Nova Southeastern University

NSUWorks

2016

Smoking Cessation and Adolescent Treatment Response with Comorbid ADHD

Marie E. Pagano
Case Western Reserve University, maria.pagano@case.edu

Christine M. Delos-Reyes
Case Western Reserve University, christina.delosreyes@uhhospitals.org

Sherry Wasilow
Carleton University

Kathleen M. Svala
Case Western Reserve University

Steven P. Kurtz
Nova Southeastern University, steven.kurtz@nova.edu

Follow this and additional works at: https://nsuworks.nova.edu/shss_facarticles

Part of the Arts and Humanities Commons, and the Social and Behavioral Sciences Commons

NSUWorks Citation

Pagano, M. E., Delos-Reyes, C. M., Wasilow, S., Svala, K. M., & Kurtz, S. P. (2016). Smoking Cessation and Adolescent Treatment Response with Comorbid ADHD. *Journal of Substance Abuse Treatment, 70*, 21-27. https://doi.org/10.1016/j.jsat.2016.07.008

Smoking cessation and adolescent treatment response with comorbid ADHD[☆],,[☆☆],,[★]

Maria E. Pagano, Ph.D.[a,*], **Christina M. Delos-Reyes, M.D.**[a], **Sherry Wasilow, Ph.D.**[b], **Kathleen M. Svala, M.D.**[a], and **Steven P. Kurtz, Ph.D.**[c]

[a]Case Western Reserve University (CWRU), Department of Psychiatry, Cleveland, OH

[b]Carleton University, School of Journalism and Communication, Ottawa, ON

[c]Center for Applied Research on Substance Use and Health Disparities, Department of Justice and Human Services, Nova Southeastern University, Miami, FL

Abstract

Minors entering treatment for alcohol and other drug (AOD) use disorders tend to smoke at high rates, and many have comorbid attention deficit hyperactivity disorder (ADHD). Clear-air laws force patients to refrain from smoking on the premises of AOD treatment facilities, which may hinder the progress of treatment-seeking populations who smoke and struggle with ADHD comorbidity in particular. This study explores clinical characteristics associated with smoking among youths presenting for residential treatment, clinical characteristics associated with smoking cessation, and the impact of smoking cessation with ADHD comorbidity on AOD treatment response. Participants were 195 adolescents (52% female, aged 14–18 years) court-referred to residential treatment. Data were collected at intake, prospectively each week for the 10-week treatment period, and at discharge. Two-thirds (67%) of the enrollment sample entered treatment smoking half a pack a day on average, a large proportion (50%) of which did not smoke during treatment. ADHD patients were more likely to smoke before and during treatment except for those who got active in service and step-work. Quitting smoking did not adversely affect AOD outcomes and was associated with better prognosis of lowered AOD cravings for youths with and without ADHD. Smoking cessation during adolescent AOD treatment is recommended with provision of pharmaceutical and/or behavioral modalities that reduce nicotine withdrawal.

Keywords

Smoking cessation; Substance abuse treatment; Adolescents; ADHD; Service

1. Introduction

Tobacco use is the number one preventable cause of disease, disability, and death in the United States (CDC, 2010a). Some populations are more at risk of tobacco use disorders than others. Whereas approximately one out of every four Americans smokes, three out of four individuals with alcohol and other drug (AOD) use disorders are smokers (Bobo & Husten, 2000; Grant, Hasin, Chou, Stinson, & Dawson, 2004). Furthermore, smoking is more likely to kill patients than the AOD problems for which they sought treatment (Hser, McCarthy, & Anglin, 1994; Hurt et al., 1996). Neuropsychiatric disorders characterized by impaired cognition and impulsivity such as attention deficit hyperactivity disorder (ADHD) also increase the risk of tobacco use disorders; smoking rates are twice as high among individuals with ADHD than the general population or controls without ADHD (Kollins, McClernon, & Fuemmeler, 2005). Minors are also disproportionately vulnerable to tobacco use disorders; tobacco use frequently starts in adolescence, and 80 percent of teen initiators continue to smoke into adulthood, curtailing lung growth, brain development, and longevity (CDC, 2010b; DiFranza et al., 2002; Kandel & Chen, 2000). The risk of tobacco use disorders and associated medical comorbidity is compounded for substance dependent youths with ADHD (Biederman et al., 2006).

The last few decades have witnessed an explosion of pharmacological aids in the treatment of nicotine dependence, alcohol and drug addiction, and ADHD, including: 1) nicotine replacement therapies (NRTs) to aid smoking quit attempts (American Cancer Society, 2015); 2) naltrexone and acamprosate to reduce the reinforcing qualities of alcohol (Bouza, Magro, Muñoz, & Amate, 2004); 3) suboxone and methadone replacement pharmacotherapies for the treatment of narcotic use disorders (Miller, Wilbourne, & Hettema, 2003); and 4) stimulants for the treatment of ADHD. ADHD pharmacotherapies, in particular, have demonstrated large effects (d = 0.80) in reducing ADHD symptoms and in preventing addiction among young adults (Jain, Jain, & Islam, 2011; Lambert & Hartsough, 1998).

1.1. Treatment

Despite these biomedical advances, associated benefits do not reach populations who suffer the most with all three conditions, and minors in particular. Co-existing tobacco-use disorders are often inadequately addressed in AOD treatment programs, as patients are frequently warned not to tackle smoking cessation during treatment for fear of jeopardizing their progress with recovery from addiction (Gil & Bennett, 2000; Hahn, Warnick, & Plemmons, 1999). In fact, only 8% of clients are told by counselors to quit tobacco use during AOD treatment (Joseph, Willenbring, Nugent, & Nelson, 2004). For adolescent patients who want to quit smoking during AOD treatment, NRTs may not be readily available, prescribable to minors, or without cost. As well, comorbid ADHD often goes unrecognized, particularly among girls (Biederman et al., 1999; Gaub & Carlson, 1997). Even if recognized, stimulant medications are considered off-limits for AOD-dependent youths with ADHD due to the addictive potential of stimulants. Untreated nicotine

withdrawal symptoms, AOD cravings, and impaired attention may decrease youths' chances of smoking cessation during treatment and increase their likelihood of treatment drop-out.

