

Incidence of Drug Problems in Young Adults Exposed to Trauma and Posttraumatic Stress Disorder

Do Early Life Experiences and Predispositions Matter?

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Context: Most estimated associations of posttraumatic stress disorder (PTSD) with *DSM-IV* drug dependence and abuse are from cross-sectional studies or from prospective studies of adults that generally do not take into account suspected causal determinants measured in early childhood.

Objective: To estimate risk for incident drug disorders associated with prior *DSM-IV* PTSD.

Design: Multiwave longitudinal study of an epidemiologic sample of young adults first assessed at entry to first grade of primary school in the fall semesters of 1985 and 1986, with 2 young adult follow-up assessments.

Setting: Mid-Atlantic US urban community.

Participants: Young adults (n=988; aged 19-24 years) free of clinical features of *DSM-IV* drug use disorders at the first young adult assessment and therefore at risk for newly incident drug use disorders during the 1-year follow-up period.

Main Outcome Measures: During the 12-month interval between the 2 young adult follow-up assessments, newly incident (1) *DSM-IV* drug abuse or dependence; (2) *DSM-IV* drug abuse; (3) *DSM-IV* drug dependence; and (4) emerging dependence problems

(1 or 2 newly incident clinical features of *DSM-IV* drug dependence), among subjects with no prior clinical features of drug use disorders.

Results: Prior PTSD (but not trauma only) was associated with excess risk for drug abuse or dependence (adjusted relative risk, 4.9; 95% confidence interval, 1.6-15.2) and emerging dependence problems (adjusted relative risk, 4.9; 95% confidence interval, 1.2-20.1) compared with the no-trauma group controlling for childhood factors. Subjects with PTSD also had a greater adjusted relative risk for drug abuse or dependence compared with subjects exposed to trauma only (adjusted relative risk, 2.0; 95% confidence interval, 1.1-3.8) controlling for childhood factors.

Conclusions: Association of PTSD with subsequent incident drug use disorders remained substantial after statistical adjustment for early life experiences and predispositions reported in previous studies as carrying elevated risk for both disorders. Posttraumatic stress disorder might be a causal determinant of drug use disorders, possibly representing complications such as attempts to self-medicate troubling trauma-associated memories, nightmares, or painful hyperarousal symptoms.

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PREVIOUS STUDIES¹⁻¹⁰ HAVE DESCRIBED associations between posttraumatic stress disorder (PTSD) and drug use disorders in samples of civilians and combat veterans. For example, comparing adults with a baseline history of PTSD with adults who have never been exposed to trauma, Breslau et al⁹ reported odds ratios of 4.3 for 10-year incidence of *DSM-III-R* drug dependence or abuse and 4.0 for nicotine dependence but found no association with subsequent onset of *DSM-III-R* alcohol dependence or abuse. Nonetheless, estimates of this type

have been based primarily on cross-sectional data gathered from adults, and none to our knowledge have included early measurement of important antecedents that are common to both disorders. Suspected early antecedents of drug use disorders include childhood conduct problems, academic achievement and cognitive problem solving, temperament, and socioeconomic status (SES).¹¹⁻²¹ Some of the same factors also have been identified as predictors of exposure to traumatic events and PTSD,^{22,23} especially conduct problems and cognitive ability (eg, in the studies by Breslau et al²⁴ and Storr et al²⁵). It is there-

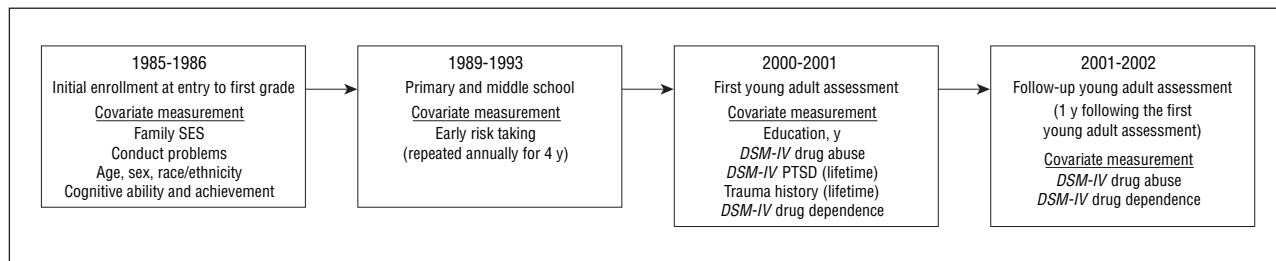


Figure. Sequence of assessments from enrollment at first grade to the follow-up young adult assessment. SES indicates socioeconomic status; PTSD, posttraumatic stress disorder.

fore essential to examine the PTSD–drug use disorder relationship taking into account these common early life factors that might account for the association.

