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Substance abuse treatment patients with early onset cocaine use respond as well to contingency management interventions as those with later onset cocaine use

Lindsay M. Weiss and Nancy M. Petry*

University of Connecticut School of Medicine

Abstract

Early onset drug use is associated with increased risk of developing substance use disorders, but relatively little is known about the correlates of early drug use among adults receiving treatment. A retrospective analysis of a randomized study of contingency management treatment compared cocaine-dependent patients who reported initial cocaine use at age 14 or younger ($n = 41$) to those who began using after age 14 ($n = 387$). Patients with early onset cocaine use had more legal and psychiatric problems than those who initiated cocaine use later. Patients with early-onset cocaine use also dropped out of treatment sooner and achieved less sustained abstinence than those who began using at older ages, but the interaction between age of first use and treatment condition was not significant. Early-onset cocaine use is associated with persistent psychosocial problems and an overall poor response to treatment. However, contingency management is efficacious in improving outcomes in early onset cocaine users.

Keywords

early onset drug use; contingency management; cocaine; outpatient treatment

1. Introduction

Contingency management (CM) is the psychosocial intervention with the greatest effect size for reducing substance use (Dutra et al., 2008). This treatment is efficacious in treating a range of drug use disorders, including cocaine (Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Prendergast, Podus, Finney, Greenwell, & Roll, 2006). However, one individual factor that appears to impact effectiveness of CM is continued cocaine use at time of initiating treatment (Preston, Chutuape, Bigelow, & Stitzer, 2000; Stitzer et al., 2007); submission of positive samples at treatment initiation are related to overall poor response to

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*To whom all correspondence should be addressed. Nancy M. Petry, Ph.D., Calhoun Cardiology Center, Department of Medicine, University of Connecticut Health Center MC-3944, 263 Farmington Avenue, Farmington, CT 06030-3944 Npetry@uchc.edu; Phone: 860-679-2593; Fax: 860-679-1312.

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treatment, including CM, especially when the reinforcers provided are of relatively low magnitudes (Silverman et al., 1999). Another individual factor that may impact response to treatment generally, and CM specifically, relates to age of initiation of cocaine use.

Early onset substance use is a well-established risk factor for development of substance use disorders (Chen, Storr, & Anthony, 2009; Sartor, Lynskey, Heath, Jacob, & True, 2007; Behrendt, Wittchen, Höfler, Lieb, & Beesdo, 2009; Hingson, Heren, & Winter, 2006). Children who begin using substances in early adolescence have a two- to three-fold increased risk of developing alcohol or drug use disorders (Odgers et al., 2008; King & Chassin, 2007; Anthony & Petronis, 1995). Most children who begin using substances start with alcohol or marijuana before moving to “harder” drugs such as cocaine (Windle & Windle, 2012). Although initiating any substance use in early adolescence carries a poor prognosis, moving to “harder” drugs such as cocaine at a young age may be indicative of particularly poor outcomes, given that use of these drugs may further marginalize youth and lead to greater psychosocial difficulties.

In treatment-seeking youth, early onset drug use is associated with conduct disorder (Hser, Grella, Collins, & Teruya, 2003; Gordon, Kinlock, & Battjes, 2004) and progression to antisocial personality disorder (Myers, Stewart, & Brown, 1998), as well as school problems and risky sexual behaviors (Gordon et al., 2004). Further, treatment-seeking adolescents with early onset substance use are more likely to have had multiple previous treatment episodes (Gordon, Kinlock, & Battjes, 2004), more severe drug use, shorter treatment stays, and more family, social, and legal problems than their counterparts who initiate drug use later (Hser et al., 2003).

Although early onset substance use appears to be relatively common in samples of treated youth and associated with increased psychosocial problems, study of early substance initiation in adult treatment-seeking samples is relatively limited, and has been studied primarily in the context of alcohol use disorders. Although not synonymous with early onset, a popular conceptualization of alcoholics relates to a Type A/B distinction (Babor et al., 1992). Type B alcoholics are characterized by earlier onset and more severe symptoms of dependence and comorbid psychopathology; these patients also have poorer response to treatment than their later onset, Type A, counterparts (e.g., Babor et al., 1992). This classification system has also been evaluated, but much less extensively, in cocaine-dependent patients. For example, Ball, Carroll, Babor, and Rounsaville (1995) reported that Type B cocaine-dependent individuals had more severe cocaine dependence symptoms and greater legal and family-social problems than their Type A counterparts.

