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Preliminary examination of tobacco withdrawal in adolescent smokers during smoking cessation treatment

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Abstract

Tobacco withdrawal symptoms have been shown to play a significant role in mediating relapse to smoking in adult smokers; however, there are few prospective studies that have examined the course of tobacco withdrawal symptoms over time and their connection to lapse in adolescent smokers. Withdrawal symptoms were assessed weekly for four weeks in a sample of adolescent smokers participating in pilot cessation intervention. Adolescent smokers experienced an exacerbation in overall withdrawal symptoms, and particularly of cravings and restlessness, although symptoms were generally of mild severity. The course of symptoms was different for boys and girls, with girls generally experiencing a peak and subsequent decline in symptoms early in the establishment of abstinence, while boys experienced a constant level of symptoms which did not decline over the four weeks. Finally, withdrawal symptoms experienced on quit day were not related to lapse to smoking during the course of treatment for either boys or girls. These results suggest that while possibly uncomfortable, withdrawal symptoms may not be most salient to a lapse to smoking for adolescent smokers attempting to quit. Both of these findings have direct implications for the design and implementation of treatment of nicotine dependence in adolescent smokers.

The clinical significance of withdrawal discomfort lies in its potential contribution to lapse during cessation attempts. Pharmacological treatments, designed to reduce the discomfort of symptoms, tend to almost double success rates in cessation attempts among adults (Hughes et al, 2003). Similarly, effective psychosocial treatments tend to focus on cognitive and behavioral strategies for coping with withdrawal symptoms, cravings, and the environmental risks associated with increasing symptoms and cravings (McDonald et al, 2003; Fiore et al., 2000; Hall, et al., 2002). Although the pattern, duration, and severity of tobacco withdrawal symptoms are significant predictors of relapse in adult smokers (Piasecki et al., 1998; 2000), less research has examined the effects of tobacco withdrawal in adolescent smokers.

Adolescents have reported subjective symptoms of withdrawal such as craving, nervousness, restlessness, irritability, hunger, difficult concentrating, sadness, and sleep disturbances (McNeil, et al 1986; Rojas et al, 1998; Killen, et al, 2001; Prokhorov, et al, 2005) – all symptoms consistent with reports from adults (see Hughes, 2007 for a review). However there is emerging preclinical and intervention related evidence to suspect that withdrawal may be a different experience for adolescents. For example, preclinical studies indicate that while adult rats evidence symptoms of withdrawal, similar indicators are absent in adolescent rats (O'Dell et al., 2004). In adolescent humans, the nicotine patch may not prevent development of withdrawal symptoms (Killen et al., 2001) and its efficacy has been

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less conclusively established with adolescent smokers (Hurt et al., 2000; Smith et al., 1996; Hanson et al., 2003; Moolchan et al 2005). Finally, interestingly, although they report withdrawal symptoms, adolescent smokers may in fact only differ from their nonsmoking peers on reports of cravings in response to abstinence (Smith et al, under review; Prokhorov et al. 2005). In addition, adolescents' patterns of tobacco use are likely more highly constrained than those of adults by such factors as school or home rules and regulations (Wiltshire, Amos, Haw, & McNeill, 2005). As a result, not only the experience of symptoms but the course of these symptoms may vary considerably from those of adults.

In general, reports of adolescent withdrawal symptoms have been limited by using single time point self-report or retrospective recall of experienced symptoms (e.g. Henningfield, Clayton, & Pollin, 1990; Killen et al, 2001; McNeil, et al., 1986; Stanton, 1995), both of which are problematic given the variability of course and duration of symptoms over time (Piasecki, 2006) and selective recall bias which suggests that memories of experienced symptoms may be distorted for some smokers (Pomerleau et al, 1994). Therefore, the purpose of the current study was to conduct preliminary analyses using data from a smoking cessation treatment program in adolescent smokers (Krishnan-Sarin et al., 2006) to prospectively examine the emergence and course of withdrawal symptoms. Additionally, considering emerging evidence that male and female adolescent smokers differ in their experience of tobacco dependence (diFranza et al, 2002) and abstinence (Panday et al, 2007; Strong et al, 2004), we also compared male and female adolescents' reports of withdrawal symptoms. And finally, as emergence of withdrawal symptoms following the establishment of abstinence have been shown to increase the likelihood of relapse to smoking in adults (al' Absi et al, 2004; West et al, 1989), and cravings have been associated with relapse in adolescents (Bagot et al, 2007), we examined the relationship between withdrawal symptoms on quit day and relapse to smoking.

