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Smokers versus snorters: Do treatment outcomes differ according to route of cocaine administration?

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Abstract

Smoking cocaine achieves maximal concentration and effect far more rapidly than through the intranasal ('snorting') route, and it is associated with greater propensity for dependence and more severe consequences. However, very little is known about differences in treatment outcome according to route of administration. This study compared treatment outcomes, such as frequency of cocaine use and Addiction Severity Index (ASI) composite scores, by primary route of cocaine administration (smoking vs. intranasal) among a pooled sample of 412 cocaine-dependent individuals participating in one of five randomized clinical trials. The majority (80%) reported smoking as their primary route of cocaine administration. Overall, results indicated better cocaine use outcomes both during the treatment phase and through a 12-month follow-up period for intranasal users compared to smokers, although not all differences reached statistical significance. Intranasal users remained in treatment longer [$F(1,408) = 3.55$, $p < .05$], and showed a trend toward achieving longer periods of sustained abstinence within treatment [$F(1,378) = 2.68$, $p = .08$], as well as less use over time during the follow-up period than smokers (Time x Route: $t = 1.87$, $p = .06$). Also, intranasal users' ASI cocaine composite score decreased more than smokers, but there were overall decreases in the other ASI domains for all participants over the course of the study period. These results suggest that intranasal users may achieve better cocaine use outcomes than smokers, yet this doesn't appear to translate to differential changes in the severity of problems experienced in other life areas.

Keywords

cocaine; route of administration; treatment outcome; problem severity

Differences in the effect of cocaine based on the route of administration have been an interest of researchers and clinicians for the past few decades. Intranasal administration of the powder form of cocaine (cocaine hydrochloride) was most popular in the United States up until the early-1980s when a smokeable form of cocaine (cocaine base or 'crack') became more widespread, and quickly reached epidemic proportions leading to greater scientific and societal attention (Hatsukami & Fischman, 1996). Although the underlying parent compound remains the same and has a similar metabolic profile regardless of the form (Cone, 1995; Hatsukami & Fischman, 1996), cocaine's effects vary with the route of administration (e.g., intraveneous, inhalation, intranasal, oral). These differential effects contribute to cocaine's addictive properties and associated consequences.

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Several lines of research have demonstrated the speed of penetration and development of peak plasma concentration are highly dependent upon the route of cocaine administration (Balster & Schuster, 1973; Bradberry, 2002; Cone, 1995; Javaid, Fischman, Schuster, Dekirmenjian, & Davis, 1978), with intravenous or inhalation (i.e., 'smoking') achieving maximal concentration and effect most rapidly, followed by intranasal (i.e., 'snorting') and oral ingestion. Coinciding with the physiological effects, the subjective effects of smoked cocaine occur much faster than intranasal ingestion, and users of smoked cocaine tend to report a more intense 'high' than intranasal or intravenous users (Evans, Cone, & Henningfield, 1996; Foltin & Fischman, 1991; Javaid et al., 1978; Volkow et al., 2000). The differences in the immediacy and magnitude of a drug's effect has been considered an important determinant towards its potential for addiction (Samaha & Robinson, 2005), and evidence suggests these differences correspond to cocaine's greater abuse liability, propensity for dependence, and more severe consequences when smoked or injected compared to when administered intranasally (Chen & Anthony, 2004; Chen & Kandel, 2002; Hatsukami & Fischman, 1996; Verebey & Gold, 1988). However, despite the likelihood for greater abuse, dependence, and consequences, it remains unclear whether smoking cocaine, rather than snorting it, is associated with differential treatment outcomes.

Cocaine users, regardless of their route of administration, are difficult to treat. There is still no approved pharmacotherapy (Borders et al., 2008); behavioral treatments for cocaine dependence, particularly cognitive-behavioral and contingency management, produce a moderate effect size, yet the studies for cocaine treatment yield fairly large dropout rates compared to other substances (Dutra et al., 2008; Patrizi et al., 2006). Treatment completion rates, although poor across a range of substance abuse treatments, are often less than 50% in cocaine clinical trials (Stotts et al., 2007). Few studies have directly compared treatment outcomes according to the route of cocaine administration (likely due to small sample sizes for certain routes of administration); of those that have, the results are mixed. Findings from the Drug Abuse Treatment Outcome Study (DATOS; Flynn, Craddock, Hubbard, Anderson, & Etheridge, 1997), a large multisite national treatment evaluation, indicated that pretreatment crack use was negatively associated with the likelihood of post-treatment abstinence (Hser, Joshi, Anglin, & Fletcher, 1999), crack users had lower treatment retention rates than non-crack users (Rowan-Szal, Joe, & Simpson, 2000), and the duration of relapse after treatment was longer for crack users than powder cocaine users (Grella, Hser, & Hsieh, 2003).