The Type A/B distinction relies on a somewhat complex classification system integrating 17 domains and therefore may not be useful in the context of clinical practice (Shuckit et al., 1995). Simply evaluating age of onset of cocaine use may represent a meaningful way to assess severity of problems and possibly poor prognosis, as well as need for more intensive treatment.

The purpose of this study was to evaluate the association between early onset cocaine use and psychosocial problems and treatment response in cocaine-dependent patients. We

hypothesized that early onset cocaine use would be related to more significant psychopathology and legal difficulties, as well as poorer response to treatment. We also examined, for the first time, whether CM would improve outcomes in patients with early onset cocaine use. Identification of subgroups who are more or less responsive to CM is needed to target this intervention toward those most likely to benefit from it.

2. Methods

2.1 Participants

Participants in this study were drawn from a randomized clinical trial evaluating CM interventions (Petry, Barry, Alessi, Rounsaville, & Carroll, 2012), which was approved by the University of Connecticut School of Medicine Institutional Review Board. For the parent trial, inclusion criteria were beginning outpatient treatment, age 18 years or older, able to speak English, and met past-year Diagnostic and Statistical Manual of Mental Disorders-IV (American Psychiatric Association, 2000) criteria for cocaine dependence. Exclusion criteria were uncontrolled psychotic symptoms, active suicidality, or in recovery for pathological gambling (but see Petry & Alessi, 2010; Petry, et al., 2006). Participants were recruited into the trial from those initiating treatment at one of four community-based treatment clinics that provided standard outpatient (non-medication assisted) substance abuse treatment services (see Petry et al., 2012). Of the 442 individuals randomized in the trial, 14 (3.2%) were excluded due to missing data related to age of onset of use, leaving 428 participants for analyses.

2.2 Procedures

After obtaining written informed consent, research assistants conducted an interview, which included demographic questionnaires, drug dependence checklists derived from the Structured Clinical Interview for the DSM-IV (First, Spitzer, Williams, & Gibbon, 1995), and the Addiction Severity Index (ASI; Bovasso, Alterman, Cacciola, & Cook, 2001; Kosten, Rounsaville, & Kleber, 1983), which evaluates severity of problems across seven domains: employment, family/social, legal, drug, alcohol, medical, and psychiatric. Composite scores range from 0.00 to 1.00 on each domain, with higher scores reflecting greater problem severity. Responses to individual items on the ASI were used to characterize specific problems for indices that differed between early and late onset participants.

2.3 Treatment group assignment

Research assistants used a computerized urn randomization program to assign patients to standard care or a CM intervention that awarded chances of winning prizes ranging from \$1 to \$100. Treatment groups were balanced on clinic, baseline urine toxicology results, gender, and direct transfer from inpatient detoxification services or not. The details of the treatments are provided in the primary study (Petry et al., 2012). Briefly, patients in all conditions received standard care, which involved group therapy related to life skills training, relapse prevention, AIDS education, and 12-step therapy. Intensive care (up to four hours/day, five days/week) was available for up to six weeks, and then intensity of care decreased down to one group per week. In addition to standard care, study patients were

expected to submit 21 urine and breath samples over a 12-week period according to a tapering schedule that mimicked reductions in clinical care over time. Samples were scheduled three days per week during weeks 1-3 (Monday, Wednesday, Friday), two days per week during weeks 4-6 (e.g., Mondays and Fridays) and one day per week during weeks 7-12. Research assistants collected urine specimens that were tested for cocaine and opioids using OnTrak TesTstiks (Varian, Inc., Walnut Creek, CA) and breath samples that were tested for alcohol using an Intoximeter Breathalyzer (Intoximeters, St. Louis, Mo). Research assistants congratulated patients when they tested negative for all three substances: cocaine, opioids and alcohol. If results were positive, RAs encouraged patients to discuss use with clinical staff, but results were research data and not shared with clinical staff. Patients assigned to CM earned the chance to draw from a bowl and win prizes ranging from \$1 to \$100 in value for attending treatment or submitting drug negative specimens as described in Petry et al. (2012).