1.2. Smoking cessation and treatment response with comorbid ADHD

ADHD has high overlap with nicotine dependence, and may further challenge youths' ability to adhere to traditional treatment programs that are largely cognitive, behavioral, and social in nature. Given that ADHD is the most common psychiatric diagnosis of minors, the majority of individuals with AOD use disorders smoke (Friend & Pagano, 2005a, 2005b), and the smoke-free policies enforced at treatment facilities, the paucity of data on the impact of smoking cessation on AOD treatment response and in the presence of ADHD is surprising. Among adults, there is evidence that smoking cessation during AOD treatment is not associated with worse but improved drinking outcomes (Friend & Pagano, 2005a, 2005b, 2007), although there is some argument to consider quitting smoking once AOD treatment is completed (Joseph et al., 2004). In fact, adults who continue smoking show worse drinking outcomes (Cooney, Cooney, Pilkey, Kranzler, & Oncken, 2003). Among youths, smoke-free policies in adolescent treatment facilities show no negative effects on retention rates (Callaghan et al., 2007). Initial evidence suggests no negative effects of smoking cessation among adolescents admitted into psychiatric hospitalization for axis 1 disorders including substance use (Brown et al., 2009; Myers & Kelly, 2006). It is unclear whether these findings extend to adolescents entering treatment for substance dependency and how ADHD complicates the picture. The handful of effectiveness studies of AOD treatment among youth with psychiatric comorbidity have been limited by insufficient sampling of girls to understand effects of ADHD inclusive of ADD without hyperactivity. In practice, ADHD is not an assessed condition that qualifies for dual-diagnosis treatment.

1.3. Purpose of this paper

The ability to focus, process higher-level cognition, and endure AOD cravings is a challenge for most AOD dependent patients in the initial months of AOD abstinence. Agitation and nicotine cravings from not being able to smoke during treatment can add to this common mental fog in early AOD recovery. Now add irritability, difficulty with peers, and impaired attention from untreated ADHD (Mrug, Hoza, Pelham, Gnagy, & Greiner, 2007; Pliszka, Greenhill, Crismon, et al., 2000) that is no longer medicated by AOD or nicotine use. The deck may be stacked against AOD dependent smokers with comorbid ADHD making progress in treatment. This paper aims to inform critical gaps between the mental health and addiction literatures by examining three research questions: 1) what are the clinical impairments associated with smoking among youths presenting for treatment?; 2) what are the characteristics of youths who successfully quit smoking during treatment?; and 3) what is the impact of smoking cessation on treatment response among smokers with and without ADHD? Understanding the interplay between smoking cessation, addiction, and ADHD can inform the integration and tailoring of treatment services to optimize patient health long-term.

2. Material and methods

2.1. Procedures

Data are drawn from a naturalistic, longitudinal study that enrolled a large, representative sample of AOD-dependent youths court-referred to treatment, selected for equal gender proportions to optimize generalization of study findings. Patients were recruited from a large adolescent residential treatment program in northeast Ohio. Inclusion criteria included: ages 14–18 years, English speaking, stable address and telephone, met diagnostic criteria (APA, 2000) for current AOD dependence, and medically stable. Exclusion criteria included: a major chronic health problem other than AOD disorders likely to require hospitalization, currently suicidal or homicidal, or expected incarceration in the subsequent 12 months. Participants were referred to AOD treatment from multiple sources, the most common of which were juvenile court (83%) and mental health professionals (65%). In the week before admission date, participants were sent an information packet with an invitation letter to participate in the study. Following admission, participants were approached to participate and given a brief description of the study. Participants were assured that their answers to study assessments would be kept confidential, and would not be shared with family members or treatment staff except when necessary to prevent harm to the participant or someone else. Eligible participants signed statements of informed assent with their parent/legal guardian providing informed consent. Participants were paid $25 for completed assessments. All procedures of this study were approved by the University Hospitals Case Medical Center Institutional Review Board for human investigation, and a Certificate of Confidentiality from the National Institute on Alcohol Abuse and Alcoholism was obtained. The general aims, organization, and research design of longitudinal investigation can be read about in further detail elsewhere (Kelly, Pagano, Stout, & Johnson, 2011).

2.2. Setting

New Directions is a 24-hour monitored, intensive residential AOD treatment program lasting two months on average (M=2.2) that provides a range of evidenced-based therapies. Using the Drug and Alcohol Program Treatment Inventory (Swindle, Peterson, Paradise, & Moos, 1995), the top five treatment modalities at the site are cognitive–behavioral ($M = 11.0$), psychodynamic ($M = 11.0$), therapeutic community ($M = 10.0$), family ($M = 9.0$), and 12-step facilitated ($M = 9.0$), and are comparable to other adolescent AOD programs (Kelly & Urbanoski, 2012). Each week, clients spend approximately 20 hours in therapeutic activities and attend up to five 12-step meetings in the local community. Nicotine use is not allowed inside or outside the grounds of the facility. Nicotine patches are available upon client request, and clients are permitted to smoke when on pass or attending local 12-step meetings. Addiction medications and schedule II–IV medications (i.e. controlled substances) are not available to clients in adolescent AOD treatment.

2.3. Participants

A total of 482 adolescents were admitted into AOD treatment during the study enrollment period from February 2007 to August 2009. All youth with scheduled admission appointments as well as those unscheduled but occurring during regular weekday hours (8 AM–6 PM), one weekday evening (5 PM–8 PM), and one weekend day (9 AM–5 PM), were

approached by research staff. All approached subjects (N = 211) met eligibility criteria and few (N = 16) refused to participate, who were equally represented by gender. There was a higher proportion of females among youth enrolled (52%) versus not enrolled (17%, $p < .0001$), due to the study design's gender stratification. At the time of enrollment, all participants were between the ages of 14–18 and had approximately 7±3 days of sobriety. No participants were taking psychotropic medication or had a history of pathology that might have affected cognitive function.

Eighty-nine percent of the enrollment sample completed treatment, 6% were prematurely discharged against medical advice, and 5% were transferred to a higher-level medical facility – rates similar to other adolescent populations in AOD treatment (Kaminer, Burleson, & Goldberger, 2002; Wise, Cuffe, & Fischer, 2001). Eight discharge assessments were unable to be scheduled for 3 treatment completers, 3 premature discharges, and 2 higher-level facility discharges. There were no significant intake differences between adolescents who were enrolled versus not enrolled but treated during the enrollment period in terms of intake characteristics and rates of treatment retention, as reported in detail elsewhere (Kelly et al., 2011). Participants without a discharge interview (4% of the enrollment sample) did not differ from participants with a discharge interview, as described in detail elsewhere (Lee, Pagano, Johnson, & Post, 2016).

