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Intolerance for Withdrawal Discomfort and Motivation Predict Voucher-Based Smoking Treatment Outcomes for Smokers with Substance Use Disorders

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Abstract

Identifying predictors of abstinence with voucher-based treatment is important for improving its efficacy. Smokers with substance use disorders have very low smoking cessation rates so identifying predictors of smoking treatment response is particularly important for these difficult-to-treat smokers. Intolerance for Smoking Abstinence Discomfort (IDQ-S), motivation to quit smoking, nicotine dependence severity (FTND), and cigarettes per day were examined as predictors of smoking abstinence during and after voucher-based smoking treatment with motivational counseling. We also investigated the relationship between IDQ-S and motivation to quit smoking. Smokers in residential substance treatment ($n = 184$) were provided 14 days of vouchers for complete smoking abstinence (CV) after a 5-day smoking reduction lead-in period or vouchers not contingent on abstinence. Carbon monoxide readings indicated about 25% of days abstinent during the 14 days of vouchers for abstinence in the CV group; only 3–4% of all participants were abstinent at follow-ups. The IDQ-S Withdrawal Intolerance scale and FTND each significantly predicted fewer abstinent days during voucher treatment; FTND was non-significant when controlling for variance shared with Withdrawal Intolerance. The one significant predictor of 1-month abstinence was pretreatment motivation to quit smoking, becoming marginal ($p < .06$) when controlling for FTND. Lower Withdrawal Intolerance significantly predicted 3 month abstinence when controlling for FTND. Higher Withdrawal Intolerance pretreatment correlated with less motivation to quit smoking. Implications for voucher-based treatment include

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Contributors

Drs. Sirota, Rohsenow, Tidey, and Swift designed the novel study instruments. Drs. Rohsenow, Sirota, Kahler, Colby, Tidey and Martin designed this study with these aims. Drs. Rohsenow and Martin guided all of the scientific aspects of the project, wrote the protocol, obtained and maintained institutional review board approvals, planned and guided the statistical analyses, and drafted the final manuscript. Dr. Martin ensured the integrity of the data sets throughout. All authors participated in writing the manuscript, contributed to interpretation of results, and have approved the final manuscript.

Conflict of Interest

No authors have any conflict of interest with this study.

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the importance of focusing on reducing these expectancies of anticipated smoking withdrawal discomfort, increasing tolerance for abstinence discomfort, and increasing motivation.

Keywords

Intolerance for discomfort; contingent vouchers; contingency management; point-prevalence abstinence; nicotine dependence; motivation to quit smoking

1. Introduction

1.1 Rationale for the Study

Ability to predict smoking relapse after an initial quit attempt can provide guidance to theories of addiction, to medications development, and to developing better approaches to smoking cessation counseling. The majority of smoking quit attempts do not lead to lasting tobacco abstinence (Fiore et al., 2008). While the aversiveness of tobacco withdrawal plays a role in relapse (Hughes, 2007), individual differences in ability to tolerate or cope with the withdrawal and other stressors from abstinence are also likely to affect success of a smoking quit attempt since some smokers seem better able to endure abstinence distress stoically or to rationalize that the discomforts from abstinence are worth the gains (Sirota, Rohsenow, Dolan, Martin & Kahler, 2013). Beliefs or expectancies, while smoking, about one's inability to tolerate withdrawal when abstinent from smoking may lead to a decision not to become abstinent.

A related but not identical construct, the ability to tolerate distress or anxiety in general, has been investigated as a correlate of smoking history and as a predictor of smoking treatment response (Brandon, Herzog, Juliano, Irvin, Lazev, & Simmons, 2003; Brown, Lejuez, Kahler, & Strong, 2002; Brown, Lejuez, Kahler, Strong, & Zvolensky, 2005; Brown, Lejuez, et al., 2009; Hajek, 1999; Hajek, Belcher, & Stapleton, 1987). This construct has been assessed with persistence on breath holding or cold pressor tasks (Hajek, et al., 1987; Kahler et al., 2013; Sirota et al., 2013), persistence with emotionally stressful tasks (e.g., Quinn, Brandon & Copeland, 1996), and questionnaires of ability to tolerate anxiety (Zvolensky, et al., 2006), feeling distressed or upset in general (Simons & Gaher, 2005) or physical discomfort in general (Schmidt et al., 2006). The behavioral persistence tasks may be reasonable indicators of willingness to persist with the physical or emotional discomfort of smoking cessation, but may not be easily used in clinical settings as part of a busy clinical practice. The questionnaires assessing tolerance of various negative emotions or physical discomfort are relevant to ability to tolerate emotional and physical smoking relapse precipitants, but these measures do not assess the specific set of physical, affective, and craving symptoms that occur during acute tobacco abstinence. Anxiety itself is only one of the eight or nine nicotine withdrawal symptoms found to be valid (Hughes & Hatsukami, 1998; Hughes et al., 1999; Hughes, 2007) and may be less relevant to smokers more bothered by craving, depression, anger, fatigue, difficulty concentrating, or other sequelae of abstinence.