Method

Participants

This sample consisted of 54 adolescent smokers (30 males, 24 females) who volunteered to participate in a four week smoking cessation program. Demographic variables are presented in Table 1. Adolescents were included if they reported smoking at least ten cigarettes per day for the past six months and had quantitative urine cotinine levels of 350 ng/ml or higher. 55% of participants (N=30, N=16 male, N=14 female) completed the four weeks of treatment and were abstinent throughout according to self-reports confirmed by biochemical measures (CO and urinary cotinine).

Procedures

Study procedures were approved by Yale University IRB and participating school boards. Adolescent smokers were recruited from area high schools to participate in a smoking cessation program. Eligible participants received weekly cognitive behavioral therapy (CBT) in one of two different schedules (once a week or three times/week) for smoking cessation with or without contingency management of tobacco abstinence (CM; see Krishnan-Sarin et al., 2006; Cavallo et al., in press for more details). All treatment sessions (including a preparation to quit session which occurred within a week of each individual's quit day, a quit day session, and the weekly sessions) were used to provide support and teach specific skills to support the adolescent's quit effort. Adolescents also attended daily appointments at which abstinence from cigarettes was assessed (using urine cotinine and breath carbon monoxide levels) – for participants in one of the CM conditions abstinence was reinforced with a cash reward, participants in the CBT alone condition were reinforced for attending the appointment regardless of abstinence. Withdrawal symptoms were assessed

at a baseline interview, one week prior to the quit day, the quit day (approximately 14 hours following the participants' last reported cigarette), and on a weekly basis during the 4 week intervention period.

Withdrawal Symptoms

Participants rated the extent of their experience on each of eight items assessing subjective experience of tobacco withdrawal on a 0 (none) to 4 (severe) scale using the Minnesota Nicotine Withdrawal Scale (Hughes & Hatsukami, 1986). Analyses were conducted on individual items (desire or craving to smoke, irritability, anxious, difficulty with concentration, restlessness, increase in appetite/weight gain/hunger, depressed mood, and insomnia/sleep problems) and for a summed overall "withdrawal discomfort score" (as recommended by Shiffman, West, and Gilbert, 2004),

Abstinence from Smoking

Abstinence was determined biochemically by means of breath carbon monoxide levels and semi-quantitative immunoassay strips for cotinine on a daily basis during the first three weeks and once every other day in the last week of the program. A breath CO reading of <8 ppm was considered indicative of negative for smoking; a criterion used in several previous studies (Roll & Higgins, 200; Heil et al, 2001, Krishnan-Sarin et al., 2006; Stitzer et al., 1986, Javors et al, 2005). Semiquantitative Nicometer Immunoassay Test Strips (ITS; Jant Pharmacal Corporation, Enrico, CA) were used to determine cotinine levels on a daily basis; abstinence was defined as urine cotinine levels which were less than the level on the earlier day in the first week and 100 ng/ml during following weeks. Verification of abstinence began on the adolescent's quit day. The 45% of participants who dropped out of treatment were considered non-abstinent. (i.e. lapsed). Drop out was determined following three sequential missed appointments and unsuccessful attempts to contact the adolescent and reschedule.