Several explanations of the association of PTSD and drug use disorders have been suggested.²⁶⁻²⁸ One model posits that drug use disorders increase the risk of exposure to trauma and consequently increase the risk for PTSD.^{29,30} Recent evidence has not supported this view.⁸ A second model suggests that the drugs are used to mitigate symptoms of PTSD.²⁷ Current research emphasis has been on the examination of complex neurobiological processes that may underlie this self-medication hypothesis.³¹ A third model considers shared genetic or environmental influences on PTSD and drug use disorders.^{32,33} Early life experiences represent examples of this third model that potentially are causal factors for both PTSD and drug use disorders.

The goal of this prospective study is to estimate the excess risk for drug use disorders associated with trauma and PTSD while controlling statistically for early life antecedents. We nested the investigation within an ongoing longitudinal study of a cohort enrolled on entry to first grade in the fall semesters of 1985 and 1986 and reassessed at 2 times in young adulthood. Assessments of early conduct problems, cognitive ability and academic achievement, early family SES, and risk-taking disposition obtained during the years of primary school allowed us to control statistically for these common antecedents of PTSD and drug use disorders. Further, by limiting our analysis to young adults who had never experienced problems of drug dependence and by using a short follow-up period of 1 year, we have established stringent criteria for incident cases of drug use disorders as the study outcomes. The 1-year follow-up period also addresses concerns of recall bias in the assessment of outcomes and reduces the time during which events occurring during the follow-up interval might confound the study results.

METHODS

DATA AND SAMPLE

As described elsewhere, participants originally were enrolled in fall 1985 and fall 1986 as they entered first grade from 19 primary schools located in 5 preselected urban areas of a public school system in a large mid-Atlantic US city.³⁴⁻³⁶ City planning officials participated in the selection of the urban areas to ensure representativeness of between-area variation in ethnicity, type of housing, income, and other US census characteristics. Residents ranged from very poor to low middle class, with vary-

ing numbers of African American and non-Hispanic white persons. Each area included 3 to 4 public elementary schools. All of the entering first graders in these schools were recruited.

Several waves of assessment were completed in primary and middle school as part of a longitudinal study (eg, see the article by Lloyd and Anthony³⁷). The **Figure** depicts the assessment sequence for the study with early assessments beginning in fall 1985 to spring 1986 and continuing in fall 1989 through spring 1993, followed by 2 waves of assessment completed during young adulthood roughly 1 year apart. The first young adult assessment wave occurred during the years 2000 through 2001, and the follow-up assessment was completed about 1 year later for each person during the years 2001 through 2002. The age range at the time of the first young adult assessment was 19 to 24 years. Most subjects were aged 19 to 22 years, 65 were aged 23 years, and 9 were aged 24 years. Information from the primary and middle school assessments was used to control for early antecedents that might influence the relationship between the hypothesized suspected causes (trauma and PTSD) and outcomes (drug use disorders).

STUDY SAMPLE AT FOLLOW-UP IN YOUNG ADULTHOOD

As described in prior articles,^{36,38-40} at follow-up during the years 2000 through 2001, nearly 75% of the original 2311 youths were traced, reconsented, and were reassessed at the first young adult assessment ($n = 1698$), by which time the participants were aged 19 to 24 years. An additional 307 subjects (13%) were located, of which 133 could not be reached (eg, military postings out of the country or living out of state with no telephone number), 142 refused to be interviewed, and 32 had died.

Of 1698 participants completing the first young adult assessment conducted during 2000 and 2001, 1436 met the study eligibility criteria: (1) had not previously experienced DSM-IV drug dependence (lifetime); and (2) had no clinical features of DSM-IV drug abuse or drug dependence during the 12 months prior to the first young adult assessment. Roughly 1 year after each initial young adult assessment, 1147 participants were reassessed with respect to drug abuse and dependence. Study funds were exhausted before completion of field work. Included in the follow-up assessment were 988 of the 1436 young adults (69%) with no drug use problems at the first young adult assessment. This group of 988 young adults constitutes the sample for this study.