2.4. Measures

Data were gathered via rater-administered, semi-structured interviews, medical chart review, biomarkers, clinician reports, and youth self-reports. Experienced research assistants (bachelor's to doctor of medicine degree) administered 60-minute interviews at intake within the initial week after admission, and in the week of treatment discharge (*M*=2.1 months between interviews). Interviewers received extensive training before beginning data collection and obtained National Institutes of Health's required certification on the protection of human subjects. Background, clinical, and AOD severity variables were assessed at intake; 12-step participation, outcomes, and nicotine variables were assessed at intake and discharge.

2.4.1. Background—Background variables included gender, race, ethnicity, age, parental marital status and education, and urbanicity of residence. Urbanicity of residence was assessed using the zip code approximation version of the census tract-based rural–urban commuting area codes (available at http://depts.washington.edu/uwruca/ruca-data.php).

2.4.2. Clinical—Five clinical indices included general health, ADHD, attempted suicide history, trauma experiences, and violent offenses. Using an item from the Youth Risk Behavior Survey (Kann, Brener, Warren, Collins, & Gioviono, 2002), participants rated their general health on a Likert scale from 1 ("poor") to 5 ("excellent"). The rater-administered, semi-structured, MINI-International Neuropsychiatric Interview Plus (MINI-Plus; Arnaud et al., 2010; Sheehan et al., 1998) was used to assess DSM IV-TR AOD use disorders and ADHD, including age of disorder onset. Participants who endorsed ADHD criteria in the past 6 months were considered positive for current ADHD diagnosis. All participants received an initial diagnostic evaluation by the medical director board-certified in child

psychiatry as part of the admissions interview. Kappa statistics showed high agreement with clinician assessment of ADHD ($\kappa = 0.92$), and rates of ADHD (combined, $n = 68$; inattentive only, $n=45$; hyperactivity only, $n=0$) were comparable to other studies with AOD dependent minors (Kaminer et al., 2002; Waldron, Slesnick, Brody, Turner, & Peterson, 2001). An item from the MINI-Plus was used to assess attempted suicide ("I have tried to commit suicide"). Trauma experiences were assessed with the four-item Traumatic Experiences scale adapted from the valid Massachusetts Youth Screening Inventory (Grisso & Barnum, 2000), which showed good internal consistency in the current sample ($\alpha = 0.86$). Violent offenses, the most serious of crimes (Gottesman & Wile, 2011), were assessed with the self-report of delinquency (Elliott, Huizinga, & Menard, 1989). With reference to the past year, 10 items were rated from 0 ("never") to 8 ("2–3 times a day") and summed (range=0–80). Internal consistency of the violent offense score was high ($\alpha=.90$). Intra-correlations between clinical indices were non-significant except between traumatic experiences and violent offenses ($r=.2$, $p < .01$) and attempted suicide ($r = .2$, $p < .01$).

2.4.3. AOD severity—AOD severity indices were years of AOD use and readiness to change. Readiness to change was assessed using the University of Rhode Island Change Assessment scale (DiClemente, Schlundt, & Gemmell, 2004; Dozois, Westra, Collins, Fung, & Garry, 2004), which showed good internal consistency in the current sample ($\alpha=0.91$). With reference to the past month, 32 items were rated from 1 (strong disagreement) to 5 (strong agreement). Correlations between AOD severity indices were non-significant ($rs = -0.1–0.2$).

2.4.4. 12-step participation—Three indicators of 12-step participation included service, step-work, and meeting attendance. Service was assessed with the Service to Others in Sobriety (SOS) questionnaire (Pagano et al., 2010). With reference to the previous 90 days, 12 items were rated from 1 (rarely) to 5 (always) and summed (range=12–60). The SOS demonstrated adequate psychometric properties in the current sample, including inter-informant reliability (r= .5), internal consistency ($\alpha = .90$), and convergent validity ($rs = -0.3–0.3$; Pagano et al., 2013). Step-work was assessed with the General Alcoholics Anonymous (AA) Tools of Recovery (GAATOR) scale (Greenfield & Tonigan, 2013), a 24-item self-report of the practice of the 12 steps in daily living. With reference to the past 90 days, each item was rated on a Likert scale from 0 ("definitely false") to 3 ("definitely true") and summed (range = 0–72). The GAATOR demonstrated good internal reliability with the current sample ($\alpha > .80$). Meeting attendance was assessed with the single item, "How many 12-step meetings have you attended in the past 90 days?" Intake correlations between 12-step indicators were low to moderate ($rs = 0.2–0.4$, $p < .01$).

2.4.5. Outcomes—Three treatment outcomes shown to predict relapse were assessed, including AOD use, AOD cravings, and global functioning (Brown, Vik, Patterson, Grant, & Schuckit, 1995; MacKillop et al., 2010). AOD use was assessed using the Time Line Follow Back (TLFB) interview (Donohue et al., 2004), a calendar-grid method for tracking daily use of alcohol and eight types of drugs (amphetamines, hallucinogens, cocaine, marijuana, inhalants, sedatives, narcotics, steroids) over an assessment period. To calculate the percentage of days drinking or using each drug type, the number of days a subject reported

use of each substance was divided by the number of days in the time period multiplied by 100. Percentage of days abstinent (PDA) was calculated as the number of days a subject was abstinent from AOD divided by the number of days in the time period multiplied by 100. The Adolescent Obsessive Compulsive Drinking (AOCD) scale (Deas, Roberts, Randall, & Anton, 2002) was used to assess AOD cravings and obsessive thoughts. With reference to the past week, 14-items were rated on a Likert scale from 0 ("none/never") to 5 ("always/ extreme") and summed (range = 0–72). The AOCD scale showed good internal consistency in the current sample (α = .85). Participants' worst global functioning at home, school, and with peers was measured with the clinician-rated Children's Global Assessment Scale (range = 0–100; Rey, Starling, Wever, Dossetor, & Plapp, 1995). There were low correlations between outcome variables at intake and discharge (rs = −0.1–0.1, ns).

2.4.6. Nicotine use—Participants' nicotine consumption was primarily cigarettes (no cigar use), and two subjects reported chewing tobacco once. Therefore, nicotine variables included: number of days smoked in the current period, number of cigarettes per day, and time to first cigarette upon awakening on last smoking day. Daily consumption of nicotine products (cigarettes, tobacco chew, cigars) was collected using the TLFB nicotine assessment. Nicotine users were identified using nicotine consumption thresholds recommended by others conducting research with AOD populations who smoke (Center for Substance Abuse Treatment, 2005; Naqvi, Rudrauf, Damasio, & Bechara, 2007), participants who smoked at least 10 cigarettes per month and more than five cigarettes per smoking day were considered to smoke. Very few participants smoked at least 1 cigarette but below this threshold at baseline (N=5) or during the 10-week treatment period (N=0). Nicotine replacement therapies prescribed to participants during AOD treatment were recorded from medical chart records. Nicotine use variables were moderately correlated at intake and discharge (rs= −0.3–0.3, p < .01).