The Intolerance for Smoking Abstinence Discomfort Questionnaire (IDQ-S) was designed to specifically assess the ability to tolerate the acute discomforts of recent smoking

abstinence (Sirota et al., 2010). A large pool of items was reduced empirically; the two final subscales derived from principal components analysis, Withdrawal Intolerance and Lack of Cognitive Coping, were found to be reliable and valid, with only 2–7% of variance in common (Sirota et al., 2010). Only 7–25% of variance in the Withdrawal Intolerance scale was shared with nicotine dependence severity and 4% with nicotine withdrawal severity after overnight abstinence (Kahler, McHugh, Metrik, Spillane, & Rohsenow, 2013; Sirota et al., 2010; 2013). In a direct comparison of the IDQ-S with three laboratory measures of physical and emotional distress tolerance and an anxiety sensitivity questionnaire, only the IDQ-S showed a consistent relationship to smoking dependence and rate measures and to number of past smoking quit attempts, suggesting it might also be a predictor of outcome (Sirota et al., 2013). Withdrawal Intolerance was more strongly related to measures of smoking dependence and cigarettes per day, while Lack of Cognitive Coping was more strongly related to number of past quit attempts, with none of the other measures of more general tolerance for discomfort being significant. In a laboratory analog study of smoking lapse in which participants received cash reinforcement for delaying smoking, breath holding persistence, but not IDQ-S score, predicted longer latency to smoking after controlling for nicotine dependence and withdrawal symptoms (Kahler et al., 2013). However, the IDQ-S has not yet been examined as a prospective predictor of tobacco abstinence during or after smoking treatment.

1.2 Goals, Aims and Hypotheses

Finding predictors of abstinence during voucher-based treatment is particularly important for suggesting way to strengthen the effectiveness of these approaches. Smokers with substance use disorders (SUD) have very low smoking cessation rates so identifying pre-treatment predictors of smoking treatment response is particularly important for these difficult-to-treat smokers. The primary aim of the present study was to investigate the ability of the two IDQ-S scales to predict abstinence from smoking during and after treatment with abstinence-contingent vouchers and motivational counseling for smokers in treatment for SUD. In addition, a standard measure of nicotine dependence severity and cigarettes per day pretreatment were also compared as predictors. The other primary aim was to replicate our previous finding that motivation as measured by the Contemplation Ladder predicted 1 and 3 month abstinence outcomes more strongly than pretreatment nicotine dependence severity or number of cigarettes (Rohsenow, Martin, Tidey, Monti, & Colby, 2013), and compare motivation to IDQ-S as a predictor. The primary hypotheses were that smokers with more motivation to quit smoking or less self-reported ability to tolerate the discomfort of smoking abstinence would have less abstinence from smoking at each time point. Since the IDQ-S subscale Lack of Cognitive Coping had a stronger relationship to number of past quit attempts than did other measures (Sirota et al., 2013), we hypothesized that this IDQ-S scale would be a stronger predictor of low rates of smoking abstinence during and after treatment than the Withdrawal Intolerance scale. We also reran analyses controlling for nicotine dependence severity to determine the incremental contribution of the other predictors, since nicotine dependence severity is considered the “gold standard” predictor. Secondly, we investigated the hypothesis that the IDQ-S scales would inversely correlate with a pretreatment motivation to change smoking, a question not investigated previously.