Conversely, other large multisite national studies reported few outcome differences for users of crack and powder cocaine. In the National Treatment Improvement Evaluation Study (NTIES; Meszaros et al., 2011), substantial reductions in use of both crack and cocaine powder were found following treatment, with roughly a 50% reduction in the number of participants reporting drug use through either route (without differences between them) during the 12-months before and after treatment (Richard W. Foltin, Fischman, & Levin, 1995). Data from the National Treatment Outcome Research Study (NTORS; Gunter, Philibert, & Hollenbeck, 2009) indicated significant increases in cocaine abstinence rates at 1-year following treatment for both crack and powder cocaine users in residential treatment, but abstinence rates at the 4-5 year follow-up time point were maintained for cocaine powder users only, whereas crack users abstinence rates returned to the rates at intake (Stein, 1999). Interestingly, analyses revealed a more complex pattern of change for crack users, such that users of crack at intake actually reduced by more than half at the follow-up point, whereas a gradual increase in crack use occurred for those not using crack at intake, indicating the return to baseline abstinence rates for crack users was mostly due to new users of crack at the follow-up point (Brickner, Willard, Eichhorn, Black, & Grayburn, 1991). However, many of these large-scale multisite studies predominantly included individuals seeking treatment for opiate dependence, many of which were also cocaine abusers, and

treatments were provided in various settings, such as methadone maintenance, residential, and correctional facilities. Therefore there is little evidence of treatment outcome differences according to route of cocaine administration for individuals seeking treatment for cocaine dependence in community outpatient treatment facilities.

This study aimed to examine baseline and treatment outcome differences according to participants' primary route of cocaine administration, using data collected from five different randomized controlled trials evaluating treatments for cocaine dependence in several outpatient settings. Given the prior evidence that smokers of crack cocaine have more severe dependence and consequences than intranasal users of cocaine hydrochloride, we expected the smokers to have greater problem severity upon treatment entry, and worse treatment outcomes at the end of treatment and through a follow-up period than those who were intranasal users.

Method

Participants

Participants were drawn from a pooled sample of outpatient treatment-seeking cocaine users who participated in one of five randomized controlled trials examining various forms of treatment for cocaine dependence conducted by our research group at Yale over the past 20 years. The following inclusion criteria for the trials were identical, such that all participants: (1) were at least 18 years of age or older, (2) met Diagnostic and Statistical Manual - fourth edition (DSM-IV; American Psychiatric Association, 1994) criteria for current (past 30 days) cocaine dependence and reported use of cocaine within the month prior to screening, (3) did not meet DSM-IV criteria for a lifetime psychotic or bipolar disorder, and (4) were not physically dependent on alcohol such that detoxification was necessary.

Assessments

Although assessments across the five trials varied somewhat, all trials had a similar assessment schedule that included measurements at a pre-treatment time point (capturing data for the 28-days prior to treatment initiation), weekly during the active treatment phase, at the end-of-treatment time point, and at multiple intervals during the follow-up phase (1-, 3-, 6-, and 12-months post treatment). Also, all trials utilized a substance use calendar similar to the Time Line Follow-Back (Fals-Stewart, O'Farrell, Freitas, McFarlin, & Rutigliano, 2000; Sobell & Sobell, 1992), for assessing self-reported substance use throughout the entire study period, as well as urine toxicology screens conducted at each research visit. The frequency of urine samples collected during the active treatment phase varied across trials depending on the setting, but all were collected at least weekly. Additionally, all trials included a brief version of the Addiction Severity Index (ASI; McLellan et al., 1992) for measuring the severity of problems in non-drug using domains, such as medical, employment, legal, family and social relationships, and psychiatric. The ASI was administered at pre-treatment, monthly during the treatment phase, and at each follow-up assessment point.

Treatments

The five independent randomized controlled trials investigated various behavioral and pharmacologic treatments for cocaine dependence in different populations (e.g., general outpatient, methadone maintenance, comorbid alcohol and cocaine dependent). Described in detail elsewhere, the study treatments were:

Study A **(Carroll, Nich, Ball, McCance-Katz, & Rounsaville, 1998; Carroll et al., 2000)—**12-week trial comparing: (1) Cognitive Behavioral Therapy (CBT) alone, (2)

Twelve-Step Facilitation (TSF) alone, (3) CBT plus disulfiram, (4) TSF plus disulfiram, and (5) disulfiram plus clinical management. The treatments were provided in an outpatient treatment setting for cocaine-dependent individuals with comorbid alcohol abuse or dependence (N = 91).