2.4.7. Statistical analysis plan—Statistical analyses were performed with SAS Version 9.2 (SAS Institute Inc., 2008). Fisher's Exact Tests for binary variables or Kruskal–Wallis chi-square tests for continuous variables were performed to evaluate differences between groups. Distributions of variables were examined for normality. The negatively skewed PDA variable received an arcsine transformation. Following descriptive analyses, we first evaluated intake characteristics associated with smoking. We then used logistic regression analysis to identify intake characteristics that distinguished participants who continued to smoke during the 10-week treatment period. Finally, hierarchical linear regression analyses were performed to evaluate the impact of smoking cessation, ADHD, and their interaction term on 12-step participation and outcomes collected at discharge. Intake covariates associated with either 12-step participation or outcomes in prior research such as antisocial behaviors (Biederman et al., 2006; Pagano, Zemore, Onder, & Stout, 2009) were controlled for in analytic models, including: background, clinical, AOD severity, number of days smoking, and the dependent variable at intake. Preliminary analyses suggested that linear modeling was adequate. Examination of the correlation matrix for independent variables in analytic models found no correlation to exceed 0.3 and collinearity diagnostics indicated no problems. The family-wise error rate for the two sets of treatment response indicators was

set at $p < .05$ (two-tailed). For the purposes of interpretation, Cohen (1988) considers $r = 0.1$ "small," $r = 0.3$ "medium," and $r = 0.5$ "large."

3. Results

3.1. Intake profile

Approximately half the sample was male (48%; quota sample), from single parent households (50%), and resided in rural/small town settings (53%). The mean age was 16 years ($SD = 1.1$). Thirty percent were Black and 8% were Hispanic. Large majorities had a parent with a high-school education or less (74%) and were in good health (68%). Thirty-five percent met current criteria for combination ADHD and 23% met current criteria for ADD (inattentive only); the mean age of disorder onset was 5.7 years ($SD = 1.3$). Thirty-one percent had 2 or more lifetime traumatic experiences ($M = 1.7$, $SD = 1.5$) and 24% had a history of attempted suicide. The majority entered treatment with marijuana dependence (92%), comorbid alcohol dependence (60%), and elevated AOD cravings ($M = 33.5$, $SD = 11.3$). The most prevalent drug dependence substances comorbid with marijuana dependence were narcotics (36%), hallucinogens (35%), and stimulants (30%). Participants were, on average, in the pre-contemplative stage of change ($M = 11.0$, $SD = 2.5$) and used AOD at least half (60%) of the past month.

Two out of three youths (67%) reported smoking on 10+days in the month prior to treatment ($M = 21.4$ days, $SD = 9.4$) and 5+ cigarettes on smoking days ($M = 12.5$ cigarettes, $SD = 9.0$). The average time to first cigarette was within an hour upon awakening ($M = 53.6$ minutes, $SD = 81.1$). Smoking was associated with higher trauma ($X^2 = 4.6$, $p < .05$), attempted suicide ($X^2 = 5.3$, $p < .05$), and ADHD ($X^2 = 5.5$, $p < .05$; Table 1).

3.2. Discharge profile

After approximately 2 months of treatment ($M = 10.2$ weeks, $SD = 2.1$), the smoking sample overall ($N = 149$) showed improvements in 12-step participation (step-work: $t = -7.7$, $p < .001$; service: $t = -8.2$, $p < .001$; meeting attendance: $t = -14.2$, $p < .001$), global functioning ($t = -25.4$, $p < .001$), AOD cravings ($t = 25.9$, $p < .001$), and PDA ($t = 25.9$, $p < .001$), although half (50%) used AOD at least once. Half (50%) continued to smoke and half (50%) did not smoke on any day during the 10-week treatment period. While continuing smokers smoked on fewer days ($M = 15.0$, $SD = 8.9$; $F = 4.1$, $p < .01$), the number of cigarettes they smoked on smoking days ($M = 10.6$, $SD = 9.2$) and time to first cigarette ($M = 70.1$, $SD = 120$) were similar to pre-treatment levels. Youths who continued to smoke versus quit smoking were similar at intake in terms of background characteristics, AOD dependence substances, and nicotine use ($M = 21.2$ vs $M = 22.2$ days smoking, ns; $M = 12.1$ vs $M = 12.2$ cigarettes/per smoking day, ns; $M = 54.3$ vs $M = 55.1$ minutes to first cigarette, ns). Few youths who continued to smoke or quit smoking received nicotine patches during treatment (4% vs 6%, ns).

3.3. Predictors of smoking cessation

Most intake characteristics were not associated with smoking cessation (Table 2). However, ADHD significantly increased the likelihood of continuing to smoke ($OR = 4.1$, $p < .0001$).

Post-hoc analyses were performed to evaluate that the extent to continuing smokers with ADHD was similar at baseline from quitters with and without ADHD, which found no differences.

3.4. Impact of smoking cessation on treatment response with ADHD comorbidity

Table 3 shows treatment response variables among youths who continued to smoke versus quit smoking with and without ADHD. Results of hierarchical linear regression analyses found no significant main effects of smoking cessation on treatment duration, 12-step participation, and outcomes with one exception. A significant main effect of smoking cessation on AOD cravings ($F = 9.6$, $p < .01$) indicated that continuing smokers were discharged with higher levels of AOD cravings ($M = 10.6$) than quitters ($M = 5.6$). ADHD was associated with lower step-work ($M = 68.9$ vs $M = 75.0$, $F = 10.3$, $p < .01$), service ($M = 29.6$ vs $M = 33.1$, $F = 4.0$, $p < .05$), and functioning ($M = 57.4$ vs $M = 59.3$, $F = 3.8$, $p < .05$). However, a significant interaction between smoking cessation X ADHD was found for service ($F = 3.9$, $p < .05$) and step-work ($F = 8.9$, $p < .01$). Step-work was highest among continuing smokers without ADHD, followed by those who quit smoking (with and without ADHD), and lowest among continuing smokers with ADHD. Continuing smokers without ADHD and youths who quit smoking (with and without ADHD) had similar levels of service which were significantly higher than continuing smokers with ADHD.