2. Methods

2.1 Participants

Participants were 184 smokers recruited from a 28-day inner city residential substance treatment program for a study of contingent vouchers plus counseling on smoking abstinence (Rohsenow et al., submitted). Participants did not need to want to quit smoking to be recruited. Participants had to be at least 18 years old, have substance abuse or dependence (see 2.2.1), and have smoked 10 or more cigarettes per day for at least 6 months, and not be engaged in any other smoking treatment. Patients were excluded for active psychosis (i.e., hallucinating or delusional), being actively suicidal, terminal illness, or unable to understand informed consent. The 30-patient residential program was abstinence-oriented and provided group substance education based on 12-Step models, with outpatient aftercare available. Detoxification was conducted elsewhere so no patients were in substance withdrawal. Smoking cessation was not addressed by the program but staff supported our efforts, and smoking was allowed outdoors at breaks.

2.2 Procedures

After providing informed content and completing pretreatment assessment that included two baseline breath carbon monoxide (CO) readings (collected using a Bedfont Micro Smokerlyzer®), participants were randomized to 19 days of contingent vouchers (CV) versus noncontingent vouchers (NCV), and to 4 sessions of Brief Advice to quit smoking (BA) versus Motivational Interviewing (MI) over the 19 days of vouchers. Both counseling methods were manualized motivational approaches adapted to address sobriety issues (see Rohsenow et al., submitted, for full description and outcome). Participants were told not to use pharmacotherapy for smoking during the voucher period (to avoid confounds with differential medication use) but free nicotine replacement (patch or gum) was available on request afterwards.

In CV, the voucher period began with a 5-day lead-in period during which vouchers could be earned for reductions from baseline in CO levels (once daily readings), followed by a 14-day period of twice-daily readings during which only CO ≤ 6 ppm earned vouchers. Voucher payments escalated with consecutive abstinent readings (from \$3 to \$16.50, total possible = \$433) and were reset to the lowest level when CO readings were missed or indicated non-abstinence (Higgins, Budney, Bickel, Foerg, & Badger, 1994). In the NCV condition, participants could earn the same average payment per day for providing scheduled breath samples (once daily for 5 days then twice daily for 14 days) regardless of CO level. Participants received vouchers with the amounts earned at each reading, with the vouchers redeemable for merchandise certificates to stores in the area.

Outcome assessments were conducted at 1 and 3 months after start of treatment. If breath alcohol was not $< .02$ g%, the interview was rescheduled, interviews were conducted away from the treatment facility whenever possible, and participants were assured that clinical staff would not be informed of any results (per Sobell & Sobell, 1986). Self-reported past 7-day point prevalence abstinence status at 1 and 3 months verified by CO ≤ 8 ppm and cotinine ≤ 15 ng/ml (for people not using nicotine replacement) are the dependent measures.

2.2.1 Measures—Substance abuse or dependence diagnoses were made using the criteria of the Structured Clinical Interview for DSM-IV Patient version (First et al, 1995), administered by trained research staff. Pretreatment questionnaires included demographics, smoking history, the Contemplation Ladder (Biener & Abrams, 1991), pretreatment average number of cigarettes per day over the past 7 days, and the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991). Lifetime number of 24-hour quit attempts was used from the smoking history questionnaire for descriptive purposes.

The IDQ-S has 17 items with two subscales derived from principal component analysis (Sirota et al., 2010): Withdrawal Intolerance (12 items), reflecting intolerance of affective, cognitive and physical symptoms of tobacco abstinence (e.g., “I cannot stand how I feel when I need a cigarette”, “I can’t stand the boredom that goes along with quitting cigarettes”); and Lack of Cognitive Coping (5 items), reflecting various ways to rationalize experiencing withdrawal (e.g., “It’s OK if I have to feel lousy for a while in order to quit smoking”, “I will feel irritable when quitting smoking but it will be temporary and I can deal with it”, “To get through a day without a cigarette, I think to myself, ‘no pain, no gain’”), reverse scored to keep the directions consistent in analyses to ease interpretation. Items are rated on Likert-rating scales from 1 = strongly disagree to 5 = strongly agree. In three previous samples, the scales had Chronbach’s alphas of .90 for Withdrawal Intolerance and .68 to .70 for Lack of Cognitive Coping (Sirota et al., 2010, 2013). The mean of all items is used for the total score for each scale.

At each follow-up assessment, using a daily calendar, participants were asked about number of cigarettes smoked per day for the previous 7 days; reports of complete abstinence were considered confirmed if CO of ≤ 10 ppm. Missed CO readings were considered indicative of smoking with the following exceptions: one participant became incarcerated at follow-up and since CO equipment was not allowed in prison, self-report was accepted (Brown, Strong et al., 2009); one participant died during follow-up for unrelated reasons and readings were coded as missing; four people missed single readings during the voucher phase due to off-site appointments, but since their other readings were all confirmed abstinent for days on either side of the missed reading, the missed reading was considered abstinent (O’Malley et al., 2006).