2.4 Data analyses

Independent sample t-tests, Mann-Whitney U tests, and chi-square tests evaluated differences in baseline characteristics in patients with early onset cocaine use compared to those with later onset cocaine use. Age 14 or younger was the cut point, because this age represented one standard deviation below the mean age of onset in this sample, 20.7 ± 6.6 years, and it is similar to the age of initiation reported in youth samples (e.g., Bracken, Rodolico, & Hill, 2013).

Treatment outcome data were available from all randomized patients, and an intent-to-treat approach was employed. Variables that differed between early and late onset groups were examined for relatedness to treatment outcomes and those associated (e.g., current age and race) were used as covariates in subsequent analyses. Other variables, including ASI scores that differed between age of onset groups, were unrelated to treatment outcomes ($ps > .22$) and therefore not included in the model. In the model outlined below, treatment condition and race were entered as categorical variables, and others as continuous variables. Age of onset of cocaine use was entered as a continuous variable in analyses, and results were similar if age of onset was entered as a dichotomous variable, i.e., 14 or younger versus older.

Multivariate analysis of covariance (MANCOVA), was used to test the main effect of age of first cocaine use, treatment condition (CM or standard care), and the interaction of age of onset and treatment condition on three primary treatment outcomes: number of days on which patients attended treatment sessions, longest consecutive period of objectively determined abstinence (LDA), and proportions of negative samples submitted. Attendance data were abstracted from clinical charts. A week of consecutive abstinence was a 7-day period during which all scheduled samples tested negative. Because frequency of sample collection tapered over time, one week of abstinence was recorded for three consecutive negative samples during early phases, two during middle periods, and one during the last weeks. If a patient refused or missed a sample because of an unexcused absence, the LDA was broken. Proportion of negative samples was analyzed using the actual number of samples submitted in the denominator such that this variable was not impacted by duration

of time in treatment. For all analyses, samples were negative if they tested negative for cocaine, opioids, and alcohol. The vast majority of positive samples tested positive for cocaine, with less than 1% alcohol positive and less than 5% opioid positive. Analyses were performed on SPSS for Windows (Version 15), with two-tailed $\alpha < 0.05$ considered significant.

3. Results

3.1 Demographic and baseline characteristics

Table 1 shows baseline characteristics for patients with early versus later ages of onset of cocaine use. The earliest cocaine use was reported at age 11. Patients who initiated cocaine use at age 14 or younger were younger overall and more likely to be of White or Hispanic race/ethnicity than those with a later age of initiation of cocaine use. Patients with early onset cocaine use had more serious legal and psychiatric problems, as assessed by ASI scores, than their counterparts with later onset use. In terms of specific legal and psychiatric problems, patients with early onset use were more likely to be awaiting charges than those with later onset use; they were also more likely to report recent problems with controlling violent behavior, and recent and lifetime suicide ideation and attempts. Early onset cocaine users had more outpatient psychiatric treatment episodes, and they were more likely to report having been sexually abused than those with later onset cocaine use.

3.2 During Treatment Outcomes

Treatment condition was significantly associated with longest durations of abstinence achieved (LDA), $F(1,420) = 14.58, p < .001$, and patients assigned to CM achieved significantly longer periods of abstinence than those assigned to standard care. Patients assigned to CM achieved on average 5.0 ± 0.4 weeks of continuous abstinence versus 3.4 ± 0.3 weeks for those assigned to standard care. Race was significantly associated with percent negative samples submitted, $F(2,420) = 6.00, p < .01$; on average, African Americans submitted $71.4\% \pm 2.4$ negative samples versus $80.5\% \pm 3.9$ for Hispanic Americans and $82.7\% \pm 2.4$ for Whites.

After controlling for these variables and current age, age of initiation of cocaine use was significantly associated with treatment sessions attended, $F(1,420) = 14.58, p < .001$, and longest duration of abstinence achieved, $F(1,420) = 14.58, p < .001$, but not proportion of negative samples submitted, $p > .30$. The interaction between treatment condition and age of onset of cocaine use was not significant, $p > .58$. Figure 1 shows the adjusted means of the three outcome variables for individuals who began using cocaine at or before age 14 versus those who initiated use after age 14 according to treatment group assignment.