4. Discussion

4.1. Impact of smoking cessation on treatment response

The treatment of nicotine addiction during AOD treatment has been largely avoided without a sound scientific rationale. This study suggests that AOD treatment outcomes are better if alcohol, drug, and nicotine addictions are treated simultaneously. In this sample of substance dependent youths, smoking cessation was not associated with worse treatment outcomes but better prognosis in terms of lower AOD cravings. In contrast, continuing to smoke was associated with more severe AOD cravings, which has been shown to increase the risk of AOD relapse post-treatment (MacKillop et al., 2010). If the conditional appetite motivational theory of AOD cravings (Rohsenow & Monte, 1999) applies across substances, lighting up a cigarette may trigger cravings to smoke other substances like nicotine, which warrants future research. These findings extend prior work with treatment-seeking adults (Friend & Pagano, 2005a, 2005b), and are consistent with community studies with adolescents that show smoking associated with problems with AOD use even at low levels of smoking (Cavazos-Rehg, Krauss, Spitznagel, Grucza, & Bierut, 2014). While continuing smokers had fewer days of smoking, this decline is likely due to being confined to a smoke-free, 24-hour monitored residential program, given their nicotine consumption patterns were similar on the days they did smoke. Study findings suggest that clean air policies in AOD treatment settings do not interfere with youth progress during AOD treatment and enhance smoking cessation efforts.

4.2. Impact of smoking cessation on treatment response with ADHD comorbidity

This study highlights a common problem many adolescents face upon entry into AOD residential treatment: they cannot smoke and they cannot receive front-line, stimulant

medication for ADHD comorbidity. Is smoking cessation beneficial for these youths with comorbid ADHD? Results appear more complicated for ADHD patients who smoke. ADHD clearly decreased the chances of smoking cessation and was associated with worse functioning, which may be due to lower performance in treatment classrooms, poor executive functioning, and impulsive symptoms associated with this disorder. Untreated ADHD may pose a barrier to participating and benefiting from the 12-step program. While ADHD did not interfere with meeting attendance, it was associated with less step-work and service participation. ADHD symptoms of impaired attention and lack of task persistence may hinder step-work whereas irritability, aggression, and low social skills (Mrug et al., 2007; Pliszka et al., 2000) may interfere with getting along with peers in mutual-help activities. This is unfortunate given that AA provides a natural, social platform for finding sober peers and support for a chronic, lifelong disease.

Unless channeled in action-oriented programmatic activities, frustration tolerance may be too low in early recovery for many ADHD patients to endure symptoms without smoking. Smoking before or after meetings in the local community may also limit opportunity and invitations to help set up or put away chairs, greet newcomers, or make coffee – natural, low-intensity tasks that facilitate getting to know and be known by AA members. ADHD patients who quit smoking participated in service and step-work at comparable levels to youths without ADHD who quit smoking, whereas continuing smokers with ADHD had significantly lower levels in these activities. We speculate that becoming active in service may distract quitters from symptoms of nicotine withdrawal, provide an outlet for ADHD, and fan motivation to continue with step-work. Getting active in service may be particularly useful for smoking cessation with or without ADHD comorbidity as a mild form of exercise, which has some efficacy in reducing adolescent nicotine use and increasing focus (Escobedo, Marcus, Holtzman, & Giovino, 1993; Thorlindsson, Vilhjalmsson, & Valgeirsson, 1990).

4.3. Limitations and strengths

Some limitations of our study merit attention. First, nicotine use variables were self-reported and not validated with biochemical testing. However, prior studies using biochemical markers show low rates of false reporting (Joseph et al., 2004). Related, because nicotine use but not withdrawal symptomology was measured, future research is warranted and underway (R01 CA190130) to explore the observed escalation of nicotine dependence among adolescents (Kleinjan et al., 2012) and influence on quit attempts and outcomes. Second, sample sizes were too small to examine differential outcomes by ADHD type and receipt of nicotine patches. Third, participants were forced to not smoke on the premises of the residential treatment facility and results may not generalize to populations seeking help to quit smoking. Lastly, a randomized control trial is needed to determine the causal relationships between smoking cessation, ADHD, and adolescent treatment response. However, intake characteristics including severity of nicotine use, treatment duration, and meeting attendance were similar between youths who quit smoking versus continued to smoke with and without ADHD, suggesting that differences between groups cannot be explained by intake characteristics, an equal dose of formal treatment, and similar opportunity to smoke at local meetings. Strengths of this study include: closely spaced

longitudinal data on AOD and nicotine use; robust analyses that control for potential confounding variables such as antisocial behaviors; and a representative sample of juveniles with substance dependency (52% females, 30% minority). The large sample and balanced smoking cessation groups (74 smokers versus 75 quitters) were ideal for maximizing power (>80% available) to detect at least moderate differences between groups. The environment in which subjects were studied (e.g., 24-hour monitored care for 10 consecutive weeks) provided a natural laboratory to study adolescent behavior independent of familial or deviant peer-group influences.

4.4. Clinical implications

Smoking is associated with increased clinical vulnerabilities including ADHD and more trauma. Quitting smoking did not adversely affect AOD outcomes and was associated with better prognosis of lowered AOD cravings for youths with and without ADHD. Adolescent patients who smoke and those with ADHD in particular should be routinely offered NRT and warned about the link between tobacco use and higher AOD cravings. Low-cost, non-pharmaceutical approaches like service may enhance quit attempts during treatment, aid with attention deficit, and support smoking cessation long-term. Facilitation of youth engagement in service activities may allow more ADHD smokers to benefit. Future research is recommended to determine which ADHD symptoms are aggravated in response to smoking cessation and respond to 12-step involvement.

Acknowledgements

References

American Cancer Society. [Accessed on August 5, 2015] Prescription drugs to help you quit smoking. 2015. Retrieved from http://www.cancer.org/healthy/stayawayfromtobacco/guidetoquittingsmoking/guide-to-quitting-smoking-help-phys-rx-drugs

American Psychiatric Association (APA). Diagnostic and statistical manual of mental disorders, 4th edition (DSM-IV-TR). APA; Washington, DC: 2000.

Arnaud M, Malet L, Teissedre F, Izaute M, Moustafa F, Geneste J, Brousse G. Validity study of Kessler's psychological distress scales conducted among patients admitted to French emergency department for alcohol consumption-related disorders. Alcoholism, Clinical and Experimental Research. 2010; 34:1127–1302.

Biederman J, Faraone SV, Mick E, Williamson S, Wilens T, Spencer TJ, Zallen B. Clinical correlates of ADHD in females. Journal of American Academy of Child and Adolescent Psychiatry. 1999; 38:966–975.