We examined whether subjects participating in both young adult assessments differed from subjects only participating in the first young adult assessment. Using data from the first young adult assessment, we looked at the presence of drug dependence comparing the 1147 young adults who participated in the second young adult assessment with the 551 young adults who did not participate in the second young adult assessment. There was no statistically significant difference (odds ratio, 0.7; $P = .13$) in drug dependence measured at the first assessment

when comparing the group participating with the group not participating in the second young adult assessment, a finding consistent with previous studies of this cohort.³⁸ We made further comparisons between the 2 groups with respect to the childhood antecedent covariates. There was no statistically significant association ($P = .12$) between follow-up participation and either conduct problems or cognitive ability. There were associations ($P < .01$) between follow-up participation and both risk taking and family SES. However, the associations became statistically insignificant when adjustment was included for race/ethnicity (risk taking: adjusted odds ratio, 0.9; $P = .16$; family SES: adjusted odds ratio, 1.1; $P = .31$).

The study protocol was approved by the institutional review board for protection of human subjects at Johns Hopkins University. The Michigan State University institutional review board approved the protocol for the data analysis.

MEASURES

There were 4 key outcome variables in this study during the interval between the first and second young adult assessments: (1) incident *DSM-IV* drug abuse or dependence indicated by the occurrence of 3 or more clinical features of drug dependence or 1 or more clinical features of drug abuse, with reference to any of 12 illegal or prescription drugs (cannabis, crack or other cocaine, smoked methamphetamine [“ice”], heroin, opium, 3,4-methylenedioxymethamphetamine [“ecstasy” or “MDMA”], inhalants, hallucinogens, anxiolytics, sedatives, stimulants, and analgesics such as oxycodone); (2) incident *DSM-IV* drug abuse indicated by the occurrence of 1 or more clinical features of drug abuse (in the absence of drug dependence); (3) incident *DSM-IV* drug dependence defined as the occurrence of 3 or more newly incident clinical features of drug dependence; and (4) emerging drug dependence problems indicated by the occurrence of 1 or 2 newly incident clinical features of drug dependence.

As described previously, the assessments of drug use problems incorporated in the face-to-face interviews followed the general approach of the National Comorbidity Study to facilitate direct comparisons of results in the future.^{38,41} Assessment of drug abuse or dependence used 15 standard questions about *DSM-IV* clinical features of drug abuse and drug dependence. Assessment of drug dependence and emerging dependence problems was based on the 11 standard interview questions focused on *DSM-IV* clinical features of drug dependence. Assessment of drug abuse was based on the 4 questions concerned with abuse.⁴¹

The principal covariates of interest in the study were lifetime exposure to at least 1 *DSM-IV*-qualifying traumatic event in the absence of subsequent PTSD (trauma only) and *DSM-IV* PTSD (lifetime) following exposure to a traumatic event (PTSD). The assessment of lifetime exposure to traumatic events and PTSD was part of the interview conducted at the first young adult assessment and has been described in detail previously.^{36,42,43} Briefly, respondents were asked whether they had experienced each of 18 types of traumatic events that operationalized the *DSM-IV* stressor criterion as well as the frequency and age at each event occurrence. If multiple events were reported by a respondent, a list of the events was read back followed by instructions to “identify the event that was most stressful to you” (the worst event). The worst event was evaluated for PTSD using version 2.1 (PTSD section) of the World Health Organization Composite International Diagnostic Interview.⁴⁴ This procedure has been validated against independent clinical interviews.⁴⁵

A set of early antecedents of adult psychiatric problems measured soon after entry into primary school have been included

as potential confounders: (1) family SES at the time of school entry; (2) conduct problems; (3) cognitive ability and academic achievement; and (4) risk taking.^{16,21,24,46-48} Low family SES was indicated by eligibility for federally subsidized lunch at the time of school entry. Conduct problems were measured using teacher ratings of pupil conduct problems (primarily aggression related) using the Teacher Observation of Classroom Adaptation-Revised scale at ages 6 to 8 years.^{34,49} Cognitive ability was measured using the mean of the standard scores of first-grade math and reading achievement tests. Risk-taking tendency was measured using the mean of standard scores of 4 assessments completed during consecutive years of elementary and middle school. The risk-taking assessment consisted of the presentation of a scenario in which the student was asked to indicate the height from which he or she would be willing to jump from a platform to the ground. Greater heights were scored and interpreted as indicating higher risk-taking disposition. Scores on the risk-taking measure have been found to be associated with drug use in later life.^{50,51} Further, Morrongiello⁵² reported that similar assessments of children’s intention to take physical risk related to heights are strongly associated with actual risk taking and are a proxy for actual risk taking.