Statistical Analyses

Demographic and baseline characteristics were summarized comparing all male and female smokers. Data provided by participants who attained abstinence and completed the entire 4-week program (55% of the sample; n= 30), were included in repeated measures ANOVAs to test for changes in symptoms across the course of treatment, starting with quit day symptoms. Baseline symptoms were not included in these analyses as time between baseline assessments and quit days differed between all participants. (Only two participants who completed the four weeks did not have data at all time points; these participants were excluded from the analyses, resulting in N=15 males and N=13 females). Nicotine dependence at baseline (as assessed by the modified Fagerstrom Tolerance Questionnaire; Prokhorov et al., 1998) was included as a covariate and intervention group (ie. CBT alone, weekly CBT+CM, thrice weekly CBT +CM) was included as a between subjects factor in order to control for the influence of these factors on symptoms. Analyses were conducted for the overall withdrawal symptom score as well as for each individual symptom. Prior to analyses we transformed withdrawal variables using a log transformation to correct for positively skewed distributions.

Logistic regression equations assessed the relationship between overall withdrawal symptoms (continuous variable with scores ranging from 0 to 29) on quit day to lapse to smoking at any point during the treatment period (dichotomously coded as 0 (no lapse) and 1 (lapse)). A second logistic regression equation was run for associations between change in total symptoms reported at the preparation to quit session to the quit day session (continuous ranging from -7 to 23) and lapse to smoking at any point during the treatment period.

Associations between symptoms and lapse were controlled for gender, intervention group, baseline nicotine dependence scores, and extent of tobacco use (determined by cotinine levels at baseline).

Results

Between the baseline to quit day assessments, there was a significant increase in overall symptoms (baseline: 5.48 ± 4.35 , quit day: 8.27 ± 6.69 ; paired t-test: $t(49) = -2.76$, $p = .008$) as well as individual symptoms of craving (baseline: 1.97 ± 1.27 , quit day: 2.44 ± 1.38 ; paired t-test: $t(29) = -3.97$, $p < .001$) and restlessness (baseline: $.61 \pm .86$, quit day: 1.08 ± 1.17 ; paired t-test: $t(49) = -2.51$, $p = .016$).

As seen in Table 2, Repeated Measures ANOVAs indicated a significant effect of time on overall symptoms and the individual symptom of craving, with symptoms peaking at the end of the first week of abstinence and then declining over the following weeks. There were also significant interactions between time and gender for overall withdrawal scores and the single item craving. Subsequent post-hoc examination of repeated measures ANOVAs run separately for each gender, indicated that for overall withdrawal scores, girls' symptoms decreased over time ($F(4,48) = 4.93$, $p < .005$) while boys' symptoms did not change ($F(4,56) = 1.17$, $p = .34$). Overall, girls appeared to have a peak in overall symptoms at day 7, which then declined over the following weeks of treatment, while boys appeared to have fairly consistent levels of symptoms across the weeks. Similarly, cravings decreased significantly over time for girls ($F(4,40) = 4.76$, $p = .003$), but not for boys ($F(4,44) = 1.77$, $p = .15$), and girls reported a greater change from day 1 cravings to day 28 than did boys ($F(1,29) = 6.04$, $p < .05$).

The logistic regressions indicated no contribution of overall symptoms experienced on quit day or change in symptoms from baseline (one week pre-quit) to quit day to the likelihood of lapse over the entire course of treatment.

Discussion

Following initiation of tobacco abstinence, adolescent smokers experienced an increase in overall withdrawal symptoms from baseline levels. They particularly experienced increases in cravings and restlessness, consistent with building evidence that craving may be one of the most important influences on smoking behavior and cessation (Bagot et al, 2007; Piasecki, 2006; Killen et al, 2001; Prokhorov et al., 2001; Riedel, et al., 2003; Rojas et al., 1998). As has been shown previously (e.g. Killen et al, 2001; Smith et al, under review), symptoms were relatively mild and few in number with craving being the most notable effect.