4. Discussion

Consistent with other studies of adults seeking substance abuse treatment for cocaine (Higgins et al., 2007; Washio et al., 2011), about 10% of this sample reported very early onset of cocaine use, at age 14 years or younger. In contrast, studies limited to adolescent and young adults find a much high proportion of patients with early onset use (Bracken, Rodolico, & Hill, 2013). The differences in rates of persons reporting early onset cocaine

use may relate to recall bias, with older persons less likely to recall-- or admit to-- early use. It may also reflect sampling differences; adolescents with early onset cocaine use may be mandated to treatment and therefore represent a fairly large proportion of teenagers and young adults in treatment settings.

Few African Americans had early onset cocaine use in this sample, consistent with literature on ethnicity and early illicit drug use (Barnes, Welte, & Hoffman, 2002). There was a significant association between early onset cocaine use and greater current legal difficulties. Gustavson et al. (2007) likewise found that early-onset substance use disorders were associated with violent behavior, conduct disorder, and antisocial personality disorder in adults.

Not surprising, early onset cocaine use also related to more severe lifetime as well as current psychiatric problems, including suicidal ideation and attempts (see also Felts, Chernier, & Barnes, 1992; Cho, Hallfors, & Iritani, 2007). Further, over half this sample with early onset cocaine use reported a history of sexual abuse; others have likewise noted associations of sexual abuse and early onset drug use (Ompad et al., 2005; Bensley, Spieker, Van Eenwyk, & Schoder, 1999; Dube et al., 2003). In this study, sexual abuse was ascertained via a single item on the ASI. Although responses to this item are sensitive and specific (Langeland, van den Brink, Draijer, & Hartgers, 2001; Najavits et al., 1998), this study cannot provide a more refined analyses of associations between sexual abuse (e.g., timing, duration or perpetrator) and early onset drug use, but it does suggest that sexual abuse may be intricately related to early onset cocaine use.

Neither severity of legal nor psychiatric problems related to treatment outcomes, but age of onset of cocaine use was significantly negatively associated with treatment retention and duration of abstinence achieved. Contingency management treatment, nevertheless, was equally effective regardless of age of initial cocaine use. These data suggest that CM is well suited for patients with severe and persistent psychosocial problems and early onset drug use.

Limitations and strengths

These findings are limited by the retrospective nature of assessing age of first cocaine use. A relatively small number of patients reported very early initiation of cocaine use, which may have limited power to detect all but the most robust between group differences.

Additionally, other psychiatric diagnoses were not assessed, and as noted earlier, thorough information regarding the nature of sexual abuse histories was not obtained. Despite these limitations, this study randomly assigned patients to treatment conditions, assessed multiple objective outcome measures longitudinally, and employed intent-to-treat analyses. We also recruited a large ethnically and racially diverse sample from four community-based treatment sites. These features increase generalization of findings.

Conclusion

In summary, this study found that initiating cocaine use at a very young age is associated with persistent psychosocial problems in treatment-seeking cocaine users and overall poor response to treatment. Contingency management improved outcomes relative to standard

care, adding to the growing literature demonstrating benefits of this intervention in difficult-to-treat subpopulations of substance abusing patients (e.g., DeFulio et al., 2013; Messina, Farabee, & Rawson, 2003; Petry, Ford, & Barry, 2011). This study adds to the generalization and utility of CM for patient subgroups who otherwise very rarely remain engaged in treatment or achieve long durations of abstinence. Ultimately, CM may be particularly cost-effective in patient subgroups that respond poorly to usual care procedures.

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Figure 1. Substance abuse treatment outcomes by age of onset of cocaine use and treatment condition. Patients assigned to standard care are denoted in open bars and patients assigned to contingency management are denoted in filled bars. Values represent means and standard errors. Age of onset of cocaine use was significantly negatively associated with days attended treatment and longest duration of abstinence achieved, $ps < .05$. Contingency

management treatment was significantly and positively associated with days attended treatment and longest duration of abstinence achieved, $ps < .05$ See text for more details.