Biederman J, Monuteaux MC, Mick E, Spencer T, Wilens TE, Silva JM, Faraone SV. Young adult outcome of attention deficit hyperactivity disorder: A controlled 10-year follow-up study. Psychological Medicine. 2006; 36:167–179. [PubMed: 16420713]

Bobo JK, Husten C. Sociocultural influences on smoking and drinking. Alcoholism, Clinical and Experimental Research. 2000; 24:225–232.

Bouza C, Magro A, Muñoz A, Amate JM. Efficacy and safety of naltrexone and acamprosate in the treatment of alcohol dependence: A systematic review. Addiction. 2004; 99:811–828. [PubMed: 15200577]

Brown RA, Strong DR, Abrantes AM, Myers MG, Ramsey SE, Kahler CW. Effects on substance use outcomes in adolescents receiving motivational interviewing for smoking cessation during psychiatric hospitalization. Addictive Behaviors. 2009; 34:887–891. [PubMed: 19342179]

Brown SA, Vik PW, Patterson TL, Grant I, Schuckit MA. Stress, vulnerability and adult alcohol relapse. Journal of Studies on Alcohol. 1995; 56:538–545. [PubMed: 7475034]

Callaghan RC, Brewster JM, Johnson J, Taylor L, Beach G, Lentz T. Do total smoking bans affect the recruitment and retention of adolescents in inpatient substance abuse treatment programs? A 5-year medical chart review, 2001–2005. Journal of Substance Abuse Treatment. 2007; 33:279–285. [PubMed: 17376637]

Cavazos-Rehg PA, Krauss MJ, Spitznagel EL, Grucza RA, Bierut LJ. Youth tobacco use type and associations with substance use disorders. Addiction. 2014; 109:1371–1380. [PubMed: 24717237]

Center for Disease Control and Prevention (CDC). [Accessed on March 7, 2015] Vital signs: Tobacco use. 2010a. Retrieved from http://www.cdc.gov/vitalsigns/tobaccouse/smoking

Center for Substance Abuse Treatment. Substance abuse treatment for persons with co-occurring disorders. Substance Abuse and Mental Health Services Administration; Rockville, MD: 2005. p. 340Treatment improvement protocol (TIP) series 42DHHS publication no. (SMA) 05-3992

Centers for Disease Control and Prevention (CDC). Tobacco use among middle and high school students-U.S., 2000–2009. MMWR. 2010b; 59:1063–1068. [PubMed: 20798668]

Cohen, J. Statistical power analysis for the behavioral sciences. 2nd ed.. Lawrence Earlbaum Associates, Inc; Hillsdale, NJ: 1988.

Cooney JL, Cooney NL, Pilkey DT, Kranzler HR, Oncken CA. Effects of nicotine deprivation on urges to drink and smoke in alcoholic smokers. Addiction. 2003; 98:913–921. [PubMed: 12814497]

Deas D, Roberts JS, Randall CL, Anton RF. Confirmatory analysis of the adolescent obsessive compulsive drinking scale (A-OCDS): A measure of craving and problem drinking in adolescents/young adults. Journal of the National Medical Association. 2002; 94:879–887. [PubMed: 12408692]

DiClemente CC, Schlundt D, Gemmell L. Readiness and stages of change in addiction treatment. The American Journal on Addictions. 2004; 13:103–119. [PubMed: 15204662]

DiFranza JR, Savageau JA, Fletcher K, Ockene JK, Rigotti NA, McNeill AD, Wood C. Measuring the loss of autonomy over nicotine use in adolescents: The DANDY study. Archives of Pediatrics & Adolescent Medicine. 2002; 156:397–403. [PubMed: 11929376]

Donohue B, Azrin NH, Strada MJ, Silver NC, Teichner G, Murphy H. Psychometric evaluation of self- and collateral timeline follow-back reports of drug and alcohol use in a sample of drug-abusing and conduct disordered adolescents and their parents. Psychology of Addictive Behaviors. 2004; 18:184–189. [PubMed: 15238061]

Dozois DJA, Westra HA, Collins KA, Fung TS, Garry JK. Stages of change in anxiety: Psychometric properties of the University of Rhode Island change assessment (URICA) scale. Behaviour Research and Therapy. 2004; 42:711–729. [PubMed: 15081886]

Elliott, DS.; Huizinga, D.; Menard, S. Multiple problem youth: delinquency, substance use, and mental health problems. Springer-Verlag; New York: 1989.

Escobedo LG, Marcus SE, Holtzman D, Giovino GA. Sports participation, age at smoking initiation, and the risk of smoking among US high school students. JAMA. 1993; 269:1391–1395. [PubMed: 8441214]

Friend KB, Pagano ME. Changes in cigarette consumption and drinking outcomes: Findings from project MATCH. Journal of Substance Abuse Treatment. 2005a; 29:221–229. [PubMed: 16183471]

Friend KB, Pagano ME. Smoking cessation and alcohol consumption in individuals in treatment for alcohol use disorders. Journal of Addictive Diseases. 2005b; 24:61–75.

Friend KB, Pagano ME. Timevarying predictors of smoking cessation among individuals in treatment for alcohol abuse and dependence: Findings from project MATCH. Alcohol and Alcoholism. 2007; 42:234–2340. [PubMed: 17526633]

Gaub M, Carlson CL. Gender differences in ADHD: A meta-analysis and critical review. Journal of American Academy of Child and Adolescent Psychiatry. 1997; 36:1036–1046.

Gil BS, Bennett DL. Addiction professionals' attitudes regarding treatment of nicotine dependence. Journal of Substance Abuse Treatment. 2000; 19:317–318. [PubMed: 11281125]

Gottesman, D.; Wile, S. Juvenile justice in the U.S. facts for policymakers. Columbia University, National Center for Children in Poverty; New York, NY: 2011.

Grant BF, Hasin DS, Chou SP, Stinson FS, Dawson DA. Nicotine dependence and psychiatric disorders in the United States. Archives of General Psychiatry. 2004; 61:1107–1115. [PubMed: 15520358]

Greenfield BL, Tonigan JS. The General Alcoholics Anonymous Tools of Recovery: the adoption of 12-step practices and beliefs. Psychology of Addictive Behaviors. 2013; 27:553–561. [PubMed: 22867293]

Grisso, T.; Barnum, R. User's manual and technical reports. Univ. MA Medical School; Boston, MA: 2000. Massachusetts youth screening instrument-second version.

Hahn EJ, Warnick TA, Plemmons S. Smoking cessation in drug treatment programs. Journal of Addictive Diseases. 1999; 18:89–101.