***Study B* (Carroll et al., 2004): 12-week trial comparing—**(1) CBT plus disulfiram, (2) CBT plus placebo, (3) Interpersonal Therapy (IPT) plus disulfiram, and (4) IPT plus placebo. Treatments were provided in a general outpatient setting with cocaine-dependent individuals (N = 107).

***Study C* (Carroll et al., in press)—**12-week trial comparing: (1) TSF plus disulfiram, (2) TSF plus placebo, (3) disulfiram plus standard counseling, and (4) placebo plus standard counseling. Treatments were provided in an outpatient methadone clinic for individuals receiving methadone maintenance for opiate dependence, who were also cocaine dependent (N = 112).

***Study D* (Carroll et al., 2008; Carroll et al., 2009)—**8-week trial evaluating the effectiveness of a computer-delivered version of cognitive behavioral therapy (CBT4CBT) as an adjunct to treatment as usual in a general outpatient sample of substance users. Treatments were provided in a general outpatient setting with individuals having a range of substance use disorders. Only individuals with primary cocaine dependence were included in the current analyses (N = 38).

***Study E* (Carroll, Petry, Eagan, Shi, & Ball, 2013)—**12-week trial comparing: (1) disulfiram plus Contingency Management (CM), (2) disulfiram alone, (3) placebo plus CM, and (4) placebo alone. Participants in each of the four treatment arms also received weekly individual CBT. Treatments were provided in a general outpatient treatment setting with cocaine-dependent individuals (N = 85).

Data Analysis

The pooled sample was divided according to participants' self-report of their primary route of cocaine administration (oral, intranasal, intravenous, smoking) at the time of screening. However, only the participants reporting intranasal or smoking routes were included in the following analyses because of the focus of this study and the small sample of participants reporting either oral (n=1) or intravenous administration (n=20). Chi-square and one-way Analysis of Variance (ANOVA) tests were used to evaluate differences according to baseline demographic characteristics, as well as substance use and ASI data at the pre-treatment time point. Demographic characteristics, such as race, age, and gender, as well as study source were included as covariates in subsequent analyses. Because there is no universally agreed upon cocaine use outcome measure (Donovan et al., 2012), several within-treatment cocaine use measures were evaluated across the two groups. These included dichotomous measures, such as achievement of abstinence for at least 21 consecutive days, as well as continuous measures commonly reported in the cocaine treatment literature (Donovan et al., 2012; Dutra et al., 2008; McKay et al., 2001) such as the percentage of days abstinent and the maximum consecutive days of abstinence (for a details on the calculation of each outcome measure, see Carroll, Kiluk, et al., 2013). Post-treatment cocaine use was indicated by the average number of self-reported cocaine use days during the 28-day period preceding the follow-up interview (1-, 3-, 6-, and 12-months post-treatment). Repeated measures ANOVA were run on pre- to post-treatment outcomes and random effects regression analyses were utilized to examine longitudinal changes according to the route of administration. We also examined differences for non-cocaine use treatment outcomes, such as the number of days retained in treatment, and problem severity from the

ASI (which was examined at each individual assessment point as well as longitudinally). Lastly, we conducted additional analyses excluding the sample of participants from Study C, in order to evaluate outcomes only among those in outpatient treatment for primary cocaine dependence.

Results

Baseline Characteristics

A total sample of 412 cocaine-dependent treatment-seekers were included in these analyses, with nearly 80% (n = 328) reporting smoking, and 20% (n = 84) reporting intranasal as their primary route of administration. The distribution by route of administration did not differ across the five study samples ($\chi^2 = 1.32$, p = ns), with the proportion of smokers ranging from 77% in *Study A* to 84% in *Study E*. The total sample was comprised of 50% Caucasian, 41% African American, 8% Hispanic, and 2% self-identified as other racial categories (Native American, multiracial, or other). Differences on baseline characteristics according to whether individuals reported intranasal or smoking as their primary route of administration are presented in Table 1. There were significant variations in route of administration by ethnicity/race, with the majority (60%) of intranasal users identifying as Caucasian, whereas primary cocaine smokers consisted of roughly equal proportions of Caucasians and African Americans. Examination of route of administration within each racial category revealed 91% of African Americans and 76% of Caucasians reported smoking as their primary route of administration, whereas 56% of Hispanics reported smoking. Overall, those who reported smoking cocaine were more likely to be single/not cohabiting (74% vs. 63%), more likely to have an anxiety disorder during their lifetime (12% vs. 2%), and also reported more arrests and prior treatments for substance abuse than those who reported intranasal cocaine use. The intranasal users were younger, began using cocaine at an earlier age, reported more days of paid work and fewer employment problems in the 28 days prior to treatment initiation, yet trended toward having a greater prevalence of antisocial personality disorder than smokers. However, there were no other differences on ASI areas between the two groups.