Table 1

Demographic and Baseline Characteristics

Variable	Age of First Cocaine Use (years)		Statistical test, <i>p</i>
	14 (n= 41)	15 (n= 387)	
Treatment group, n (%)			$\chi^2(1) = 1.14, .29$
Contingency management	31 (75.6)	261 (67.4)	
Standard care	10 (24.4)	126 (32.6)	
Ethnicity, n (%) *			$\chi^2(2) = 27.90, .00$
African American	5 (12.2)	153 (39.5)	
Caucasian	17 (41.5)	176 (45.5)	
Hispanic	19 (46.3)	58 (15.0)	
Male gender, n (%)	14 (34.1)	179 (46.3)	$\chi^2(1) = 2.20, .14$
Age, mean (SD) *	33.2 (6.5)	37.3 (9.2)	$t(426) = -2.79, .01$
Married, n (%)	3 (7.3)	29 (7.5)	$\chi^2(1) = .002, .97$
Employment status, n (%)			$\chi^2(2) = 2.04, .36$
Full Time	17 (50)	126 (38.0)	
Part Time	7 (20.6)	96 (28.9)	
Unemployed/other	34 (29.4)	110 (33.1)	
Years of education, mean (SD)	11.4 (2.0)	11.9 (1.9)	$t(426) = -1.77, .08$
Income, mean (SD)	\$8,745 (13,173)	\$6,087 (11,131)	$t(426) = 1.43, .15$
Cocaine positive sample, n (%)	6 (14.6)	97 (25.1)	$\chi^2(1) = 2.20, .14$
Opioid positive sample, n (%)	1 (2.4)	17 (4.4)	$\chi^2(1) = .35, .55$
Alcohol use disorder, n (%)	26 (63.4)	238 (61.5)	$\chi^2(1) = .06, .81$
Addiction Severity Index scores, mean (SD)			
Medical	0.31 (0.40)	0.27 (0.37)	$t(426) = .59, .55$
Employment	0.81 (0.25)	0.78 (0.25)	$t(426) = .69, .49$
Alcohol	0.20 (0.24)	0.21 (0.25)	$t(426) = -.22, .83$
Drug use	0.19 (0.26)	0.18 (0.09)	$t(426) = 1.67, .10$
Legal *	0.20 (0.22)	0.11 (0.20)	$t(426) = 2.30, .02$
Family/social	0.38 (0.28)	0.17 (0.21)	$t(426) = .84, .40$
Psychological *	0.01 (0.03)	0.29 (0.23)	$t(426) = 2.15, .03$
On parole or probation, n (%)	12 (29.3)	107 (27.6)	$\chi^2(1) = .05, .83$
Awaiting charges, n (%) *	13 (31.7)	72 (18.7)	$\chi^2(1) = 3.96, .04$
Total months in jail, median (IQR)	22.5 (44.3)	7.0 (29.0)	$U = 7191.5, .31$
Experienced in past 30 days, n (%)			
Serious anxiety	23 (56.1)	193 (49.9)	$\chi^2(1) = .58, .45$
Serious depression	22 (53.7)	150 (38.8)	$\chi^2(1) = 3.42, .06$
Thoughts of suicide	6 (14.6)	28 (7.2)	$\chi^2(1) = 2.78, .10$
Trouble with violent behavior *	10 (24.4)	28 (7.2)	$\chi^2(1) = 13.49, .00$

Variable	Age of First Cocaine Use (years)		Statistical test, <i>p</i>
	14 (n= 41)	15 (n= 387)	
Currently prescribed psychiatric medication, n (%)	16 (39.0)	123 (31.8)	$\chi^2(1) = .89, .35$
Experienced within lifetime, n (%)			
Thoughts of suicide *	25 (61.0)	154 (39.8)	$\chi^2(1) = 6.84, .01$
Attempted suicide *	20 (48.8)	110 (28.4)	$\chi^2(1) = 7.26, .01$
Emotional abuse	26 (63.4)	194 (50.1)	$\chi^2(1) = 2.62, .11$
Physical abuse	20 (48.8)	136 (35.1)	$\chi^2(1) = 2.98, .08$
Sexual abuse *	22 (53.7)	92 (23.8)	$\chi^2(1) = 16.95, .00$
Inpatient psychiatric treatments, median (IQR)	1.0 (3)	0.0 (1)	$U = 6961.0, .14$
Outpatient psychiatric treatments, median (IQR) *	1.0 (4)	1.0 (2)	$U = 5763.5, .00$

Note. Values represent means and standard deviations unless otherwise indicated. IQR = Interquartile range.

* Significant between group difference, $p < .05$.