Other covariates included in regression models as measures of potential confounders were sex, age, race/ethnicity, and the number of years of education completed by the participant by the time of the first young adult assessment.^{21,53,54} Sex, age, race/ethnicity, and subsidized lunch eligibility in the first grade were abstracted from the administrative database maintained by the school system.

STATISTICAL ANALYSIS

For the prospective analyses of incident disorders and problems, regression analyses were based on the general linear model implemented under the Stata version 9.1 statistical software procedure binreg, which generates estimates of risk ratios using the log link function.⁵⁵ The model estimates the relative risk (RR) for each outcome as a function of (1) PTSD and (2) exposure to trauma only, relative to the no-exposure group as a reference (no trauma). Analyses took into account the clustering of students within classrooms, a part of the sampling design. We began with an analysis of the unadjusted (bivariate) risk ratios and then added covariates to the models.

Because both PTSD and drug use disorders have a relatively low prevalence, we were cognizant of the preponderance of small cell frequencies when adding covariates to the prediction model. To address this issue, for each outcome we computed risk ratios for the exposures adjusted for each covariate individually (eg, risk of drug abuse or dependence comparing the PTSD group with the no-trauma group adjusted for sex). This involved 32 individual analyses, 8 for each outcome. These analyses were repeated using exact methods of computation. The exact methods had no material impact on results and were not reported.

Drug use specificity was taken into account by using $k-1$ terms for the 12 (k) drug categories under study.^{38,56} In this study, including terms for the individual drug variables had virtually no impact on the results and were not included in the final models for which results were reported.

RESULTS

Sample characteristics are presented in **Table 1** to describe the original cohort enrolled at entry into first grade ($n = 2311$); all of the participants in the first young adult assessment ($n = 1698$); young adults with no history of

Table 1. Sample Characteristics at Initial Enrollment at Entry to First Grade in 1985 and 1986 and at the Time of the 2 Young Adult Assessments in 2000 to 2002^a

| Characteristic | All Participants Enrolled at Entry to First Grade in 1985-1986 (n=2311) | First Young Adult Assessment in 2000-2001 (n=1698) | Young Adults With 0 Clinical Features of Drug Abuse or Dependence at the First Young Adult Assessment (n=1436) | All Young Adults Assessed at the Second Young Adult Assessment (n=1147) ^b | Young Adults With 0 Clinical Features of Drug Dependence at the First Young Adult Assessment Who Were Reassessed 1 Year Later (n=988) |
|---|---|--|--|--|---|
| Male, No. (%) | 1151 (50.2) | 794 (46.8) | 622 (43.3) | 497 (43.3) | 397 (40.2) |
| Female, No. (%) | 1160 (49.8) | 904 (53.2) | 814 (56.7) | 650 (56.7) | 591 (59.8) |
| White, No. (%) | 761 (32.9) | 476 (28.0) | 389 (27.1) | 276 (24.1) | 229 (23.2) |
| Nonwhite, No. (%) ^b | 1550 (67.1) | 1222 (72.0) | 1047 (72.9) | 871 (75.9) | 759 (76.8) |
| Age at first young adult assessment, mean (SD), y | 21.8 (0.70) | 21.8 (0.69) | 21.8 (0.69) | 21.8 (0.70) | 21.8 (0.69) |
| Exposure, No. (%) ^c | | | | | |
| No trauma | NA | 297 (17.5) | 277 (19.3) | 215 (18.8) | 199 (20.1) |
| Trauma only | NA | 1280 (75.4) | 1052 (73.3) | 845 (73.8) | 714 (72.3) |
| PTSD | NA | 121 (7.1) | 107 (7.4) | 83 (7.3) | 75 (7.6) |

Abbreviations: NA, not applicable; PTSD, posttraumatic stress disorder.

^aData are from the Johns Hopkins University Prevention Research Center cohort originally recruited in the fall semesters of 1985 and 1986 at entry to first grade from 19 schools in a mid-Atlantic US school system and reassessed as young adults. The first young adult assessment was conducted during the 2-year period of 2000 through 2001, and the second young adult assessment was conducted approximately 1 year after the first assessment for each person. There were 9 young adults aged 24 years and 65 young adults aged 23 years. The remainder of the 1698 young adults were aged 19 to 22 years.