Because the route of administration differed across racial categories we repeated analyses on the significant baseline characteristics while controlling for race. Also, because 91% of the sample consisted of either Caucasians or African Americans, we ran several additional analyses to examine any interaction between route of administration and these racial categories on the baseline characteristics. Results indicated that the ASI employment composite, number of days paid for working in the past month, age of first cocaine use, and the number of prior inpatient and outpatient treatments, remained significantly different according to the route of administration while controlling for race. However, participant age and the total number of prior arrests no longer differed according to route of administration when race was included in the model. Subsequent analyses on arrest history revealed a significant interaction between race (Caucasian & African American only) and route of administration, $F(1,368) = 8.31$, $p<.01$. Although the number of prior arrests did not differ for Caucasians and African Americans as a whole ($M(SD) = 5.9(8.9)$ vs. $5.2(7.8)$, respectively), Caucasian smokers reported more arrests than African American smokers ($M(SD) = 6.9(9.8)$ vs $4.8(7.3)$, respectively), but African American intranasal users reported more arrests than Caucasian intranasal users ($M(SD) = 8.2(11.6)$ vs $2.8(3.3)$, respectively).

Within-treatment outcomes

Within-treatment outcome measures, controlling for racial category, age, gender, and study source are displayed in Table 2 (the number of prior inpatient and outpatient treatments were not included as covariates because these data were not available on all participants and resulted in a reduced sample size). In general, intranasal users demonstrated better outcomes

than smokers, although not all differences reached a level of statistical significance. In terms of statistically significant differences, intranasal users stayed in treatment longer than smokers (approximately 7 days longer), and had a greater number of maximum days abstinent during the last two weeks of treatment than smokers (10.1 vs. 8.4 days). Also, there was a trend toward intranasal users achieving a greater number of maximum consecutive days abstinent (27.4 vs. 21.6 days), and toward more intranasal users achieving at least two weeks of consecutive abstinence at any time during the treatment period (60% vs. 48%), however these differences did not reach a level of statistical significance ($p<.10$) after controlling for covariates. There were no other statistically significant cocaine use outcome differences, yet nearly all results were in the same direction, with intranasal users having better outcomes than smokers.

The average ASI composite scores across time points during the trials' treatment phase (collected at the end of month 1, month 2, and month 3 of treatment period) are also displayed in Table 2. After controlling for race, age, gender, and study source only the employment composite score differed between the groups, [$F(1,354) = 572$, $p<.01$], with smokers having a higher average composite score (i.e., more severe problems) than intranasal users during the treatment period. However, evaluating the change over time from pre-treatment through the end of the treatment using random effects regression models (number of observations = 1,648), an interaction between time and route of administration was found for the employment composite (Time x Route: $t = 2.34$, $p<.05$), such that the severity of employment problems increased over time for the intranasal users, yet slightly decreased for the smokers. Random effects regression also revealed significant main effects of time for the alcohol composite ($t = -1.62$, $p<.01$), cocaine composite ($t = -5.66$, $p<.001$), other drugs composite ($t = 2.30$, $p<.05$), and the family/social composite ($t = -2.64$, $p<.01$). These time effects indicated a decrease in severity for the domains of cocaine, alcohol, and family/social problems, however an increase in problem severity over time was present for the other drugs domain.

In order to evaluate treatment outcomes among only participants in outpatient treatment for primary cocaine dependence, we excluded the sample of participants from Study C, which consisted of participants receiving methadone maintenance therapy for primary opiate dependence (n = 97). This resulted in a sample of 315 participants, with 79% (n = 250) reporting smoking and 21% (n = 65) reporting intranasal cocaine use, similar to the proportions from the full sample. Results indicated similar outcome differences as noted in the full sample, in addition to several other differences in this reduced sample. Again, intranasal users remained in treatment longer than smokers with a slightly larger mean difference (approximately 10 days longer) when the methadone maintained sample was excluded [$F(1,309) = 4.29$, $p<.05$]. Also, there remained a trend toward intranasal users achieving a greater number of maximum consecutive days abstinent, as well as new trends that indicated intranasal users achieved a greater percentage of days abstinent than smokers [$F(1,278) = 2.72$, $p=.10$], greater percent reduction in frequency of cocaine [$F(1,234) = 3.24$, $p=.07$], and a greater percentage reached at least a 50% reduction in frequency of cocaine use than smokers (43% vs. 30%, respectively; $\chi^2 = 4.01$, $p<.05$). However, as for the full sample, there were significant effects of time for ASI composite scores in the domains reported above, yet no differences according to the route of administration.