Hser YI, McCarthy WJ, Anglin MD. Tobacco use as a distal predictor of mortality among long-term narcotics addicts. Preventive Medicine. 1994; 23:61–69. [PubMed: 8016035]

Hurt RD, Offord KP, Croghan IT, Gomez-Dahl L, Kottke TE, Morse RM, Melton LJ. Mortality following inpatient addictions treatment. Role of tobacco use in a community-based cohort. JAMA. 1996; 275:1097–1103. [PubMed: 8601929]

Jain S, Jain R, Islam J. Do stimulants for ADHD increase the risk of substance use disorders? Current Psychiatry. 2011; 10:20–24.

Joseph AM, Willenbring ML, Nugent SM, Nelson DB. A randomized trial of concurrent versus delayed smoking intervention for patients in alcohol dependence treatment. Journal of Studies on Alcohol. 2004; 65:681–691. [PubMed: 15700504]

Kaminer Y, Burleson J, Goldberger R. Cognitive-behavioral coping skills and psychoeducation therapies for adolescent substance abuse. Journal of Nervous and Mental Disease. 2002; 190:737–745. [PubMed: 12436013]

Kandel DB, Chen K. Extent of smoking and nicotine dependence in the United States: 1991–1993. Nicotine & Tobacco Research. 2000; 2:263–274. [PubMed: 11082827]

Kann L, Brener ND, Warren CW, Collins JL, Gioviono GA. An assessment of the effect of data collection setting on the prevalence of health risk behaviors among adolescents. The Journal of Antibiotics. 2002; 31:327–335.

Kelly JF, Urbanoski K. Youth recovery contexts: The incremental effects of 12-step attendance and involvement on adolescent outpatient outcomes. Alcoholism, Clinical and Experimental Research. 2012; 36:1219–1229.

Kelly JF, Pagano ME, Stout RL, Johnson SM. Influence of religiosity on 12-step participation and treatment response among substance-dependent adolescents. Journal of Studies on Alcohol and Drugs. 2011; 72:1000–1011. [PubMed: 22051214]

Kleinjan M, Vitaro F, Wanner B, Brug J, Van den Eijnden RJ, Engels RC. Predicting nicotine dependence profiles among adolescent smokers. BMC Public Health. 2012; 12:196–208. [PubMed: 22424115]

Kollins SH, McClernon FJ, Fuemmeler BF. Association between smoking and attention-deficit/hyperactivity disorder symptoms in a population-based sample of young adults. Archives of General Psychiatry. 2005; 62:1142–1147. [PubMed: 16203959]

Lambert NM, Hartsough CS. Prospective study of tobacco smoking and substance dependencies among samples of ADHD and non-ADHD participants. Journal of Learning Disabilities. 1998; 31:533–544. [PubMed: 9813951]

Lee MT, Pagano ME, Johnson BR, Post SG. Love and service in adolescent addiction recovery. Alcoholism Treatment Quarterly. 2016; 34:197–222. [PubMed: 27482142]

MacKillop J, Miranda R, Monti PM, Ray LA, Murphy JG, Rohsenow DJ, Gwaltney CJ. Alcohol demand, delayed reward discounting, and craving in relation to drinking and alcohol use disorders. Journal of Abnormal Psychology. 2010; 119:106–114. [PubMed: 20141247]

Miller, WR.; Wilbourne, PL.; Hettema, J. What works? A summary of alcohol treatment outcome research. In: R. K.; W. R., editors. Handbook of alcoholism treatment approaches: effective alternatives. Allyn & Bacon; Boston, MA: 2003. p. 13-63.

Mrug S, Hoza B, Pelham WE, Gnagy EM, Greiner AR. Behavior and peer status in children with ADHD: Continuity and change. Journal of Attention Disorders. 2007; 10:359–371. [PubMed: 17449835]

Myers MG, Kelly JF. Cigarette smoking among adolescents with alcohol and other drug use problems. Alcohol Research & Health. 2006; 29:221–227. [PubMed: 17373413]

Naqvi NH, Rudrauf D, Damasio H, Bechara A. Damage to the insula disrupts addiction to cigarette smoking. Science. 2007; 315:531–534. [PubMed: 17255515]

Pagano ME, Kelly JF, Scur MD, Ionescu RA, Stout RL, Post SG. Assessing youth participation in AA-related helping: Validity of the service to others in sobriety questionnaire (SOS) in an adolescent sample. The American Journal on Addictions. 2013; 22:60–66. [PubMed: 23398228]

Pagano ME, Krentzman AR, Onder CC, Baryak JL, Murphy JL, Zywiak WH, Stout RL. Service to others in sobriety (SOS). Alcoholism Treatment Quarterly. 2010; 28:111–127. [PubMed: 21399711]

Pagano ME, Zemore SE, Onder CC, Stout RL. Predictors of initial AA-related helping: Findings from project MATCH. Journal of Studies on Alcohol and Drugs. 2009; 70:117–125. [PubMed: 19118400]

Pliszka SR, Greenhill LL, Crismon ML, Sedillo A, Carlson C, Conners CK, Toprac MG. The Texas Children's medication algorithm project: Report of the Texas consensus panel on medication treatment of children attention-deficit/hyperactivity disorder. Part II: Tactics. Journal of the American Academy of Child and Adolescent Psychiatry. 2000; 39:920–927. [PubMed: 10892235]

Rey JM, Starling J, Wever C, Dossetor DR, Plapp JM. Inter-rater reliability of global assessment of functioning in a clinical setting. Journal of Child Psychology and Psychiatry. 1995; 36:787–792. [PubMed: 7559845]

Rohsenow DJ, Monte PM. Does urge to drink predict relapse after treatment? Alcohol Research & Health. 1999; 23:225–232. [PubMed: 10890818]

SAS Institute Inc.. SAS/STAT® 9.2. User's guide. SAS Institute Inc; Cary, NC: 2008.

Sheehan DV, Lecrubier Y, Sheehan KH, Amorim P, Janavas J, Weiller E, Dunbar GC. The mini-international interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. Journal of Clinical Psychiatry. 1998; 59:22–33.

Swindle RW, Peterson KA, Paradise MJ, Moos RH. Measuring substance abuse program treatment orientations. Journal of Substance Abuse. 1995; 7:61–78. [PubMed: 7655312]

Thorlindsson T, Vilhjalmsson R, Valgeirsson G. Sport participation and perceived health status: A study of adolescents. Social Science & Medicine. 1990; 31:551–556. [PubMed: 2218637]

Waldron HB, Slesnick N, Brody JL, Turner CW, Peterson TR. Treatment outcomes for adolescent substance abuse at 4 and 7 month assessments. Journal of Consulting and Clinical Psychology. 2001; 69:802–813. [PubMed: 11680557]

Wise BK, Cuffe SP, Fischer T. Dual diagnosis and successful participation of adolescents in substance abuse treatment. Journal of Substance Abuse Treatment. 2001; 21:161–165. [PubMed: 11728790]

Table 1

Intake profile.