For the 53% of our participants who were successful in attaining abstinence throughout the 4 weeks, the course of overall withdrawal discomfort and cravings varied for boys and girls. Symptoms for girls generally illustrated a pattern of initial peaking of symptoms which declined over time. In contrast, boys experienced little change in their overall discomfort and cravings over the course of treatment. The pattern we observed in this sample of treatment seeking adolescents may reflect underlying gender differences related to tobacco dependence. For example, compared with boys, adolescent girls may experience more severe withdrawal symptoms overall (Strong et al, 2004; Panday et al, 2007) and appear to experience symptoms of dependence sooner following the initiation of smoking (DiFranza et al, 2002). Furthermore, adult women have been found to experience greater peaking of symptoms in response to acute abstinence (Leventhal et al, 2007). Thus these adolescent girls experienced greater reactivity initially to the establishment of abstinence which then

declined, while boys experienced less acute response and therefore had diminished decline. Another explanation may be related to expectancies regarding withdrawal following cessation. Adult women have been found to anticipate greater difficulty and distress in response to abstinence (McKee et al, 2005) which may influence their experience of withdrawal. If adolescent girls hold similar expectancies their early experience of withdrawal may be one of greater discomfort which declines with longer “real-life” experience.

In line with prospective studies of adult withdrawal which describe no differences in the experiences of symptoms in men and women (e.g. Svikis et al.1986; Hughes, 1992; Perkins et al. 1999; Pomerleau, et al, 1994), we found that adolescent boys and girls may experience similar severity of symptoms. However, limited power for such comparisons – particularly as symptoms for both boys and girls were reported to be mild and minimal, the distribution of scores had little variation, and differences between boys and girls were small – inherently limits interpretation of the absence of any differences.

Withdrawal symptoms experienced on quit day did not predict lapse from treatment at any point in the four weeks, possibly suggesting that adolescents do not resume smoking to relieve withdrawal effects. However, alternate theoretical and methodological explanations may account for this finding. For example, the affective response to withdrawal and craving symptoms may be more relevant to relapse than the symptoms themselves (Brown, Lejeuz, Kahler, Strong, & Zvlonsky, 2005) particularly due to the relative mild severity of symptoms it is possible that those adolescents who relapsed to smoking or dropped out of treatment had lower thresholds of tolerance for their experienced symptoms and their distress rather than their symptoms may have predicted lapse. Furthermore, as noted, the minimal reported discomfort may in itself also account for the lack in association with lapse. Finally, this single snap shot of withdrawal effects is insufficient to capture the influence of withdrawal on lapse. Indeed rather than a unidimensional picture of withdrawal, a combination of multiple interdependent aspects of the withdrawal experience – such as overall exacerbation of symptoms, variability in symptoms over time, and symptom relief experienced by smoking - have been most neatly tied to lapse (Piasecki et al, 2003). Beyond the scope of this initial evaluation, future investigations should take a more multidimensional perspective of withdrawal in its relationship to lapse.

Strengths and Limitations

As a pilot investigation on adolescent smoking cessation, these secondary findings need to be interpreted with caution due to the limitations presented by the small sample size. It is important to note, that despite this small sample, the high rates of verified abstinence attained by means of the CM-based intervention, strengthen the reported findings by insuring the validity of cessation. In addition to the small sample size, the assessment of symptoms on a weekly basis is likely not sufficient to adequately describe the course of withdrawal symptoms in adolescent smokers. 62.5% of all drop-outs (15 out of 24) occurred in the first week following quit day – it is possible that most acute symptoms were experienced immediately prior to lapse and as such the weekly assessments may not represent variations in symptoms which may be most closely related to lapse (Piasecki, 2006). The use of daily data would provide more accurate information by facilitating the assessment of symptoms on the day directly prior to a lapse. Finally, we were unable to control for a baseline level of withdrawal symptoms prior to the establishment of abstinence as baseline data was collected varying times prior to each individual’s quit date. The degree of exacerbation – while not found to be related to lapse in this case – may have an influence on the course of symptoms and further describe possible differences between boys and girls.