^bNonwhite in the original cohort comprised 98.6% African American individuals, with the remainder including Asian, Hispanic, and Native American individuals.

^cFour participants at the second young adult assessment were not assessed at the first young adult assessment.

Table 2. Exposure Distribution for the Entire Sample and for Each Outcome^a

| Exposure Group | No. (%) | | | | |
|----------------|--------------------|---------------------------------------|-------------------------------|------------------------------|--|
| | Sample Exposure | Drug Abuse or Dependence ^b | Drug Abuse Without Dependence | Drug Dependence ^c | Emerging Drug Dependence Problems ^d |
| PTSD | 75 (7.6) | 10 (13.3) | 10 (13.3) | 4 (5.3) | 3 (4.0) |
| Trauma only | 714 (72.3) | 45 (6.3) | 40 (5.6) | 19 (2.7) | 28 (3.9) |
| No trauma | 199 (20.1) | 4 (2.0) | 4 (2.0) | 1 (0.5) | 2 (1.0) |
| Total | 988 (100.0) | 59 (6.0) | 54 (5.5) | 24 (2.4) | 33 (3.3) |

Abbreviation: PTSD, posttraumatic stress disorder.

^aData are from the cohort originally recruited in the fall semesters of 1985 and 1986 at entry to first grade from 19 schools in a mid-Atlantic US school system and reassessed as young adults. The first young adult assessment was conducted during the 2-year period of 2000 through 2001, and the second young adult assessment was conducted approximately 1 year after the first assessment for each person.

^bIncident cases of *DSM-IV* drug abuse, drug dependence, or both.

^cThree or more clinical features of *DSM-IV* drug dependence clustered within the past 12 months with or without the presence of clinical features of drug abuse.

^dOne or 2 newly incident clinical features of drug dependence without the presence of any clinical features of drug abuse.

drug use problems at the first young adult assessment (n=1436); all of the participants assessed at the follow-up young adult assessment (n=1147); and the subset of this group who had no history of drug use problems at the first young adult assessment (n=988). The frequencies and proportions of young adults exposed to trauma only and to PTSD are also shown in Table 1. To evaluate the consistency of exposure proportions for the sample subsets, a χ^2 analysis was used to test the null hypothesis that there was no difference in exposure group proportions across sample subsets. The null hypothesis was not rejected ($\chi^2_6=3.8$; $P=.71$).

Table 2 shows the distribution of exposures among all of the 988 young adults in the study along with the corresponding frequencies of each outcome. In the total

group, there were 75 individuals (7.6%) with prior PTSD and 714 individuals (72.3%) exposed to trauma only. The 1-year incidence rate for drug abuse or dependence for the entire sample of young adults was 6.0% (59 of 988 individuals). There were 33 young adults (3.3%) with 1 or 2 incident clinical features of drug dependence, indicating emerging problems of drug dependence.

Table 3 presents estimates of the unadjusted (bivariate) RR associated with exposure to trauma only and with PTSD for each of the 4 drug use disorder outcomes, using the no-trauma (unexposed) group as the reference. The unadjusted risk for incident drug abuse or dependence was more than 6-fold higher for the PTSD group vs the no-trauma group (RR=6.6; 95% confidence interval [CI], 2.1-21.1). The RRs for the remaining drug use disorder

Table 3. Estimated Unadjusted (Bivariate) Relative Risks of Incident Drug Abuse or Dependence, Drug Abuse, Drug Dependence, and Emerging Problems of Dependence With Exposure to Trauma and DSM-IV Posttraumatic Stress Disorder^a

| Exposure | Drug Abuse or Dependence | | Drug Abuse Without Dependence | | Drug Dependence | | Emerging Drug Dependence Problems | |
|--------------------------|--------------------------|---------|-------------------------------|---------|-----------------|---------|-----------------------------------|---------|
| | RR (95% CI) | P Value | RR (95% CI) | P Value | RR (95% CI) | P Value | RR (95% CI) | P Value |
| No trauma as reference | | | | | | | | |
| No trauma | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Trauma only | 3.1 (1.2-8.1) | .02 | 2.5 (0.8-7.6) | .11 | 5.3 (0.7-40.5) | .11 | 4.1 (1.0-17.1) | .06 |
| PTSD | 6.6 (2.1-21.1) | .001 | 5.6 (1.4-22.0) | .01 | 10.6 (1.2-95.7) | .04 | 4.5 (1.1-17.7) | .03 |
| Trauma only as reference | | | | | | | | |
| Trauma only | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| PTSD | 2.1 (1.1-4.1) | .03 | 2.3 (1.0-5.2) | .06 | 2.0 (0.9-4.7) | .11 | 1.1 (0.3-3.7) | .87 |

Abbreviations: CI, confidence interval; PTSD, posttraumatic stress disorder; RR, relative risk.

