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Conduct Disorder and Initiation of Substance Use: A Prospective Longitudinal Study

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Clinical guidance is available at the end of this article.

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Abstract

Objective—To examine the influence of conduct disorder (CD) on substance initiation.

Method—Community adolescents without CD (n= 1165, mean baseline age= 14.6), with CD (n= 194, mean baseline age= 15.3), and youth with CD recruited from treatment (n=268, mean baseline age= 15.7) were prospectively followed and re-interviewed during young adulthood (mean ages at follow-up respectively: 20, 20.8, and 24). Young adult retrospective reports of age of substance initiation for 10 substance classes were analyzed using Cox regression analyses. Hazard ratios of initiation for the CD cohorts (community without CD as the reference) at ages 15, 18, and 21 were calculated, adjusting for baseline age, gender, and race.

Results—Among community subjects, CD was associated with elevated adjusted hazards for initiation of all substances, with comparatively greater hazard ratios of initiating illicit substances at age 15. By age 18, the adjusted hazard ratios remained significant except for alcohol. At age 21, the adjusted hazard ratios were significant only for cocaine, amphetamines, inhalants and club drugs. A substantial portion of community subjects without CD never initiated illicit substances. Clinical youth with CD demonstrated similar patterns, with comparatively larger adjusted hazard ratios.

Conclusions—CD confers increase risk for substance initiation across all substance classes at age 15 with greater relative risk for illicit substances compared to licit substances. This effect continues until age 18, with the weakest effect for alcohol. It further diminishes for other substances by 21; although, the likelihood of initiating cocaine, amphetamines, inhalants and club drugs among those who have not initiated yet continues to be highly elevated by 21.

Keywords

conduct disorder; substance use disorders

Initiation of substance use is the first step along a multi-step pathway that may eventually lead to the development of substance use disorders (SUD). Early age of initiation of substance use has been associated with a greater risk of eventually developing a SUD for alcohol, tobacco, and illicit substances¹⁻⁹. The association between early age of onset of substance initiation and the later development of SUD has important theoretical as well as public health implications. There has been substantial debate over whether early age of substance initiation is a causal risk factor for developing later SUD or whether it acts as a marker for correlated factors that confer the risk for developing SUD³. Some researchers, primarily studying the influence of alcohol use on adolescents have posited that early alcohol use alters adolescent brain development and developmental trajectories^{2,10-12}. An alternative hypothesis has emphasized that early age of substance initiation is a noncausal risk factor for the later development of SUD that acts as a marker for a range of correlated adolescent problem behaviors which themselves confer the risk for later SUD^{4,13}. These researchers have focused on the observation that adolescent antisocial behaviors, novelty seeking, early initiation of substance use are highly correlated and have emphasized that early substance use is a marker for correlated externalizing behaviors which confer risk for the development of SUD¹⁴⁻¹⁶.

From a public health perspective, if early age of initiation is a causal risk factor for later development of SUD, an implication would be that delaying the onset of substance use could result in a reduction in the number of persons who eventually develop a SUD. If the alternative hypothesis is correct, i.e., that age of initiation is a noncausal risk factor, this would imply that prevention programs may need to more broadly target a range of problematic adolescent behaviors, including antisocial behaviors, to reduce the development of SUD.