Conclusion

The physiological and psychological factors involved in maintenance of, and relapse to, smoking in adolescent smokers have not been widely systematically evaluated. The presented findings suggest that withdrawal effects experienced by treatment seeking adolescent smokers may be few and of relatively mild intensity, and craving to smoke may be the most significant symptom. There is also evidence for different courses of symptoms experienced by boys and girls when they try to quit smoking. These results, while preliminary suggest that withdrawal symptoms may not be a primary factor related to relapse for adolescent smokers and other constructs, including cue related cravings, need to be further examined.

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References

- al'Absi M, Hatsukami D, Davis GL, Wittmers LE. Prospective examination of effects of smoking abstinence on cortisol and withdrawal symptoms as predictors of early smoking relapse. *Drug and Alcohol Dependence*. 2004; 73:267–78. [PubMed: 15036549]
- Brown RA, Lejuez CW, Kahler CW, Strong DR, Zvolensky MJ. Distress tolerance and early smoking lapse. *Clinical Psychology Review*. 2005; 25:713–733. [PubMed: 16023275]
- Cavallo DA, Cooney JL, Duhig AM, Smith AE, Liss TB, McFetridge AK, Babuscio T, Nich C, Carroll KM, Rounsaville BJ, Krishnan-Sarin S. Combining Cognitive Behavioral Therapy with Contingency Management for smoking cessation in adolescent smokers: A preliminary comparison of two different CBT formats. *American Journal of Addictions*. (in press).
- DiFranza JR, Savageau JA, Rigotti NA, Fletcher K, Ockene JK, McNeill AD, Coleman M, Wood C. Development of symptoms of tobacco dependence in youths: 30 month follow up data from the DANDY study. *Tobacco Control*. 2002; 11:228–235. [PubMed: 12198274]
- Fiore, MC.; Bailey, WC.; Cohen, SJ.; Dorfman, SF.; Goldstein, MG.; Gritz, EF.; Heyman, RB.; Jaen, CR.; Kottke, TE.; Lando, HA.; Mecklenburg, RE.; Dlan Mullen, P.; Nett, LM.; Robinson, L.; Stitzer, ML.; Tommasello, AC.; Villejo, L.; Wewers, M. *Treating Tobacco Use and Dependence: Clinical Practice Guidelines*. Rockville, MD: U.S. Department of Health and Human Services. Public Health Service; 2000.
- Garvey AJ, Bliss RE, Hitchcock JL, Heinold JW. Predictors of smoking relapse among self-quitters: A report from the Normative Aging Study. *Addictive Behaviors*. 1992; 17:367–377. [PubMed: 1502970]
- Hall SM, Humfleet G, Reus VI, Munoz RF, Hartz DT, Maude-Griffin R. Psychological intervention and antidepressant treatment in smoking cessation. *Archives of General Psychiatry*. 2002; 59:930–936. [PubMed: 12365880]
- Heil SH, Tidey JW, Holmes HW, Badger GJ, Higgins ST. A contingent payment model of smoking cessation: Effects on abstinence and withdrawal. *Nicotine & Tobacco Research*. 2003; 5:205–213. [PubMed: 12745493]
- Hughes JR, Shiffman S, Callas P, Zhang J. A meta-analysis of the efficacy of over the counter nicotine replacement. *Tobacco Control*. 2003; 12:21–27. [PubMed: 12612357]
- Hughes JR, Hatsukami D. Signs and symptoms of tobacco withdrawal. *Archives of General Psychiatry*. 1986; 43:289–294. [PubMed: 3954551]
- Javors MA, Hatch JP, Lamb RJ. Cut-off levels for breath carbon monoxide as a marker for cigarette smoking. *Addiction*. 2005; 100:159–167. [PubMed: 15679745]
- Killen JD, Ammerman S, Rojas N, Varady J, Haydel F, Robinson TN. Do adolescent smokers experience withdrawal effects when deprived of nicotine? *Experimental and Clinical Psychopharmacology*. 2001; 9:176–182. [PubMed: 11518093]