^aData are from the cohort originally recruited in the fall semesters of 1985 and 1986 at entry to first grade from 19 schools in a mid-Atlantic US school system and reassessed as young adults. The first young adult assessment was conducted during the 2-year period of 2000 through 2001, and the second young adult assessment was conducted approximately 1 year after the first assessment for each person. Outcome definitions (all newly incident during the interval between the first and second young adult assessments) are as follows: drug abuse or dependence, 1 or more DSM-IV clinical features of drug abuse or 3 or more DSM-IV clinical features of drug dependence with respect to any of 12 illegal or prescription drugs; drug abuse, 1 or more DSM-IV clinical features of drug abuse (without the presence of DSM-IV drug dependence); drug dependence, 3 or more DSM-IV clinical features of drug dependence with respect to any of 12 illegal or prescription drugs (with or without DSM-IV drug abuse); and emerging drug dependence problems, 1 or 2 newly incident clinical features of drug dependence without the presence of clinical features of drug abuse.

outcomes were similar to drug abuse or dependence (Table 3). The RR for drug dependence had a wide CI (RR=10.6; 95% CI, 1.2-95.7).

Table 3 also shows the comparison of the PTSD group with the trauma-only group as the reference group. Posttraumatic stress disorder compared with trauma only was associated with a 2-fold greater risk for drug abuse or dependence (RR=2.1; 95% CI, 1.1-4.1).

Adjusting for 1 covariate at a time did not materially alter the association of exposure to any of the drug use outcomes. For example, the RR for drug abuse or dependence ranged from a low of 5.8 (adjusted for sex) to a high of 6.6 (adjusted for family SES) when comparing PTSD with no trauma exposure. The CIs were all in the range of about 2.0 to approximately 20.

With respect to the individual covariate associations with drug use outcomes, being male (adjusted RR=2.7; 95% CI, 1.5-4.8), years of education (adjusted RR=0.8; 95% CI, 0.7-0.9), and high early risk taking (adjusted RR=2.6; 95% CI, 1.1-5.7) each had statistically significant associations with drug abuse or dependence when entered as additional covariates in the prediction model (along with exposure to trauma only or PTSD). A similar pattern of individual covariate association was found when predicting drug abuse and drug dependence, with the addition that being white was also a risk factor for incident drug dependence (adjusted RR=3.2; 95% CI, 1.5-6.6).

Table 4 presents the results of regression analyses using simultaneous adjustment for all of the covariates described in the "Measures" section with the exception of individual drugs used. While there was some attenuation of effect size for PTSD, the pattern of results for the fully adjusted models is similar to that reported for the unadjusted analyses and for the single covariate-adjusted analyses. For example, the adjusted RR for drug abuse or dependence (full model) was more than 4 times greater for the PTSD group compared with the group with no trauma exposure (adjusted RR=4.9; 95% CI, 1.6-

15.2). The unadjusted RR for drug abuse or dependence was 6.6 (Table 3). Trauma exposure alone in the absence of PTSD was not associated with a statistically significant increase in risk for any of the drug use outcomes when adjusted for the demographic and early childhood experience and predisposition covariates.

Hasin and Paykin⁵⁷ as well as others have reported that individuals with emerging problems of alcohol dependence (1 or 2 symptoms but no DSM-IV diagnosis) were more than twice as likely to develop DSM-IV alcohol dependence disorder at follow-up compared with individuals with no symptoms of dependence at the baseline assessment. Degenhardt et al⁵⁸ reported that young adults with emerging problems of cannabis dependence shared many characteristics with young adults with DSM-IV cannabis dependence. To explore whether PTSD might have a role in the development of drug dependence problems, we considered emerging problems of drug dependence (1 or 2 incident clinical features of drug dependence) as the fourth outcome. To accomplish this, we excluded all of the DSM-IV cases of drug abuse or dependence at the second young adult assessment. The sample size at risk for emerging problems was 929 individuals, comprising 33 young adults with emerging problems of drug dependence and 896 young adults with no drug dependence problems at the second young adult assessment. We then compared the PTSD group with the no-trauma group with respect to risk for emerging problems. The incidence rate of emerging problems for the PTSD group was 4.6% (3 of 65 individuals) compared with 1.0% (2 of 195 individuals) for the no-trauma group (adjusted RR=4.9; 95% CI, 1.2-20.1).