Post-treatment outcomes

Results of one-way ANOVAs revealed no differences across the route of administration in the number of self-reported days of cocaine use during the month prior to each individual follow-up assessment point (1-, 3-, 6-, 12-months following treatment). However, when evaluated longitudinally using random effects regression analyses, controlling for race, for

the 408 participants with data on at least one of the 4 follow-up time points (number of observations = 1,539), results indicated an effect of time ($t = -2.60$, $p<.01$), and a near-significant trend toward an interaction of time by route of administration ($t = 1.87$, $p=.06$), with intranasal users reporting a greater decrease in the frequency of cocaine use over time compared to smokers. This is illustrated in Figure 1.

In terms of problem severity from the ASI, mean composite scores across each of the four follow-up assessment points (1-, 3-, 6-, 12-months post-treatment) were calculated on each of the ASI domains. Results of ANCOVA, with race as a covariate, indicated between-group differences on the average ASI cocaine composite [$F(1,346) = 6.20$, $p<.05$], with smokers having higher mean scores than intranasal users during the follow-up period ($M = 0.33$ vs. 0.26, respectively), as well as on the average ASI employment composite [$F(1,345) = 9.98$, $p<.01$], with smokers again having higher mean scores than intranasal users ($M = 0.65$ vs. 0.55, respectively). There were no other ASI composite mean differences. Random effects regression (number of observations = 1,426) did not indicate an effect of time, nor an interaction of time by route of administration on any of the ASI domains during the follow-up period.

Because there appeared to be little change over time during the 12-month follow-up period with respect to the ASI composite scores, we evaluated changes in the ASI composite scores over the entire study period (pre-treatment through final follow-up) using random effects regression analyses, which incorporated data from all available time points over the course of the 15-month study period (number of observations = 2,866). A significant effect of time was found, indicating an overall reduction in ASI composite scores for the domains of: legal ($t = -2.14$, $p<.05$); family/social ($t = -2.85$, $p<.01$); cocaine ($t = -6.98$, $p<.001$); and other drugs ($t = -2.13$, $p<.05$). A near-significant trend for a reduction over time was found for the ASI medical composite ($t = -1.79$, $p=.07$), employment composite ($t = -1.89$, $p=.06$), and psychiatric composite ($t = -1.92$, $p=.06$). Also, a significant interaction between time and route of administration was present for the ASI cocaine composite (Time x Route: $t = -2.13$, $p<.05$), indicating the cocaine composite scores reduced at a greater rate for intranasal users compared to smokers during the entire study period.

Discussion

This study is one of the first to directly compare various within-treatment and post-treatment outcomes among a large sample ($N = 412$) of outpatient cocaine dependent treatment-seekers according to whether participants' primary route of cocaine administration was intranasal ('snorting') or smoking. Overall, results indicated those reporting intranasal cocaine administration stayed in treatment longer, achieved better outcomes by the end of the treatment period, and reported less cocaine use during a 12-month period following treatment termination. These results extend prior findings on the differences between crack and powder cocaine users by providing some indication that intranasal users may achieve better cocaine-use outcomes at the end of treatment and report less use following treatment than smokers. Finally, despite the cocaine use outcome differences, the extent of problems experienced in other major life domains do not appear to change at different rates according to the route of administration.

Several of the differences between the smokers and intranasal cocaine users on baseline characteristic differences were consistent with those reported in the existing literature. In terms of race, a greater proportion of African Americans used cocaine by smoking rather than intranasally, which is consistent with data on crack use being more prevalent than intranasal use in the African American population (Hatsukami & Fischman, 1996; SAMHSA, 2007). However, the differences between smokers and intranasal users reported

here is not merely due to differences between racial groups. First, although the majority of intranasal users were Caucasian (60%), there were roughly equal proportions of African Americans and Caucasian cocaine smokers (46% vs 47%, respectively), indicating a relatively balanced sample demographically within the smokers category. This differs from other studies where smokers of cocaine were predominantly African American, making it difficult to disentangle the effects of race and route of administration (e.g., Havassy, Wasserman, & Hall, 1995). Moreover, all baseline and outcome analyses included race as a covariate thereby accounting for the effect of racial differences.

In terms of other baseline characteristics, cocaine smokers had a greater number of prior inpatient and outpatient treatments, and more severe employment problems than intranasal users, which is consistent with prior research suggesting more severe dependence, psychological, and financial problems among cocaine smokers (Gossop, Griffiths, Powis, & Strang, 1994; Hatsukami & Fischman, 1996). Smokers of cocaine had a greater number of prior arrests than intranasal users, although this difference was no longer significant after controlling for race. Surprisingly, the interaction between race and route of administration revealed African American cocaine smokers had fewer prior arrests than Caucasian smokers, yet differences were in the opposite direction for intranasal users. However, this is likely due to the small sample of African American intranasal users (n =16), with the average number of arrests being differentially affected by an outlier. Overall, both racial groups had equivalent arrest records, which differs from national data reports that indicate African Americans are arrested at higher rates than Caucasians (Snyder, 2011).