One class of problem behaviors consistently associated with early onset of substance use is conduct disorder (CD). CD is a syndrome characterized by aggressive behaviors, truancy, violating social norms, and lying (APA)¹⁷. Epidemiological studies have shown that youth with CD initiate substances early, have elevated rates of substance use, and elevated rates of SUD^{18,19}. National surveys of adult populations have consistently demonstrated that persons with adult antisocial personality disorder, which requires adolescent CD as a precursor, have high rates of SUD as well as more severe SUD^{20,21}. Most prospective studies examining the association between CD and substance use have focused on the initiation of commonly used substances, such as alcohol, tobacco, or marijuana^{22–24}. Population-based epidemiologic surveys of adolescents have demonstrated that by 12th grade, 71%, 42%, 43%, and 25% have tried alcohol, cigarettes, marijuana, or another illicit substances during their lifetime²⁵. Although CD has been associated with an earlier rate of initiation of substances, to our knowledge, whether the effect of CD on initiation varies by substance class has not been examined. In particular, since CD is associated with a pattern of violating social norms, we hypothesized that youth with CD may be comparatively at greater risk for initiating substances that are illicit. Alcohol and tobacco, although illicit substances for underage youth, are frequently used by adolescents and are legal to use once persons become 21 and 18, respectively. Marijuana, though once considered illicit for all ages, is also commonly used; in 18 states marijuana is now available through a medical recommendation²⁶ and was recently legalized in two states for adult recreational consumption. Other illicit substances are experimented with by proportionally fewer adolescents²⁵. The goals of this study were to: 1) examine the influence of CD on substance initiation, across substance classes; 2) to explore whether CD is associated with an earlier age of initiation across all substances; and 3) to examine whether CD conferred relatively greater hazards of initiating substances. We hypothesized that youth with CD are more likely to have ever used a substance, have a younger age of substance experimentation, and have greater hazards for substance initiation at earlier ages compared with youth without CD, and that these hazard ratios would be comparatively greater for illicit as compared to licit substances

Method

Sample

All subjects in this study were assessed at two time points, adolescence and young adulthood. Subjects were originally recruited from three sources: 1) the Colorado Twin Registry (CTR; $n = 1,246$); 2) a clinical sample of adolescents recruited from a treatment program for youth with serious conduct and substance problems ($n = 280$); and 3) an additional community sample of adolescents ($n = 156$) who were, at baseline, matched to the clinical sample on age, race/ethnicity, gender, and ZIP code of residence. Follow-up rates for the CTR are 86.1%, the clinical sample 68.7%, and the matched community sample 70.6%. The CTR includes a Community Twin Sample, recruited through the Colorado Department of Public Health and Environment and Colorado school districts as well as a Longitudinal Twin Sample, recruited through the Colorado Department of Vital Statistics. For this study, one twin was randomly selected from each twin pair. The second wave of data collection for both clinical and community subjects was completed between 2002–2008. Details for the subjects recruited from treatment for substance use disorders and the community sample have been described in detail elsewhere²⁷.

These samples were divided into three groups: Community subjects (from either the twin registry or the additional community sample) who did not meet criteria for CD at either wave 1 or 2 ($n = 1165$), community subjects who met the criteria for CD at either wave 1 or 2 ($n = 194$), and clinical subjects who met the criteria for CD at either wave 1 or 2 ($n = 268$).

Measures

For this study, self-report CD was used. A participant was considered to have a CD diagnosis if they endorsed 3 or more adolescent symptoms of CD reported concurrently (i.e., queried in adolescence) or retrospectively (i.e., queried in young adulthood). We utilized this approach because some subjects may have developed CD after initial assessment. During adolescence, CD diagnosis was obtained through a structured interview by a trained interviewer, using either the paper-pencil *DSM-III-R* or *DSM-IV* Diagnostic Interview Schedule for Children (DISC)²⁸, or the *DSM-IV* Diagnostic Interview Schedule (DIS)²⁹ for participants ages 18 and over. During young adulthood, the CD diagnosis was similarly obtained from self-report by a trained interviewer utilizing the computerized *DSM-IV* DIS.

Ages of initiation for 10 classes of substances as classified by the Composite International Diagnostic Interview–Substance Abuse Module (CIDI-SAM)³⁰, which includes tobacco, alcohol, marijuana, cocaine, amphetamines, sedative, inhalants, hallucinogens, opiates, and club drugs, were extracted from a supplemental questionnaire. This questionnaire asks about ever using any substance, age of initial and regular use, typical pattern of use, and recency of use³¹. For these analyses, the outcome variables were based upon the answers to the question, “How old were you the first time you used [drug],” which was separately asked for each of the 10 substances the subject endorsed ever using in his/her lifetime. To assist subjects in accurately recalling past events a timeline³² approach was used as a guide. Subjects were asked to recall memorable events as well as their living arrangements and this was used to anchor developmental timepoints.