We also examined the frequencies (prevalence) of clinical features of drug abuse or dependence that had developed at follow-up. The most frequently occurring clinical feature of drug abuse or dependence was "You used [drug] even though you promised yourself you wouldn't, or you used a lot more than intended," describing steps

Table 4. Estimated Adjusted Relative Risks of Incident Drug Abuse or Dependence, Drug Abuse, Drug Dependence, and Emerging Problems of Dependence With Exposure to Trauma and *DSM-IV* Posttraumatic Stress Disorder^a

| Exposure | Drug Abuse or Dependence | | Drug Abuse Without Dependence | | Drug Dependence | | Emerging Drug Dependence Problems | |
|--------------------------|--------------------------|---------|-------------------------------|---------|----------------------|---------|-----------------------------------|---------|
| | Adjusted RR (95% CI) | P Value | Adjusted RR (95% CI) | P Value | Adjusted RR (95% CI) | P Value | Adjusted RR (95% CI) | P Value |
| No trauma as reference | | | | | | | | |
| No trauma | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| Trauma only | 2.4 (0.9-6.3) | .06 | 1.2 (0.6-5.8) | .27 | 4.6 (0.6-31.3) | .12 | 4.2 (1.0-18.1) | .06 |
| PTSD | 4.9 (1.6-15.2) | .006 | 4.3 (1.2-15.0) | .02 | 9.1 (1.0-82.8) | .049 | 4.9 (1.2-20.1) | .03 |
| Trauma only as reference | | | | | | | | |
| Trauma only | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | | 1 [Reference] | |
| PTSD | 2.0 (1.1-3.8) | .03 | 2.3 (1.0-5.2) | .046 | 2.0 (0.8-5.0) | .12 | 1.2 (0.4-3.5) | .76 |

Abbreviations: CI, confidence interval; PTSD, posttraumatic stress disorder; RR, relative risk.

^aData are from the cohort originally recruited in the fall semesters of 1985 and 1986 at entry to first grade from 19 schools in a mid-Atlantic US school system and reassessed as young adults. The first young adult assessment was conducted during the 2-year period of 2000 through 2001, and the second young adult assessment was conducted approximately 1 year after the first assessment for each person. Outcome definitions (all newly incident during the interval between the first and second young adult assessments) are as follows: drug abuse or dependence, 1 or more *DSM-IV* clinical features of drug abuse or 3 or more *DSM-IV* clinical features of drug dependence with respect to any of 12 illegal or prescription drugs; drug abuse, 1 or more *DSM-IV* clinical features of drug abuse (without the presence of *DSM-IV* drug dependence); drug dependence, 3 or more *DSM-IV* clinical features of drug dependence with respect to any of 12 illegal or prescription drugs (with or without *DSM-IV* drug abuse); and emerging drug dependence problems, 1 or 2 newly incident clinical features of drug dependence without the presence of clinical features of drug abuse. Adjusted RRs had simultaneous adjustment for sex, race/ethnicity, age, family socioeconomic status at first grade, teacher-rated conduct problems at first grade, achievement test scores at first grade, risk taking during grades 4 to 7, and years of education at the time of the first young adult assessment.

in the pattern of compulsive use and loss of control. This symptom occurred in 49 of the 92 young adults (53.3%) with at least 1 drug abuse or dependence problem.

COMMENT

In summary, we have found that young adults with a history of PTSD but no prior drug dependence experienced substantially higher 12-month incidence of drug abuse and/or drug dependence compared with young adults who were not exposed to trauma. Emerging dependence problems were also more likely among young adults with a history of PTSD. The observed RRs were attenuated after simultaneous statistical adjustment for early antecedents common to PTSD and drug use disorders (childhood conduct problems, risk taking, and family SES) as well as sex, age, ethnicity, and years of education at the time of the first young adult assessment. However, the fully adjusted RRs for all of the outcomes remained substantial when comparing the PTSD group with the group with no trauma exposure (eg, adjusted RR for drug abuse or dependence, 4.9). This effect size is similar in magnitude to the effect size reported by Chilcoat and Breslau⁸ using a 10-year follow-up period.