Although not all differences reached a level of statistical significance, the major finding was that virtually all within-treatment and follow-up outcome differences were in the same direction - intranasal users appeared to have better outcomes than smokers. First, intranasal users remained in treatment longer than smokers of cocaine, which was consistent even after removing the sample of methadone-maintained participants, who are likely to remain in treatment longer due to the need for daily opioid maintenance medications. While the effectiveness of treatment retention toward improvement in drug use remains questionable (Pearson et al., 2012), treatment retention is often cited as a key outcome measure and several lines of research have reported positive relationships between treatment duration and drug use outcomes (C.-Y. Chen & Lin, 2009; De Giorgi et al., 2012; Khalsa, Tashkin, & Perrochet, 1992; Ruiz, Cleary, Nassiri, & Steele, 1994; Welch, Todd, & Krause, 1991). Second, intranasal users achieved longer periods of sustained abstinence than smokers (non-significant trend), yet the percentage of days abstinent did not differ between the groups. This may reflect the underlying differences in patterns of use according to the route of administration, with intranasal use of cocaine characterized by binge episodes intermixed with continuous periods of abstinence, whereas smokers of cocaine may use at more frequent intervals (Petitti, Sidney, Quesenberry, & Bernstein, 1998). Such a pattern is also reflected in the dichotomous outcomes, such that intranasal users were more likely to achieve at least two weeks of consecutive abstinence than smokers, yet rates of complete abstinence or achievement of specified reductions in days of use (e.g., 50%, 75% reduction) did not differ. Thus, while intranasal users may report longer periods of consecutive days of abstinence during treatment, the total number of days of cocaine use may be equivalent to smokers.

Such differences in prolonged periods of abstinence do not appear to have as much effect on the severity of problems in major life domains, as does the overall frequency of cocaine use. Despite intranasal users achieving longer periods of consecutive abstinence and reducing their cocaine problem severity on the ASI more than smokers, longitudinal analyses revealed reductions in problem severity over time in virtually all domains, with no differential reduction according to the route of administration. Of note, the ASI other drug composite

score appeared to increase for both groups from pre-treatment through the treatment phase, suggesting a potential drug substitution pattern, yet analyses revealed an overall decrease in problem severity across the entire study period. By and large, results from the ASI provide further evidence that the amount and frequency of use may be a more important contributor to the level of problems/consequences than the route of cocaine administration, or form of cocaine (Hatsukami & Fischman, 1996). Although the evidence linking reductions in cocaine use and improvement in psychosocial functioning is mixed (Borders et al., 1999; Kosten, Rounsaville, & Kleber, 1987; McLellan, Luborsky, Woody, O'Brien, & Kron, 1981), this study, as well as additional findings from this pooled sample (Kiluk, Nich, & Carroll, 2013), offers some indication of overall reductions in frequency of cocaine use coupled with reductions in problem severity in multiple life domains.

One of the major limitations in this study is the disproportionate sample sizes according to route of administration, which is common in most cocaine treatment studies conducted within a given geographic region (Fox et al., 2012; Hser et al., 2006; Restrepo et al., 2007). Nearly 80% of this sample reported smoking as their primary route, leaving a much smaller comparison group of intranasal users (n=84). Thus, some of the differences (or lack thereof) may have been affected by the unequal sample size. Another limitation is the uncertainty regarding whether these differences are reflective of the form of cocaine use, as opposed to the route of administration. While the available data characterized individuals according to their primary route of cocaine administration, it remains unclear whether those who reported smoking as their primary route were using crack-cocaine or freebase. Lastly, most of the cocaine use outcome measures relied on participant self-report, which introduces a potential for inaccuracy in the data. However, the percentage of discrepancy between self-report and urine toxicology results was fairly low (8-16%) across the studies included here (Nich et al., 2013), leading to greater confidence in the accuracy of self-report data.

In conclusion, these results suggest that intranasal users of cocaine may remain in treatment longer, achieve more prolonged periods of abstinence from cocaine during treatment, and may continue reducing their cocaine use at greater rates following treatment than smokers of cocaine. It does not necessarily follow, however, that smokers of cocaine are not successful in treatment, as smokers also demonstrated reductions in cocaine use during the study period. Importantly, while the intranasal users appeared to reduce their cocaine use at greater rates, reduction in the level of problems in several major life domains was no different than smokers of cocaine. Thus, although the more powerful abuse/dependence potential of smoked cocaine may make it more difficult to achieve prolonged periods of abstinence, the severity of problems in other life areas appears to be affected by cocaine use in general, regardless of the route of administration.