Analyses

One-way analysis of variances (ANOVAs; or a non-parametric alternative) and Pearson chi-square analyses were completed to compare CD group differences on demographics and ever using the 10 different substances. Analyses of covariances (ANCOVAs) were completed to compare CD group differences on initiation ages in the subset who had ever used each substance with covariates to control for baseline age, gender, and race (white versus nonwhite). Scheffé’s *post hoc* multiple comparison procedures were completed for both the ANOVAs and ANCOVAs to control for the type 1 experimentwise error rate. To determine the influence of CD on age of substance initiation among community and clinical youth, Kaplan-Meier plots were produced and Cox regression models were analyzed. Kaplan-Meier survival curves were plotted to visually compare the unadjusted effects of the three CD groups on time to onset of first substance use. Cox regression models, adjusting for covariates (baseline age, sex, and race) and, when necessary, incorporating the CD group by time interaction (non-proportional hazards), assessed the influence of CD group on initiation of 10 substances. The hazard ratios and confidence limits are calculated at ages 15, 18, and 21. The community without CD group is the reference group in the Cox regression models. All analyses were completed in SAS 9.3. To graphically display the adjusted hazard ratios, two line graphs were created to display the adjusted hazard ratios at each age between 12–22 years old for each of the 10 substances.

Results

Ever Using a Substance

Table 1 describes the baseline demographic characteristics of each group, their mean CD symptoms at wave 1, their mean age at initial assessment and wave 2 follow-up, as well as the number and percent of subjects who initiated a particular substance. Compared to those without, community subjects with CD were more likely to be male, nonwhite, and had more baseline CD symptoms. They were also older at baseline and at wave 2. Clinical subjects with CD showed a greater contrast to community subjects without CD.

A greater proportion of the community with CD group had ever used each of the 10 substances compared with the community without CD group ($p < 0.001$). In turn, a greater proportion of the clinical with CD group had ever used each of the 10 substances compared with the community without CD group ($p < 0.001$). Kaplan-Meier curves (see Figures S1, S2, and S3, available online) show the pattern of initiation for each substance by CD group, for the unadjusted effects of CD on time to onset of first substance use.

Age of Initiating Substances

Table 2 describes the age of initiation of substances by group. ANCOVAs were not completed with tobacco and sedative onset ages due to heterogeneity of slopes/variances. The ANCOVAs on the subset who reported ever using each substance revealed significant CD group differences in onset age for all substances, except amphetamines and inhalants. The *post hoc* comparisons revealed that the community with CD group had younger initiation ages for alcohol, marijuana, cocaine, and hallucinogens compared with the community without CD group. In turn, the clinical with CD group had younger initiation ages for alcohol, marijuana, cocaine, hallucinogens, opiates, and club drugs compared with the community without CD group.

Ever Using a Substance

A greater proportion of the community sample with CD group had ever used each of the 10 substances compared with the community sample without CD group ($p = 0.0005$). In turn, a greater proportion of the clinical sample with CD group had ever used each of the 10 substances compared with the community sample without CD group ($p = 0.0005$). Kaplan-Meier curves (see Figures S1, S2, and S3, available online) show the pattern of initiation for each substance by group, for unadjusted effects of CD on time to onset of first substance use.

Relative Hazard of Initiating Substances

Table 3 reports adjusted hazard ratios of initiating for community subjects with CD versus those without for 10 substances. Across all substances, youth with CD had an elevated hazard at age 15 for initiating a substance. Hazard is a measure of the probability of initiating a substance at a specific time conditioned on the fact that an individual has not initiated yet. At age 15 community youth with CD had hazard ratios ranging from 3–11 for initiating illicit substances compared to 2–3 for initiating licit substances.

Similarly, at age 18, except for alcohol, the hazard ratios are significantly greater than one. In most models, except amphetamine onset age and inhalant onset age, the CD group by time interaction was significant, indicating that the hazards change differentially in proportion, over time for each CD group. After age 18, there is a leveling off effect with fewer youth initiating substances and there are fewer significant hazard ratios. By adulthood, these differences in initiation have equalized, in part, because youth with CD have already initiated substances. A similar pattern occurs when comparing clinical subjects with CD to community subjects without CD as seen in Table 4. The adjusted hazard ratios comparing each substance use onset are significant at ages 15 and 18; although, the hazard ratios are smaller and some are non-significant at older ages. Figures 1 and 2 display these hazard ratios for both community and clinical CD groups as a function of age.

