4.8, −3.2)	−4.7 (−3.8, −5.6)
Hand Gun Carrying	+0.3 (−0.5, 1.1)	+0.7 (−0.1, 1.5)
Mean # of Behaviors	−3.7 (−4.0, −3.4)	−4.0 (−3.7, −4.3)
Substance Use Disorders		
Alcohol	−6.7 (−6.1, −7.4)	−6.9 (−6.2, −7.5)
Nicotine	−8.0 (−7.2, −8.8)	−7.8 (−7.1, −8.6)
Marijuana	−2.5 (−1.6, −3.4)	−3.3 (−2.4, −4.2)
Analgesics	−6.1 (−4.4, −7.8)	−6.5 (−4.7, −8.2)
Other Non-Prescription Drugs	−7.0 (−5.5, −8.4)	−7.6 (−6.1, −9.1)
Other Prescription drugs	−4.3 (−2.0, −6.5)	−4.7 (−2.3, −7.0)
Mean # of SUDs	−6.0 (−5.4, −6.5)	−6.3 (−5.8, −6.9)

[a]Unadjusted analyses include year as a predictor variable, with no covariates.

[b]Adjusted analyses include demographic covariates (age, sex, race/ethnicity, rural status, and household income), with categories defined as shown in Table 1.

Table 3:

Comparisons of models to assess measurement invariance of the unidimensional DQ, SUD, and EXT models.

	# Parameters	BIC	Difference	CFI	Difference
Delinquency Model					
Unconstrained (ref)	144	1,660,689	-----	0.954	-----
Constrain *a, b*	34	1,660,051	−638	0.965	0.011
Constrain *a, b,* σ^2	23	1,659,969	−720	0.973	0.019
Constrain *a, b,* $\bar{x}$	23	1,660,397	−292	0.952	−0.002
Constrain *a, b,* $\bar{x}$, σ^2	12	1,661,023	+334	0.961	0.007
SUD Model					
Unconstrained (ref)	144	1,268,727	-----	0.985	-----
Constrain *a, b*	34	1,268,001	−726	0.984	−0.001
Constrain *a, b,* σ^2	23	1,267,905	−822	0.987	0.002
Constrain *a, b,* $\bar{x}$	23	1,268,126	−601	0.970	−0.015
Constrain *a, b,* $\bar{x}$, σ^2	12	1,268,529	−198	0.974	−0.011
Externalizing Model					
Unconstrained (ref)	288	1,874,060	-------	0.916	-------
Constrain *a, b*	46	1,872,550	−1,510	0.938	0.022
Constrain *a, b,* σ^2	35	1,872,456	−1,604	0.946	0.030
Constrain *a, b,* $\bar{x}$	35	1,873,226	−834	0.929	0.013
Constrain *a, b,* $\bar{x}$, σ^2	24	1,873,745	−315	0.939	0.023

Notes: a=Item discrimination coefficient, b=threshold, $\bar{x}$=latent factor mean, $\sigma^{2=}$latent factor variance.