- Krishnan-Sarin S, Duhig AM, McKee SA, McMahon TJ, Liss T, McFetridge A, Cavallo DA. Contingency Management for Smoking Cessation in Adolescent Smokers. *Experimental and Clinical Psychopharmacology*. 2006; 14:306–310. [PubMed: 16893273]
- McDonald P, Colwell B, Backinger CL, Husten C, Maule CO. Better practices for youth tobacco cessation: Evidence of review panel. *American Journal of Health Behaviors*. 2003; 27(Suppl 2):S144–S158.
- McNeil AD, West RJ, Jarvis MJ, Jackson P, Russell MAH. Cigarette withdrawal symptoms in adolescent smokers. *Psychopharmacology*. 1986; 90:533–536. [PubMed: 3101108]
- Panday S, Reddy SP, Ruitter RAC, Bergström E, de Vries H. Nicotine dependence and withdrawal symptoms among occasional smokers. *Journal of Adolescent Health*. 2007; 40:144–150. [PubMed: 17259054]
- Piasecki TM, Fiore MC, Baker TB. Profiles in discouragement: Two studies of variability in the time course of smoking withdrawal symptoms. *Journal of Abnormal Psychology*. 1998; 107:238–251. [PubMed: 9604553]
- Piasecki TM, Niaura R, Shadel WG, Abrams DB, Goldstein MG, Fiore MC, et al. Smoking withdrawal dynamics in unaided quitters. *Journal of Abnormal Psychology*. 2000; 109:74–86. [PubMed: 10740938]
- Piasecki TM, Jorenby DE, Smith SS, Fiore MC, Baker TB. Smoking withdrawal dynamics: II. Improved tests of withdrawal relapse relations. *Journal of Abnormal Psychology*. 2003; 112:14–27. [PubMed: 12653410]
- Piasecki TM. Relapse to smoking. *Clinical Psychology Review*. 2006; 26:196–215. [PubMed: 16352382]
- Pomerleau CS, Tate JC, Lumley MA, Pomerleau OF. Gender differences in prospectively versus retrospectively assessed smoking withdrawal symptoms. *Journal of Substance Abuse*. 1994; 6:433–440. [PubMed: 7780301]
- Prokhorov AV, Hudman KS, Cinciripini PM, Marani S. “Withdrawal symptoms” in adolescents: A comparison of former smokers and never smokers. *Nicotine and Tobacco Research*. 2005; 7:909–913. [PubMed: 16298726]
- Prokhorov AV, Hudmon KS, de Mooer CA, Kelder SH, Conroy JL, Ordway N. Nicotine dependence, withdrawal symptoms, and adolescents’ readiness to quit smoking. *Nicotine and Tobacco Research*. 2001; 3:151–155. [PubMed: 11403729]
- Prokhorov AV, Koehly LM, Pallonen UE, Hudmon KS. Adolescent nicotine dependence measured by the Modified Fagerstrom Tolerance Questionnaire at two time points. *Journal of Child and Adolescent Substance Abuse*. 1998; 7:35–47.
- Riedel BW, Robinson LA, Klesges RC, McLain-Allen B. Ethnic differences in smoking withdrawal effects among adolescents. *Addictive Behaviors*. 2003; 28:129–140. [PubMed: 12507532]
- Rojas N, Killen JD, Haydel KF, Robinson TN. Nicotine dependence and withdrawal symptoms in adolescent smokers. *Archives of Pediatrics and Adolescent Medicine*. 1998; 152:151–156. [PubMed: 9491041]
- Roll JM, Reilly MP, Johanson C. The influence of exchange delays on cigarette versus money choice: A laboratory analog of voucher-based reinforcement therapy. *Experimental & Clinical Psychopharmacology*. 2000; 8:366–370. [PubMed: 10975627]
- Shiffman S, West RJ, Gilbert DG. Recommendation for the assessment of tobacco craving and withdrawal in smoking cessation trials. *Nicotine and Tobacco Research*. 2004; 6:599–614. [PubMed: 15370156]
- Slotkin TA, MacKillop EA, Rudder CL, Ryde IT, Tate CA, Seidler FJ. Permanent, sex-selective effects of prenatal or adolescent nicotine exposure, separately or sequentially, in rat brain regions: Indices of cholinergic and serotonergic synaptic function, cell signaling, and neural cell number and size at 6 months of age. *Neuropsychopharmacology*. 2007; 32:1082–1097. [PubMed: 17047666]
- Strong D, Kahler C, Ramsey S, Brown R, Abrantes A. Nicotine withdrawal among adolescents with acute psychopathology: An item response analysis. *Nicotine & Tobacco Research*. 2004; 6:547–557. [PubMed: 15203788]