Discussion

The primary purpose of this study was to examine whether the influence of CD on substance initiation differed among 10 substance classes. As hypothesized, CD was associated with earlier substance initiation across all substances. In addition, greater hazard ratios were

present for illicit substances compared to licit substances, particularly at age 15, in groups with CD compared with the community without CD group. Illicit substance hazard ratios at age 15 for community youth with CD were between 2.8 (for marijuana) up to 10.6 (for sedatives). Even greater hazard ratios were seen in the clinical sample, which exhibited CD with a greater mean severity than the community sample without CD (mean CD symptoms = 6.23 vs. 0.53, respectively). Although the hazard ratios for initiation diminish with age, hazards continue to remain elevated for a number of illicit substances until age 21. As seen in Figures 1 and 2, the hazard ratios for initiation of licit substance approach 1 by young adulthood, reflecting the fact that the majority of youth eventually initiate the substance. However, for many illicit substances, the hazards remain elevated, even into young adulthood. In conclusion, youth with CD are more likely to ever experiment with a substance, particularly an illicit one, have an earlier age of initiating, as well as have an increased hazard of using a substance at earlier ages compared with youth without CD.

To our knowledge, this is the first comparative analysis examining the influence of CD across 10 substance classes. One important result, beyond demonstrating that CD is associated with earlier age of initiation and ever initiating, is that youth with CD compared with youth without CD have larger hazard ratios for initiating illicit substances which extends into young adulthood. These findings are important because individuals who never initiate a substance are protected from developing a substance use disorder for that substance. Adolescents who do not exhibit CD are unlikely to experiment with illicit substances (except for marijuana), and thus are protected. By contrast, youth with CD not only initiate earlier, they are more likely to ever initiate illicit substances, and thus, have a greater possibility for developing a SUD upon substances that they have initiated.

Limitations of the study include reliance on only self-report for a CD diagnosis, use of retrospective reports of substance initiation, and that the clinical sample was recruited from substance abuse treatment, potentially biasing these results. While a timeline approach was used to aid in accuracy of recall³³, young adult age-of-onset reports typically suffer from a “telescoping” effect³², however, any such effect is likely to be similar across groups. The clinical sample was included primarily to examine the influence of more severe CD on initiation of less commonly used, illicit substances, however, since this sample was recruited from substance abuse treatment this creates a confound and results should be interpreted cautiously.

Although this study does not specifically examine whether early initiation of a substance is a causal risk factor for the later development of substance use disorder or whether early initiation acts as a marker for correlated behaviors, one implication of these results is that intervention or prevention approaches targeting conduct disorder may influence substance experimentation and the eventual development of substance use disorders, particularly for illicit substances.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Clinical Guidance

- Youth without conduct disorder are unlikely to experiment with illicit substances with the exception of Marijuana.
- Youth with conduct disorder are at elevated risk for experimenting with all substances, particularly illicit ones, and this elevated risk persists into young adulthood.

Figure 1. Adjusted Hazard Ratios for First Use in Community with conduct disorder (CD) versus Community without CD. Note: Y axis label = Adjusted Hazard Ratio; X axis label = Age (in years).

Figure 2. Adjusted Hazard Ratios for First Use in Clinical with conduct disorder (CD) versus Community without CD. Note: Y axis label = Adjusted Hazard Ratio; X axis label = Age (in years).