Several study limitations merit mention. First, our sample was predominantly African American (>70%) from an urban location. Whether samples from other places will produce similar associations is a question for future studies. Second, between the first young adult assessment and the 12-month follow-up assessment, 988 of 1436 eligible participants were reassessed before study funds were exhausted. As in other longitudinal studies, there is a chance that participants who were successfully contacted and assessed at follow-up differed from participants who were not included in the follow-up with respect to variables associated with key independent vari-

ables and the outcomes. We found that PTSD and exposure to trauma were not significantly associated with follow-up participation. Additionally, we considered whether ineligibility for inclusion (eg, current or lifetime drug use problems) at the time of the first young adult assessment was associated with follow-up participation. We regressed the count of problems of drug abuse or dependence at the first young adult assessment on a binary covariate indicating participation in the follow-up assessment (using negative binomial regression). For this analysis, the null hypothesis was that there was no association between problems of drug abuse or dependence at the first young adult assessment and participation at follow-up. The null hypothesis was not rejected.

As in other community studies, the cumulative incidence of PTSD in this sample up to the age at assessment (in contrast with exposure to trauma) was low. Further, the number of cases of drug use disorders was constrained by the short interval when new cases were identified. Despite these limitations on statistical power, we found substantial and, with the exception of drug dependence, moderately precise estimates of RR.

Finally, while our assessment of trauma and PTSD was a lifetime assessment and our assessment of early antecedents was made at approximately age 6 years, there remains some chance that for some subjects, trauma may have occurred prior to age 6 years and remained undetected by our PTSD assessment interview.

The study has several strengths. The prospective study design mitigates potential recall error. We have used a validated, structured interview protocol to assess exposure to *DSM-IV*-qualifying traumatic events and PTSD. While this procedure requires recall of past events, the young age of participants limits recall distortion because the risk for exposure to trauma primarily starts in midadolescence (as shown by Breslau et al^{36,43}). Inclu-

sion of measures of potential confounders measured in early childhood is an important strength. The short follow-up period of 12 months is also important because this constrains the possible influence of unmeasured confounders that might have occurred during the follow-up period but before the onset of the outcomes of interest. Additionally, recall of drug problems is likely to be more accurate than is the case when respondents are asked to review their memory for events that have occurred during long periods.

Other investigators⁵⁷⁻⁶² have found that individuals with emerging drug use problems (1 or 2 clinical features of dependence) may constitute a group distinct from both cases of drug dependence and individuals with no emerging problems of dependence. Hasin and Paykin^{57,62} have reported that in follow-up assessment, some members of the group with emerging problems progressed into having DSM-IV dependence, whereas others moved back into the group with no clinical features of dependence. Our finding of an elevated risk for emerging problems among the PTSD group (adjusted RR=3.3) leads us to speculate that PTSD might be 1 factor accounting for these differences in the progression from problems to diagnosable dependence. This suggests the possibility that early intervention to halt the progression to drug dependence for individuals with isolated problems of drug use might focus on trauma victims with PTSD.

In conclusion, this prospective study of young adults free of drug use problems found that trauma victims with PTSD were at markedly increased risk for incident drug use disorders in a 1-year follow-up period and that trauma victims who did not develop PTSD were not at increased risk for incidence of drug use problems. The association of PTSD with incident drug use disorders remained substantial even with statistical adjustment for early life experiences and predispositions that have been reported previously as carrying elevated risk for drug use disorders, exposure to trauma, and PTSD. Early cognitive achievement, conduct problems, family SES, and the predisposition for risk taking are important potential confounders and potential independent causal factors for incidence of drug use disorders in adulthood. To our knowledge, these common antecedents have not been taken into account in previous studies of the association of PTSD with subsequent first-onset drug use disorders.

The findings described here support the notions that the observed PTSD–drug use disorder associations might at least in part be causal and that the association is not fully accounted for by early experiences. An alternative to the early-experience explanation with growing empirical support is a self-medication explanation.^{8,27,28,63-65} A reliance on psychoactive drugs to relieve symptoms of PTSD might hinder the development of other coping strategies and, at the same time, lead to a more perilous drug-related trajectory.

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