- Smith AE, Cavallo D, Dahl T, Wu R, George TP, Krishnan-Sarin S. Effects of acute tobacco withdrawal in adolescent smokers as compared with nonsmokers. (under review).
- Stanton WR. DSM-III-R Tobacco dependence and quitting during late adolescence. *Addictive Behaviors*. 1995; 20:595–603. [PubMed: 8712057]
- Stitzer ML, Rand CS, Bigelow GE, Mead AM. Contingent payment procedures for smoking reduction and cessation. *Journal of Applied Behavior Analysis*. 1986; 19:197–202. [PubMed: 3733589]
- Upadhyaya HP, Drobos DJ, Thomas SE. Reactivity to smoking cues in adolescent cigarette smokers. *Addictive Behaviors*. 2004; 29:849–856. [PubMed: 15219329]
- Wiltshire S, Amos A, Haw S, McNeill A. Image, context and transition: Smoking in mid-to-late adolescence. *Journal of Adolescence*. 2005; 28:603–617. [PubMed: 16203198]

Table 1

Baseline Demographic Characteristics (N=54)

Variable	Total N (%) or M (SD)	Male N (%) or M (SD)	Female N (%) or M (SD)	F-statistic
Female	24 (44%)			
Ethnicity				
Caucasian	39 (72.2%)			
African American	1 (1.9%)			
Hispanic	11 (20.4%)			
Native American	1 (1.9%)			
Other/Mixed	2 (3.7%)			
Asian	0%			
Age	16.54 (1.05)	16.83 (1.02)	16.17 (1.00)	5.76*
Relapsed/Dropped Out of Treatment	25 (46%)	14 (46%)	11 (46%)	.107
mFTQ at Baseline	3.04 (1.09)	3.44 (2.09)	3.22 (1.63)	.825
Number of Daily Cigarettes	13.9 (5.52)	14.22 (5.13)	13.50 (6.07)	.221
Number of Years Daily Smoking	2.76 (1.78)	2.83 (1.59)	2.67 (2.01)	.115
Urine Cotinine (ng/ml) at Baseline	745.58 (508.23)	687.63 (433.64)	823.77 (597.72)	.908

Table 2

Nicotine Withdrawal Scale for Adolescent Boys and Girls.