Table 1

Demographic Description and Percent Ever Used Each Substance by Group

	Community without CD n = 1,165	Community with CD n = 194	Patients with CD n = 268	Statistic
Baseline Age, m (SD)	14.59 (2.12)	15.32 (2.07) ^a	15.73 (1.21) ^b	$F_{2,1624}=41.19^*$
Gender (Male), n (%)	558 (47.9)	143 (73.7)	246 (91.8)	$\chi^2=194.33^*$
Race/Ethnicity (White), n (%)	998 (85.7) n = 1164	148 (76.3)	155 (57.8)	$\chi^2=107.96^*$
Baseline CD Symptoms, m (SD)	0.53 (0.68)	3.02 (2.07)	6.23 (2.52) n = 267	Kruskal-Wallis Test, $\chi^2=912.41^*$
Age at Wave 2, m (SD)	19.99 (2.77)	20.78 (2.62) ^a	24.04 (2.82) ^b	$F_{2,1624}=234.17^*$
Ever used alcohol, n (%)				
Yes	933 (80.1)	186 (95.9)	268 (100.0)	$\chi^2=88.49^*$
No	232 (19.9)	8 (4.1)	0 (0.0)	
Ever used tobacco, n (%)				
Yes	632 (54.2)	167 (86.1)	264 (98.5)	$\chi^2=230.30^*$
No	533 (45.8)	27 (13.9)	4 (1.5)	
Ever used marijuana, n (%)				
Yes	559 (48.0)	160 (82.9)	265 (98.9)	$\chi^2=281.67^*$
No	605 (52.0) n = 1164	33 (17.1) n = 193	3 (1.1)	
Ever used cocaine, n (%)				
Yes	107 (9.2)	72 (37.3)	222 (82.8)	$\chi^2=654.96^*$
No	1,058 (90.8)	121 (62.7) n = 193	46 (17.2)	
Ever used amphetamines, n (%)				
Yes	105 (9.0)	65 (33.7)	185 (69.0)	$\chi^2=477.87^*$
No	1,060 (91.0)	128 (66.3) n = 193	83 (31.0)	
Ever used club drugs, n (%)				
Yes	75 (6.4)	56 (29.0)	149 (55.8)	$\chi^2=392.52^*$
No	1,090 (93.6)	137 (71.0) n = 193	118 (44.2)	
Ever used sedatives, n (%)				
Yes	54 (4.6)	39 (20.2)	79 (29.5)	$\chi^2=163.62^*$
No	1,111 (95.4)	154 (79.8) n = 193	189 (70.5)	
Ever used opiates, n (%)				$\chi^2=161.14^*$

	Community without CD n = 1,165	Community with CD n = 194	Patients with CD n = 268	Statistic
Yes	143 (12.3)	64 (33.2)	118 (44.0)	
No	1,022 (87.7)	129 (66.8) n = 193	150 (56.0)	
Ever used inhalants, n (%)				$\chi^2=186.30^*$
Yes	14 (1.2)	12 (6.2)	58 (21.6)	
No	1,151 (98.8)	181 (93.8) n = 193	210 (78.4)	
Ever used hallucinogens, n (%)				$\chi^2=504.15^*$
Yes	125 (10.7)	81 (42.0)	199 (74.3)	
No	1,040 (89.3)	112 (58.0) n = 193	69 (25.7)	

Note:

^a significant ($p = 0.05$) *post hoc* comparisons between community with conduct disorder (CD) versus community without CD.

^b significant ($p = 0.05$) *post hoc* comparisons between patients with CD versus community without CD.

* $p < 0.001$

Table 2

Onset Age (Years) of Substance Initiation by Group

	Community without CD Adjusted Means	Community with CD Adjusted Means	Patients with CD Adjusted Means	Statistic
Onset Age 1 st Alcohol Use	16.13 n = 933	14.59 ^a n = 186	12.24 ^b n = 268	F _{2,1380} =229.03 *
Onset Age 1 st Marijuana Use	16.23 n = 559	14.68 ^a n = 160	12.08 ^b n = 265	F _{2,977} =261.67 *
Onset Age 1 st Cocaine Use	18.46 n = 107	16.97 ^a n = 72	15.61 ^b n = 222	F _{2,395} =47.94 *
Onset Age 1 st Amphetamine Use	16.45 n = 105	15.84 n = 65	16.02 n = 185	F _{2,349} =0.56
Onset Age 1 st Inhalant Use	15.30 n = 15	15.20 n = 12	14.37 n = 59	F _{2,80} =1.37
Onset Age 1 st Hallucinogen Use	17.79 n = 125	16.63 ^a n = 81	14.79 ^b n = 199	F _{2,399} =75.59 *
Onset Age 1 st Opiate Use	17.77 n = 144	16.97 n = 64	16.78 ^b n = 118	F _{2,320} =4.27 **
Onset Age 1 st Club Drug Use	18.39 n = 76	17.46 n = 56	17.30 ^b n = 149	F _{2,275} =5.01 **

Note:

^a significant ($p < 0.05$) *post hoc* comparisons between community with conduct disorder (CD) versus community without CD, adjusting for covariates.