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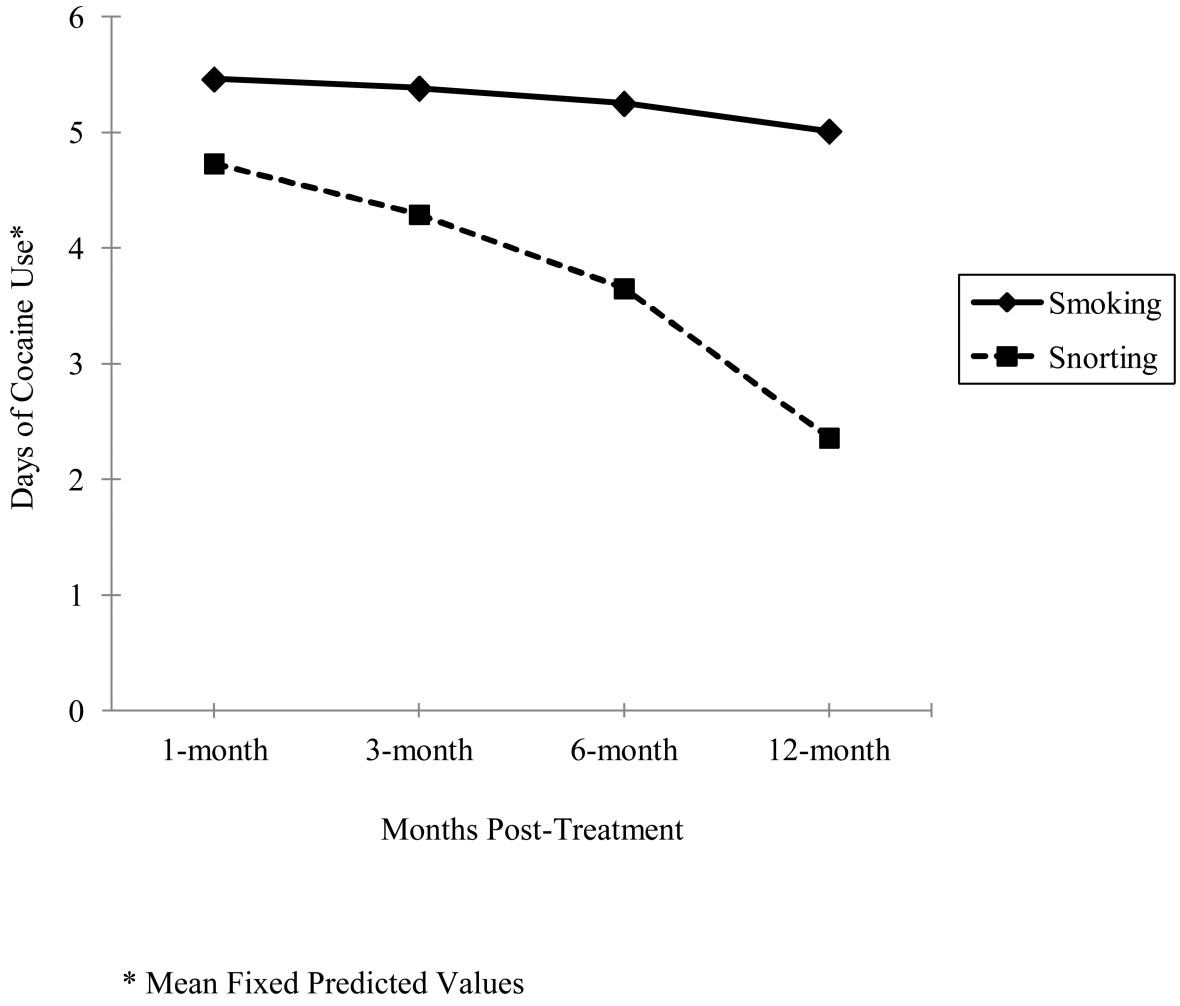

Figure 1.
Days of Cocaine Use Across the Follow-Up Period by Route of Administration

Table 1

Baseline demographic, psychiatric, and cocaine use characteristics

	Smokers		Snorters		Total		
	n	%	n	%	n	%	χ^2
% Female (number, percent)	114	34.8	22	26.2	136	33	2.219
Race							
Caucasian	155	47.3	50	59.5	205	49.8	33.17***
African-American	152	46.3	16	19	168	40.8	
Hispanic	18	5.5	14	16.7	32	7.8	
Native American	0	0	1	1.2	1	0.2	
Multiracial	2	0.6	1	1.2	3	0.7	
Other	1	0.3	2	2.4	3	0.7	
Completed High School	250	76.2	70	83.3	320	77.7	1.95
Not Married/Living Alone	242	73.8	53	63.1	295	71.6	3.76*
Unemployed	180	54.9	44	52.4	224	54.4	0.17
On probation or parole	52	15.9	14	16.7	66	15.1	0.03
On Public Assistance	116	35.4	22	26.2	138	33.5	2.52
Lifetime alcohol use disorder	217	74.6	63	79.7	280	75.7	0.9
Lifetime major depressive disorder	59	18.6	17	20.7	76	19.0	0.20
Lifetime anxiety disorder	38	11.8	2	2.4	40	10.0	6.54*
Antisocial personality disorder	68	24.2	25	35.2	93	26.4	3.54†