M (SD)																	
GROUP								TIME				GROUP x TIME					
df								F				p					
Day 28								Day 21				Day 14					
Day 7								Quit Day				Baseline					
Scale								Withdrawal				Nicotine					
TOTAL																	
Male		5.63 (4.65)		9.57 (7.17)		8.81 (8.04)		5.27 (5.34)		5.71 (4.59)		3.64 (3.54)		7.24 (7.79)		5.69 (7.54)	
Female		5.37 (4.18)		7.24 (6.23)		7.62 (8.18)		6.25 (7.27)		5.70 (6.24)		5.00 (6.22)		4.88		<.05	
Male		5.48 (4.35)		8.27 (6.69)		8.14 (8.03)		5.77 (6.32)		5.70 (6.24)		5.00 (6.22)		4.88		2.67	
Female		1.97 (1.27)		2.44 (1.38)		1.70 (1.54)		1.23 (1.38)		.90 (1.09)		.80 (1.06)		4.88		3.74	
Male		1.93 (1.28)		2.28 (1.49)		1.57 (1.54)		1.50 (1.59)		1.06 (1.29)		1.13 (1.26)		4.88		2.49	
Female		2.00 (1.31)		2.65 (1.23)		1.88 (1.59)		.93 (1.09)		.71 (.83)		.43 (.65)		4.88		<.005	
Restlessness																	
Male		.61 (.86)		1.08 (1.17)		1.11 (1.24)		.84 (.97)		.90 (1.12)		.67 (.92)		.17		.91	
Female		.60 (.86)		.86 (1.03)		.90 (1.18)		.75 (.86)		.75 (1.06)		.69 (.87)		.48		.52	
Male		.63 (.88)		1.35 (1.30)		1.38 (1.31)		.93 (1.09)		1.07 (1.21)		.64 (1.01)		.59		.45	
Female		.39 (.71)		.62 (.93)		.49 (.90)		.35 (.79)		.33 (.84)		.37 (.93)		.48		.80	
Male		.53 (.82)		.48 (.74)		.43 (.82)		.44 (1.03)		.44 (1.03)		.63 (1.20)		.80		.52	
Female		.21 (.51)		.78 (1.13)		.56 (1.03)		.27 (.51)		.21 (.58)		.07 (.27)		.57		.14	
Irritability																	
Male		.93 (1.15)		1.02 (1.23)		1.29 (1.31)		.87 (1.02)		.83 (1.09)		.63 (.99)		.48		.628	
Female		.83 (1.02)		.86 (1.09)		1.33 (1.32)		.94 (1.12)		.88 (1.26)		.88 (1.20)		.93		.488	
Male		1.04 (1.30)		1.22 (1.38)		1.25 (1.34)		.80 (.94)		.79 (.89)		.36 (.63)		.488		.695	
Female		.77 (1.16)		1.00 (1.2)		.97 (1.3)		.61 (1.08)		.63 (.96)		.50 (.97)		.488		.224	
Male		.83 (1.12)		.86 (1.19)		.80 (1.17)		.56 (1.09)		.69 (1.08)		.63 (1.09)		.488		.93	
Female		.71 (1.23)		1.17 (1.37)		1.19 (1.47)		.67 (1.11)		.57 (.85)		.36 (.84)		.488		.695	
Difficulty Concentrating																	
Male		.50 (.98)		.67 (1.11)		.95 (1.31)		.84 (1.13)		.77 (.97)		.77 (1.10)		.31		.488	
Female		.40 (.89)		.66 (1.17)		.95 (1.32)		.81 (1.11)		.69 (1.08)		.88 (1.26)		.488		1.45	
Male		.63 (1.09)		.69 (1.06)		.94 (1.34)		.87 (1.19)		.86 (.86)		.64 (.93)		.488		1.68	
Female		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	
Male		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	
Female		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	
Sleep problems																	
Male		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	
Female		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	
Male		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	
Female		.50 (.77)		.67 (1.04)		70 (1.05)		.42 (.85)		.67 (1.06)		.60 (1.10)		.97		.37	

		M (SD)			GROUP			TIME			GROUP x TIME		
					df	F	p	df	F	p	df	F	p
Nicotine Withdrawal Scale		Baseline	Quit Day	Day 7	Day 14	Day 21	Day 28						
	Male	.47 (.73)	.62 (.90)	.71 (.96)	.56 (1.03)	.56 (1.09)	.63 (1.15)						
	Female	.54 (.83)	.74 (1.21)	.69 (1.19)	.27 (.59)	.79 (1.05)	.57 (1.09)						
Anxious		.69 (.88)	.77 (1.06)	.92 (1.32)	.61 (.99)	.67 (1.09)	.67 (1.06)	1.22	.101	.33	4.88	1.37	.25
	Male	.73 (.91)	.62 (.98)	.90 (1.26)	.69 (1.08)	.63 (1.20)	.75 (1.24)						
	Female	.63 (.88)	.96 (1.15)	.94 (1.44)	.53 (.92)	.71 (.99)	.57 (.85)						