	Total	Smoking	Not smoking
Intake variable	195 (100%)	149 (76%)	46 (24%)
Background			
Male (%)	93 (48%)	71 (48%)	22 (48%)
Minority (%)	59 (30%)	46 (31%)	13 (28%)
Hispanic (%)	15 (8%)	13 (9%)	2 (4%)
Age (M, SD)	16.2 (1.1)	16.3 (1.1)	15.3 (1.0)
Single parent (%)	98 (50%)	75 (50%)	23 (50%)
Parent education <BA+ (%)	144 (74%)	105 (70%)	39 (84%)
Rural/Small town (%)	103 (53%)	79 (53%)	24 (52%)
Clinical			
Good health (%)	133 (68%)	101 (68%)	32 (70%)
ADHD (%)	113 (58%)	97 (65%)[*]	16 (35%)
Suicide attempt history (%)	46 (24%)	40 (27%)[*]	6 (13%)
Trauma experiences (m, SD)	1.7 (1.5)	1.9 (1.4)[*]	1.2 (1.4)
Violent offenses (m, SD)	1.7 (1.6)	1.8 (1.7)	1.5 (1.3)
AOD severity			
Readiness for change (M, SD)	11.0 (2.5)	10.9 (2.5)	11.2 (2.5)
Years of use (M, SD)	3.4 (1.5)	3.4 (1.5)	3.3 (1.6)
12-step			
Meeting attendance (M, SD)	2.8 (1.8)	5.3 (1.7)	4.7 (1.8)
Step-work (M, SD)	63.5 (13.7)	62.0 (14.1)	65.0 (12.1)
Service (M, SD)	26.0 (10.4)	25.8 (10.1)	26.2 (10.5)
Outcomes at intake			
Percent days using (M, SD)	0.6 (0.3)	0.6 (0.3)	0.5 (0.2)
AOD cravings (M, SD)	33.5 (11.3)	33.8 (11.4)	32.6 (11.1)
Global functioning (M, SD)	49.5 (2.7)	49.6 (2.7)	49.2 (2.3)

Note: ADHD = attention deficit hyperactivity disorder (all types); minority = black; AOD = alcohol and other drugs.

[*] $p < .05$.

Table 2

Predictors of Smoking Cessation.

Intake variable	Estimate(se)	X^2	p	OR	95% CI
Background					
Male	0.06 (0.57)	0.01	0.91	0.66	0.29, 1.50
Black	0.47 (0.51)	0.83	0.36	0.66	0.27, 1.67
Hispanic	0.89 (0.78)	1.29	0.25	0.29	0.07, 1.22
Age	0.08 (0.18)	0.17	0.67	0.95	0.66, 1.38
Single parent	0.55 (0.45)	1.45	0.22	0.57	0.26, 1.28
Parent education	0.08 (0.48)	0.02	0.86	1.03	0.75, 1.44
Rural/Small town	0.87 (0.58)	2.23	0.17	0.42	0.18, 1.03
Clinical					
Health	−0.08 (0.51)	0.02	0.87	0.92	0.39, 2.19
ADHD	2.09 (0.47)	19.33	****	4.12	3.00, 6.01
Suicide attempt history	0.37 (0.47)	0.60	0.43	0.64	0.26, 1.55
Trauma experiences	−0.22 (0.15)	2.15	0.14	1.20	0.91, 1.60
Violent offenses	0.07 (0.13)	0.25	0.61	0.78	0.59, 1.05
AOD severity					
Readiness for change	0.15 (0.10)	2.08	0.14	0.87	0.54, 1.41
Years of use	0.34 (0.62)	0.30	0.58	0.81	0.26, 2.52
12-step					
Meeting attendance	−0.03 (0.02)	0.03	0.84	0.87	0.54, 1.41
Step-work	−0.03 (0.02)	1.86	0.17	0.87	0.54, 1.41
Service	0.01 (0.02)	0.24	0.62	0.91	0.56, 1.45
Outcomes at intake					
Percent days using	0.66 (0.79)	0.70	0.39	0.87	0.54, 1.41
AOD cravings	0.01 (0.01)	0.11	0.73	0.87	0.54, 1.41
Global functioning	0.19 (0.11)	1.56	0.21	0.91	0.56, 1.45
Nicotine use					
#days smoking	−0.02 (0.02)	0.46	0.49	1.01	0.98, 1.06

Note: ADHD = attention deficit/hyperactivity disorder (all types); AOD = alcohol and other drugs; OR= odds ratio; CI= confidence interval.

****
 $p < .0001$.

Table 3

Impact of smoking cessation on treatment response with ADHD comorbidity.

| | Total | Continuing smoking | | Smoking cessation | |
| | | 74 (50%) | | 75 (50%) | |
		No ADHD	ADHD	no ADHD	ADHD
Treatment response variable	149 (100%)	13 (18%)	61 (82%)	39 (52%)	36 (48%)
Treatment duration (weeks)	10.3 (2.4)	10.7 (2.5)	9.9 (2.8)	10.4 (2.0)	10.6 (1.9)
12-step					
Meeting attendance	25.9 (4.0)	26.4 (5.1)	23.0 (3.4)	27.5 (3.9)	25.5 (4.3)
Step-work	72.5 (11.3)	77.5 (3.3)[a]	66.5 (2.5)[c]	70.5 (2.7)[b]	70.5 (2.9)[b]
Service	35.4 (8.8)	34.9 (2.5)[a]	26.9 (1.6)[b]	32.4 (1.9)[a]	31.6 (2.1)[a]
Outcomes at discharge				1	
Percent days using	0.2 (0.3)	0.2 (0.3)	0.2 (0.4)	0.2 (0.4)	0.2 (0.3)
AOD cravings	9.4 (8.8)	10.7 (2.9)[a]	10.6 (1.8)[a]	4.0 (2.1)[b]	6.1 (2.3)[b]
Global functioning	61.3 (6.0)	59.9 (1.6)	56.6 (1.1)	59.1 (1.3)	58.6 (1.4)

Note: groups sharing the same are letter are not significantly different; adjusted for background, clinical, alcohol/drug severity, nicotine use, and intake assessment of outcome; ADHD=attention deficit/hyperactivity disorder (all types).