2.2.3. Human protections—All procedures were approved by the Institutional Review Board of Brown University. All payments were made in the form of merchandise certificates to area stores.

2.3. Data analysis methods

Preliminary analyses: First, variables were checked for assumptions of normality. All were normally distributed except two variables used only for descriptive purposes: minutes to first cigarette of day and number of times quit 24 hours or more. Second, the internal consistency of the two IDQ scales was verified with Chronbach’s alpha. Third, to replicate previous work, the two IDQ-scales were correlated with FTND score and pretreatment number of

cigarettes per day to determine the amount of shared variance among the measures. A hypothesis wide $p < .05$ is acceptable per Dar, Serlin and Omer (1994).

Participants randomized to the CV condition provide the best test of the predictors of abstinence during a voucher period ($n = 97$). The first 5 days of vouchers are a reduction lead-in period designed to prepare participants for abstaining during the full voucher period so only the 14-day voucher period after the preparation via reduction lead-in is analyzed. The control group was analyzed separately for comparison to see if results were unique to voucher-facilitated abstinence, given much lower rates of abstinence without vouchers. Participants from both treatment conditions ($n = 184$) are included in the predictions of outcome and correlations of IDQ-S with other measures.

Analyses of hypotheses: First, correlations between the two IDQ-S scales and the pretreatment Contemplation Ladder score were examined. Second, for participants in the CV condition ($n = 97$), the mean number of days with both CO readings showing abstinence during the 14-day abstinence period was regressed on the two IDQ-S scales, separately, so as to compare the variance accounted for by each predictor separately, while entering treatment condition (MI vs. BA) first as a covariate to control for its variance. The analysis was repeated for patients in the NCV condition to see if results were specific to CV. Because our interest is in the scales' unique variance rather than in the residual variance after controlling for variance shared with several other measures and because we are not interested in the linear combination of variables, multivariate analysis entering all predictors together was not considered (Dar, Serlin & Omer, 1994). The multivariate approach asks what the incremental role of each measure is while controlling for shared variance with all the other measures in that analysis. Entering all predictors together would make it hard to compare to other studies of distress tolerance that have different variables in their analyses, making for sample-bound results, and would make it hard for clinicians to know the value of each measure itself as a predictor. The primary purpose of our analyses was to test whether the IDQ subscales each predicted abstinence (univariate analyses of primary hypothesis), and then to explore whether that effect occurred above and beyond the effects shared with nicotine dependence. Even though controlling for variance that is an inherent part of a measure may not be an appropriate use of covariance (Miller & Chapman, 2001), it is of interest to know if the variance in IDQ-S not shared with FTND adds to ability to predict abstinence, and vice versa. Therefore, regressions of all but FTND were then rerun adding pretreatment FTND as an additional predictor so as to control for shared variance of each other predictor with nicotine dependence and thus determine the effects of incremental variance that did not overlap.

Third, again, the primary purpose of our analyses was to test whether the IDQ subscales each predicted abstinence (univariate analyses of primary hypothesis). The two IDQ-S scales were used to predict 7-day point prevalence abstinence at 1 and 3 months in all participants, using separate logistic regressions, entering treatment conditions (MI vs. BA and CV vs. NCV) first as covariates to control for their variance. To investigate the separate hypothesis that motivation to change is a better predictor of outcome than other measures of tobacco involvement, the same regressions were also run replacing IDQ-S subscales with Contemplation Ladder, FTND, and pretreatment number of cigarettes per day, separately, as

the predictors. Then to explore whether these effects were above and beyond the effects of dependence, analyses of all but FTND were then rerun while adding pretreatment FTND to control for shared variance between FTND and other predictors.