	mean	sd	mean	sd	mean	sd	F
Days Paid for working in past 28	9.6	9.8	13.1	10.1	10.3	9.9	8.41**
Age	37	8.1	34.5	7.2	36.5	8	6.40**
Days of marijuana use past 28	3	6.9	2.7	6.4	2.9	6.8	0.08
Days of cocaine use past 28	13.6	8.5	12.7	8.8	13.4	8.5	0.81
Days of cigarette use past 28	22.7	9.6	21.1	11.9	22.4	10	0.46
Days alcohol use past 28	8.6	9.5	10.7	9.7	9	9.6	3.26
Age of first cocaine use	21.8	6.6	19.5	5.1	21.4	6.4	9.24**
Years of regular cocaine use	9.2	6.8	8.8	7.7	9.1	7	0.23
Lifetime number of arrests	5.9	8.6	3.8	6.2	5.4	8.2	4.18*
# outpatient substance abuse tx	2.2	3.5	1.2	1.4	2	3.2	5.04*
# inpatient substance abuse tx	2.9	5.5	1.1	1.6	2.6	5	6.68**
ASI Cocaine Composite	0.66	0.20	0.64	0.23	0.66	0.21	0.99
ASI Alcohol Composite	0.18	0.20	0.22	0.20	0.19	0.20	2.46
ASI Other Drug Composite	0.05	0.07	0.05	0.06	0.05	0.07	0.04
ASI Medical Composite	0.14	0.26	0.15	0.28	0.14	0.26	0.15
ASI Employment Composite	0.65	0.29	0.50	0.30	0.62	0.30	18.11***

	mean	sd	mean	sd	mean	sd	F
ASI Legal Composite	0.10	0.17	0.09	0.17	0.1	0.17	0.02
ASI Family/Social Composite	0.20	0.20	0.17	0.16	0.19	0.19	1.11
ASI Psychological Composite	0.18	0.19	0.18	0.21	0.18	0.20	<0.01

* p < .05;

** p<.01;

*** p<.001;

† p < .10

Table 2

Active-treatment outcomes according to route of cocaine administration

	Smokers		Snorters		
	n	%	n	%	χ^2
Dichotomous Outcomes[a]					
Completed Treatment	161	49.1	48	57.1	1.79
Abstinent during entire treatment period	47	14.9	12	14.5	0.01
Abstinent during last 2 weeks of treatment	99	36	30	40.5	0.77
At least 3 weeks of consecutive abstinence	133	40.5	42	50	1.86
At least 2 weeks of consecutive abstinence	157	47.9	50	59.5	2.61‡
At least 1 week of consecutive abstinence	231	70.4	67	79.8	1.76
Achieved at least 50% reduction in cocaine use	102	31.1	31	36.9	0.51
Achieved at least 75% reduction in cocaine use	52	15.9	15	17.9	0.03

Continuous Outcomes[a]	mean	sd	mean	sd	F
Days retained in treatment	51.5	33.3	59.3	29.6	3.55*
Maximum consecutive days of abstinence	21.6	24.3	27.4	24.2	2.68‡
Maximum consecutive days abstinent during last 2 weeks of treatment	8.4	4.6	10.1	4.3	4.91*
% days abstinent from cocaine	75.4	25.1	80	24.2	0.76
% cocaine positive urine specimens	61.3	36.9	56.4	38.5	0.47
% reduction in cocaine use	57.1	38	62.9	37.5	0.99
ASI Composite Scores[a]					
Cocaine Composite	0.44	0.22	0.39	0.20	1.58
Alcohol Composite	0.07	0.11	0.08	0.12	0.14
Other Drug Composite	0.15	0.42	0.15	0.37	0.18
Medical Composite	0.09	0.19	0.09	0.17	0.07
Employment Composite	0.65	0.25	0.56	0.26	6.04**
Legal Composite	0.08	0.14	0.07	0.13	0.84
Family/Social Composite	0.13	0.15	0.11	0.13	1.19
Psychiatric Composite	0.15	0.17	0.13	0.14	0.40

*p<.05;

**p<.01;

‡p<.10

[a]Analyses controlled for race, gender, age, and study source