^b significant ($p < 0.05$) *post hoc* comparisons between patients with CD versus community without CD, adjusting for covariates.

* $p < 0.0001$;

** $p < 0.01$

Table 3

Comparing Community Subjects With Conduct Disorder (CD) to Those Without on First Use of Different Substances.

Substance	Adjusted Hazard Ratio at Age 15 95% Confidence Limits	Adjusted Hazard Ratio at Age 18 95% Confidence Limits	Adjusted Hazard Ratio at Age 21 95% Confidence Limits
Alcohol	1.99 1.69, 2.36	1.27 0.97, 1.65	0.80 0.52, 1.24
Tobacco	2.10 1.75, 2.53	1.47 1.09, 1.97	1.02 0.64, 1.63
Marijuana	2.76 2.29, 3.34	1.52 1.13, 2.06	0.84 0.50, 1.41
Cocaine	9.38 5.91, 14.87	4.06 2.93, 5.63	1.76 1.0007, 3.10
Amphetamines ^a	4.07 2.96, 5.61	4.07 2.96, 5.61	4.07 2.96, 5.61
Club Drugs	8.24 4.89, 13.89	4.42 3.07, 6.36	2.37 1.29, 4.34
Sedatives	10.60 5.65, 19.91	3.99 2.51, 6.33	1.50 0.70, 3.21
Opiates	3.73 2.53, 5.51	2.51 1.82, 3.46	1.69 0.99, 2.87
Inhalants ^a	4.73 2.17, 10.32	4.73 2.17, 10.32	4.73 2.17, 10.32
Hallucinogens	6.26 4.20, 9.31	3.22 2.32, 4.45	1.65 0.89, 3.07

Note: All Cox regression models adjusted for baseline age, gender, and race. Bold-type numbers indicate significant results.

^aCD group by time interactions were not significant so the hazard ratios were time-independent.

Table 4

Comparing Clinical Subjects With Conduct Disorder (CD) to Community Subjects Without CD on First Use of Different Substances

Substance	Adjusted Hazard Ratio at Age 15 95% Confidence Limits	Adjusted Hazard Ratio at Age 18 95% Confidence Limits	Adjusted Hazard Ratio at Age 21 95% Confidence Limits
Alcohol	3.77 3.07, 4.63	1.64 1.14, 2.36	0.72 0.41, 1.25
Tobacco	3.74 2.96, 4.74	1.67 1.13, 2.45	0.74 0.42, 1.32
Marijuana	6.04 4.69, 7.78	1.67 1.02, 2.75	0.46 0.21, 1.02
Cocaine	43.43 28.71, 65.68	12.62 9.45, 16.85	3.67 2.27, 5.92
Amphetamines ^a	11.16 8.41, 14.79	11.16 8.41, 14.79	11.16 8.41, 14.79
Club Drugs	21.98 13.51, 35.77	9.97 7.20, 13.81	4.52 2.73, 7.49
Sedatives	16.05 8.79, 29.32	5.55 3.70, 8.33	1.92 1.06, 3.47
Opiates	5.85 4.05, 8.43	3.01 2.27, 3.99	1.55 1.01, 2.37
Inhalants ^a	18.71 9.77, 35.85	18.71 9.77, 35.85	18.71 9.77, 35.85
Hallucinogens	23.29 16.32, 33.24	4.02 2.80, 5.78	0.69 0.34, 1.40

Note: All Cox regression models adjusted for baseline age, gender, and race. Bold-type numbers indicate significant results.

^aCD group by time interactions were not significant so the hazard ratios were time-independent.