3. Results

3.1. Participant characteristics

Participant demographic and smoking characteristics are displayed in Table 1. The mean scores for both IDQ-S scales are virtually identical to the scores collected from 300 smokers recruited from the general population (Sirota et al., 2010), and the scores for FTND, cigarettes per day, minutes to first cigarettes and number of lifetime quit attempts are very similar to those smokers. In the present study, 69% met criteria for cocaine dependence, 60% for alcohol dependence, 50% for opiate dependence, 26% for marijuana dependence, 47% for both alcohol dependence and one or more other drug dependence diagnosis; 20% for more than one drug dependence but not alcohol dependence. Participants were highly dependent smokers whose mean response on the Contemplation Ladder was between “I often think about quitting smoking, but I have no plans to quit” and “I definitely plan to quit smoking in the next 6 months”. Participants attended a mean of 3.3 ± 1.1 [SD] of the four counseling sessions. Number of participants in analyses included $n = 184$ at baseline and $n = 183$ at each follow-up, and $n = 97$ people with data in the CV condition for analysis of predictors of abstinence during the voucher period. The counseling conditions had $n = 98$ in MI, $n = 86$ in BA.

3.2. Correlations with smoking measures and motivation

The IDQ-S had Chronbach's $\alpha = .90$ for Withdrawal Intolerance and $.76$ for Lack of Cognitive Coping. The two IDQ-S subscales correlated $r = .31$ with each other (9% of variance in common). Correlations between the IDQ-S scales and other smoking history measures and motivation to quit smoking, shown in Table 2, are in the expected directions but indicate no more than 12% of shared variance (square of the correlation).

3.3. Predicting smoking abstinence during and after treatment

Mean number of abstinent days during the voucher period for participants in the CV condition (25% of days) and 7-day point-prevalence abstinence rates at outcome for all participants are shown in Table 1. In regressions of abstinence days during the voucher period, counseling type was not significant but two significant predictors were found (see Table 3 for variable-specific statistics). Higher FTND scores predicted less abstinence, Model $R^2 = .06$, $F(2,93) = 3.11$, $p < .05$, and higher Withdrawal Intolerance scores from the IDQ-S predicted less abstinence, Model $R^2 = .09$, $F(2,94) = 4.57$, $p < .012$. When the regression on Withdrawal Intolerance was rerun together with FTND, Withdrawal Intolerance remained significant in relationship to abstinence during the voucher period (Table 3) while FTND was no longer significant, $F(1,92) = 1.96$, $p = .17$, with percentage of variance reduced from 5% to 2% ($sr^2 = .019$). The regressions for Lack of Cognitive Coping from the IDQ-S, cigarettes per day, and Contemplation Ladder were nonsignificant. All results were nonsignificant when rerun on the NCV condition, which showed abstinence on only 0.7 days (5% of days).

Results for logistic regressions predicting 7-day point-prevalence abstinence at follow-up are shown in Table 4. Pretreatment nicotine dependence and cigarettes per day pretreatment did not predict outcome. The IDQ-S scales were not significantly predictive of abstinence outcomes at 1 or 3 months, although there was a trend for people with 3-month abstinence to have lower Withdrawal Intolerance scores compared to those who smoked. When rerun controlling for pretreatment FTND, this relationship of Withdrawal Intolerance to 3-month point-prevalence abstinence was significant (abstinent, adjusted $M = 3.00 \pm 0.62$; smoked, adjusted $M = 3.61 \pm 0.70$). Pretreatment Contemplation Ladder score significantly predicted 1-month abstinence, with those abstinent at 1-month having higher pretreatment Ladder scores (adjusted $M = 6.16 \pm 1.73$) than those who smoked (adjusted $M = 4.97 \pm 1.38$). There was a trend for Pretreatment Contemplation Ladder score to predict 3-month abstinence (abstainers adjusted $M = 6.03 \pm 2.37$, smokers adjusted $M = 5.00 \pm 1.37$). When controlling for pretreatment FTND score, both relationships just missed significance ($p < .06$).

4. Discussion

The IDQ-S Withdrawal Intolerance scale significantly predicted lower motivation to quit smoking and less success with achieving abstinence during a voucher-based smoking treatment for smokers concurrently receiving treatment for substance use disorders. Higher nicotine dependence severity also predicted less success with achieving abstinence with contingent vouchers during the voucher period, but when shared variance with Withdrawal Intolerance was controlled in analyses, the relationship of nicotine dependence severity to abstinence became non-significant. FTND shared only 12% of variance with IDQ-S Withdrawal Intolerance (correlation squared), indicating that these measures mostly involve non-overlapping constructs, but variance in common partly accounted for the relationship of nicotine dependence severity to within-treatment abstinence. Possibly those aspects of nicotine dependence not in common with withdrawal intolerance reflect frequent smoking out of habit, or due to a heavy smoking social environment, or to cope with or enhance emotions, or for something to do with one's hands (e.g., Velicer, DiClemente, Rossi, & Prochaska, 1990) more than to mitigate withdrawal. Thus, smokers with greater nicotine dependence or less ability to tolerate the discomfort involved with nicotine withdrawal may fare less well with this kind of voucher based smoking treatment, or may require higher voucher values to attain and maintain abstinence. Results of the current study suggest that providing additional interventions, such as medications designed to mitigate withdrawal distress or effective cognitive-behavioral or exposure methods to learn to tolerate withdrawal distress, may be needed to improve outcomes for individuals being treated with contingent vouchers and counseling. We previously reported pilot study results showing rates of abstinence during contingent voucher more than doubling when we combined vouchers with nicotine replacement (Rohsenow et al., 2005), consistent with the recommendations to mitigate withdrawal distress during voucher-based treatment.

Of interest, abstinence during the voucher-based treatment was not predicted by pretreatment smoking rate, by degree of motivation to change or quit smoking, nor by reporting having cognitive coping methods for handling abstinence distress. Since Lack of Cognitive Coping was significantly related to number of past quit attempts in previous work with smokers in the general population (Sirota et al., 2013), cognitive coping may be more

relevant for unassisted quitting or smoking cessation based on other methods than for success with initial abstinence using contingent vouchers per se. These non-significant results suggest that providing cognitive coping skills to cope with withdrawal or trying to increase internal motivation may be less relevant when trying to increase the number of abstinent readings within the contingent voucher-based programs. It is useful to know that smokers high or low in motivation may be equally likely to achieve initial abstinence when provided the incentives of contingent vouchers, particularly among smokers who had not sought smoking treatment who therefore may overall have relatively lower initial readiness to quit smoking.

Abstinence at 1 month was significantly predicted only by Contemplation Ladder, consistent with our previous work where it outperformed FTND and cigarettes per day (Rohsenow et al., 2013), with a trend for Contemplation Ladder to predict 3-month abstinence. Once vouchers are no longer providing incentives for abstinence, initial intrinsic motivation to smoke is likely to play a more important role in sustaining any abstinence achieved during the voucher period. However, motivation to change is a state that is known to fluctuate over time (Prochaska et al., 1994) as other life experiences occur, and this may be why the effect of motivation levels as assessed at pretreatment are no longer significant 3 months after the voucher period. Shared variance with FTND meant that when controlling for nicotine dependence severity, the role of pretreatment motivation became a marginal trend (variance in motivation that was not shared with nicotine dependence severity did not significantly predict outcome), even though nicotine dependence itself did not predict outcome. Since only 3–4% of participants were confirmed abstinent at each outcome assessment in the present study, there was little relevant variance to be predicted so only strong effects could be detected.

There was a trend for Withdrawal Intolerance to predict 3-month abstinence despite there being little abstinence to predict. Interestingly, controlling for shared variance with pretreatment nicotine dependence severity resulted in Withdrawal Intolerance becoming a significant predictor of 3-month abstinence. Thus, the aspects of inability to tolerate smoking abstinence that are not due to degree of nicotine dependence are able to predict 3-month success at smoking abstinence while nicotine dependence severity itself did not predict success at either 1 or 3 months. While abstinence during the period immediately after the voucher period was determined more by pretreatment motivation to change, suggesting that motivation outweighs concerns about aversive effects of abstinence at that time, over time the ability to tolerate the discomfort of abstinence became a more important influence on ability to sustain abstinence. While motivation is likely to be a fluctuating state (Miller & Rollnick, 2002), the IDQ-S may tap a more stable set of beliefs that are able to exert influence on behavior after initial motivation changes. Thus, withdrawal intolerance goes beyond tobacco dependence in its influence on success after smoking treatment, indicating that this intolerance is a worthwhile target of intervention efforts in its own right. This relationship may be worth investigating in a future study that has higher abstinence rates during follow up and thus more variance to be accounted for.

4.1. Limitations and Future Directions

The study was limited to proactively recruited smokers who were not necessarily motivated to quit smoking at treatment start, as is characteristic of the population of smokers in SUD treatment. Indeed, the voucher-based treatment and two motivational counseling approaches were designed to motivate these smokers to attempt to quit smoking. Therefore, results could be different in more highly motivated participants who may be more likely to sustain smoking abstinence regardless of withdrawal discomfort. The study was also limited to smokers in treatment for substance dependence. However, this is an important population that is particularly resistant to smoking cessation efforts so finding predictors of abstinence outcomes is a particularly important effort for these difficult-to-treat smokers. Results could be different in smokers in treatment without SUD. However, these smokers with SUD had very similar scores on the IDQ-S and on smoking dependence and history measures to smokers from the general population (Sirota et al., 2010). Additionally, all participants were from one pool of urban inner-city smokers. The study was also limited to investigating contingent vouchers and two types of motivational counseling as the treatment approaches. If coping skills training were used or self-quits were studied, the IDQS Lack of Cognitive Coping scale might have better predictive power (given Sirota et al., 2013). Predictors of outcomes after other types of treatment need investigation. Despite these limitations, the current study provides valuable evidence about what constructs may or may not predict abstinence during and shortly after this type of voucher-based treatment for smoking cessation.

4.2. Conclusions

In conclusion, both the IDQ-S Withdrawal Intolerance scale and a measure of nicotine dependence severity were useful predictors of number of smoking abstinence days when using a voucher-based smoking treatment, with more variance accounted for by withdrawal intolerance (8% of variance) than by FTND (5% of variance). Since longer initial abstinence is associated with better treatment outcomes (Kenford et al., 1994; Westman et al., 1997), finding ways to increase abstinence readings is important for increasing efficacy of incentive-based approaches. Withdrawal intolerance, unlike withdrawal severity *per se*, is a set of beliefs or expectancies that can be assessed while smokers are not in withdrawal so as to predict abstinence attempts. The results indicate that withdrawal intolerance is associated with lower motivation to quit smoking and can interfere with willingness to try to quit smoking during the voucher period. The variance in Withdrawal Intolerance not shared with nicotine dependence severity also predicted abstinence at 3 months, suggesting that this set of beliefs may be fairly stable and able to exert lasting effects on behavior. These findings suggest that it is important to mitigate anticipated withdrawal distress for these smokers to even attempt to stop smoking. After vouchers ended, self-reported motivation to quit smoking was the strongest predictor of 1-month abstinence, which once again indicates the value of a motivation measure in identifying who is more likely to succeed after vouchers are discontinued. Therefore, it would be valuable for smoking cessation programs to continue to seek ways to help smokers to increase their ability to tolerate the discomfort associated with smoking cessation efforts, or to focus on adjunctive interventions

(behavioral or pharmacologic) that can help to reduce discomfort while smokers are in withdrawal, particularly in populations with substance use disorders.

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Abbreviations used

BA	brief advice
CV	contingent vouchers
CO	expired carbon monoxide
FTND	Fagerström Test for Nicotine Dependence
IDQ-S	Intolerance for Discomfort Questionnaire – Smoking
M	mean
MI	motivational interviewing
NCV	noncontingent vouchers
PVAMC	Providence Veterans Affairs Medical Center
SD	standard deviation
SUD	substance use disorders

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Highlights

- Withdrawal Intolerance and nicotine dependence predicted smoking during treatment
- Motivation to quit smoking predicted abstinence at 1 month.
- Withdrawal Intolerance, covarying tobacco dependence, predicted smoking at 3 months
- Treatments should help smokers mitigate or tolerate the discomfort of abstinence

Table 1

Characteristics of participants, scores on smoking measures, and abstinence

	Mean (S.D.) or n (%)
<i>Demographics and Diagnosis</i>	
Age	34.5 (8.2) (range = 18–54)
Education	12.2 (1.7) (range = 6–16)
Male	82 (45%)
Race	
White	153 (83%)
Black	17 (9%)
American Indian	5 (3%)
Other or mixed race	9 (5%)
Hispanic ethnicity	12 (7%)
Married or living together	20 (11%)
Employed full or part time	20 (11%)
Alcohol use diagnosis, past year	Dependence 60%; abuse 11%
Drug use diagnosis, past year	Dependence 88%; abuse 1%
<i>Smoking History, Rate, Dependence, IDQ-S</i>	
IDQ-S: Withdrawal Intolerance	3.4 (0.7)
IDQ-S: Lack of Cognitive Coping	2.5 (0.7)
Cigarettes per day	23.6 (11.2)
FTND score	5.4 (2.3)
Minutes to first cigarette of day	33.0 (44.6) (median = 15.0)
Number of times quit 24 hours or more	4.9 (12.5) (median = 1.0)
Contemplation Ladder	5.1 (1.4)
<i>Abstinence outcomes during and after treatment</i>	
Mean # days abstinent during voucher period*	3.5 (4.7)
Point-prevalence 7-day abstinence at 1 month	8 (4.4%)
Point-prevalence 7-day abstinence at 3 months	6 (3.3%)

Note: When distribution is significantly skewed, median is provided as additional information.

IDQ-S = Intolerance for Smoking Abstinence Discomfort Questionnaire

FTND = Fagerström Test for Nicotine Dependence total score

CO = expired carbon monoxide readings

* Mean during the 14 days after the lead-in period when abstinence was required to earn vouchers, contingent vouchers condition only

Table 2

Correlations of Intolerance for Discomfort Questionnaire-Smoking (IDQ-S) scales with smoking dependence, rate and motivation to quit smoking

	FTND total	# cigs/day past week	Contemplation Ladder
IDQ-S Withdrawal Intolerance	.34***	.14*	-.22***
IDQ-S Lack of Cognitive Coping	.11 [‡]	.02	-.26***

[‡] $p < .07$;

* $p < .05$;

** $p < .01$;

*** $p < .001$.

FTND = Fagerström Test for Nicotine Dependence total score

Note: n = 179 for FTND, otherwise n = 184.

Table 3

Linear regression results relating Intolerance for Discomfort Questionnaire-Smoking (IDQ-S) Scales, nicotine dependence severity, smoking rate, and motivation to quit (in separate regressions), to number of smoking abstinent days¹ during voucher-based treatment while covarying counseling condition. Regressions adding FTND as a second covariate are in the lower half.

	β	sr^2	Voucher period $F(1,93)$	p
IDQ-S: Withdrawal Intolerance	-0.29	.08	8.35	.005
IDQ-S: Lack of Cognitive Coping	-0.10	.01	0.99	<i>ns</i>
FTND total score	-0.23	.05	5.40	.02
Cigarettes per day	-0.13	.02	1.57	<i>ns</i>
Contemplation Ladder	0.16	.02	2.39	<i>ns</i>
<u>Covarying FTND</u>				
IDQ-S: Withdrawal Intolerance	-0.23	.05	4.69	.04
IDQ-S: Lack of Cognitive Coping	-0.07	.00	0.50	<i>ns</i>
Cigarettes per day	-0.04	.00	0.08	<i>ns</i>
Contemplation Ladder	0.12	.01	1.40	<i>ns</i>

FTND = Fagerström Test for Nicotine Dependence total score

¹ Days with both carbon monoxide readings indicative of abstinence.

Note: sr^2 indicates percentage of variance accounted for by the predictor.

Table 4

Logistic regression results relating Intolerance for Discomfort Questionnaire-Smoking (IDQ-S) Scales, nicotine dependence severity, smoking rate, and motivation to quit (in separate regressions), to confirmed 7-day point prevalence smoking abstinence at 1 and 3 months after initiating smoking treatment while controlling for voucher condition and counseling condition. Regressions adding FTND as a third covariate are in the lower half.

	1-month confirmed abstinence			3-month confirmed abstinence		
	Odds ratio	95% CI	Wald	Odds ratio	95% CI	Wald
IDQ-S: Withdrawal Intolerance	0.47	0.17–1.30	2.11	0.33	0.10–1.15	3.03
IDQ-S: Lack of Cognitive Coping	0.56	0.18–1.76	0.99	0.54	0.15–1.98	0.87
FTND total score	0.79	0.58–1.09	2.06	1.15	0.80–1.66	0.56
Cigarettes per day	0.97	0.91–1.05	0.55	1.01	0.95–1.09	0.14
Contemplation Ladder	1.72	1.05–2.81	4.68	1.61	0.92–2.80	10.80
<u>Covarying FTND</u>						
IDQ-S: Withdrawal Intolerance	0.55	0.19–1.60	1.20	0.24	0.06–0.93	4.29
IDQ-S: Lack of Cognitive Coping	0.58	0.18–1.88	0.83	0.51	0.14–1.83	1.07
Cigarettes per day	1.01	0.93–1.11	0.06	0.99	0.91–1.10	0.02
Contemplation Ladder	1.63	0.98–2.70	3.58	1.72	0.97–3.06	3.46

All $df = 1$, $n = 183$.

CI = Confidence interval.

FTND = Fagerström Test for Nicotine Dependence.

“Intolerance for withdrawal discomfort and motivation predict voucher-based smoking treatment outcomes for smoker with substance use disorders.”