The effect of successful and unsuccessful smoking cessation on short-term anxiety, depression, and suicidality

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HIGHLIGHTS

- The vast majority of quitting smokers do not have short-term increases in psychopathology.
- Changes in short-term psychopathology are comparable for successful and struggling quitters.
- Individuals with mood psychopathology are more likely to fail at quitting smoking.

ARTICLE INFO

ABSTRACT

Research on the mental health effects of quitting smoking is limited. Smokers with mental illness appear to be at a higher risk of unsuccessful smoking cessation. Recent work suggests they are at elevated risk for post-cessation increases in anxiety, depression and suicidal ideation. The current study tested the effects of successful and unsuccessful smoking cessation on short-term psychopathology in 192 community participants. Smoking cessation outcomes were classified using expired carbon monoxide levels that were taken at quit week, 1 and 2 week follow-up and 1 month follow-up. We found no psychopathology increases in participants who successfully quit smoking. For individuals struggling to quit our results partially supported a recently proposed struggling quitters hypothesis. However, the vast majority of individuals posited to be vulnerable by the struggling quitters hypothesis did not experience clinically significant increases in psychopathology. These findings have implications for clinicians whose clients are interested in smoking cessation.

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1. Introduction

The extant literature on mental health effects of successfully quitting smoking is limited. Some studies have found that quitting smoking can increase depressive symptoms among those with a history of depression (Borrelli et al., 1996; Dahl, 2004; Wright et al., 2010). Yet, other work has found smoking cessation does not necessarily have deleterious effects on mental health, and in some cases, may even be beneficial. Bomyea et al. (2013), for example, found no difference in the number of depressive episodes experienced by individuals who quit smoking as compared to those who did not quit. In a prospective study of successful quitters, one report found anxiety significantly decreased following the first week of smoking abstinence (Lambert, Cooley, Campbell, Benoit, & Stansbury, 2004). In addition, Yaworski, Robinson, Sareen, and Bolton (2011) found previously nicotine dependent people who have abstained for at least 1 year were significantly less likely to attempt suicide than people still dependent upon nicotine. Finally, Berlin,

Chen, and Covey (2010) showed that depression, anxiety, and suicidal ideation did not increase among successful quitters.

The empirical evidence related to the effects of struggling to achieve smoking cessation on mental health is limited to a single study. Berlin et al. (2010) investigated anxiety, depression, and suicidal ideation among those who were attempting to quit smoking but failing. In this group, anxiety, depression, and suicidality increased following the unsuccessful quit attempt in contrast with no changes in these mental health domains among those who successfully quit (Berlin et al., 2010). This finding led to the proposal of a 'struggling quitters hypothesis'. Namely, mood deterioration in unsuccessful quitters is the result of the disappointment with the failure of the quit attempt and the protracted withdrawal discomfort generated by struggling with urges to smoke for extended periods of time (Berlin et al., 2010).

Evaluating the mental health effects of failed quit attempts is important because this group represents the majority of smokers. Approximately 90–95% of smokers who quit on their own (Achenbach & Edelbrock, 1989) and 70–85% who attend treatment programs relapse within 1 year (Rapaport, Clary, Fayyad, & Endicott, 2005). Moreover, there are subgroups of smokers who appear to be at even greater risk for a failed quit attempt and these individuals may be more vulnerable

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to the deleterious effects of this type of failure. For example, individuals with increased rates of psychological disorders appear to be more likely to fail at their quit attempt (Silverman, Fleisig, Rabian, & Peterson, 1991; Silverman, Goedhart, Barrett, & Turner, 2003; Zvolensky & Bernstein, 2005). Therefore, in terms of the absolute number of individuals affected as well as certain vulnerable smoking subpopulations, it is arguably more important to examine the effect on mental health of unsuccessful quitting than successful quitting.

There are a number of limitations in the extant work on whether: (1) successful smoking cessation or (2) struggling to achieve smoking cessation affects mental health. For the first issue, impact of successful smoking cessation on mental health, previous findings of increased psychopathology among individuals quitting smoking successfully appears to be primarily found in smokers with a history of depression (Berlin et al., 2010; Dahl, 2004; Wright et al., 2010). Examination of this issue in a sample with diverse psychopathology is needed to better understand the broader context of potential effects. In regard to the second issue, effects of struggling to achieve smoking cessation on mental health, only one previous study has directly examined this issue (Berlin et al., 2010). One limitation of (Berlin et al., 2010) is that this study used single-item measures of anxiety and suicidal ideation with unknown reliability and validity. Measurement of these constructs with multi-item psychometrically validated measures is therefore needed. Another limitation is that the Berlin et al. (2010) sample focused on smokers with a history of depression. A sample that includes these diagnoses would be an important extension of this previous work because individuals with these diagnoses may be particularly at risk for reacting poorly to smoking cessation. The struggling quitters hypothesis may only apply to these individuals and not to those without mood psychopathology. In addition, the report did not include information about smokers who went through the smoking cessation program but decided not to quit. Information about this group would further clarify the struggling quitters hypothesis as this group would likely have disappointment about investing time in a smoking program but not quitting, yet would not have the protracted withdrawal discomfort of those trying to quit but failing. Finally, struggling quitters experienced increases in mood, anxiety and suicidal ideation. However, the clinical significance of these increases is unknown.

The primary aim of the current study was to test the effects of successful and unsuccessful smoking cessation outcomes on changes in anxiety, depression, and suicidal ideation using well validated measures in a sample with diverse levels of current psychopathology including subsamples of individuals with anxiety diagnoses and individuals with past/current depression diagnoses. The related aim was to test the Berlin et al. (2010) struggling quitters hypothesis that unsuccessful smoking cessation leads to a worsening of mental health symptoms in the overall sample as well as the two subsamples (i.e., individuals with anxiety disorders, individuals with current/past depression disorders). To help dismantle the proposed causes of the struggling quitters hypothesis (i.e. disappointment, prolonged withdrawal discomfort), we also included a group of smokers who went through the smoking cessation program but decided not to quit. Based on the only empirical work to date, we hypothesized that unsuccessful quitters in the overall sample and the anxiety sample would not show increases in psychopathology (Bomyea et al., 2013; Lambert et al., 2004). However, we did expect unsuccessful quitters in the depression diagnosis subsample to show increases in anxiety, depression, and suicidal ideation (Berlin et al., 2010). Based on the modest increases reported in the Berlin et al. (2010) study we did not expect these increases to be clinically significant.

2. Method

2.1. Participants

The sample consisted of 192 adult smokers ages 18–68 years ($M = 42.15$, $SD = 12.81$; 58.3% female) recruited from the general

community through various media outlets including newspaper ads, flyers, and radio announcements. To be eligible for inclusion, participants had to be 18 years of age or older, a daily smoker for at least 1 year, currently smoke a minimum of 8 cigarettes per day, and report motivation to quit smoking within the next month. Participants were excluded if they were psychotic, using any other smoking cessation pharmacotherapy or other tobacco products. The ethnic and racial composition of the current sample was as follows: 85.1% White/Caucasian, 6.5% Black Non-Hispanic, .6% Black Hispanic, 4.8% Hispanic, 1.2% Asian, and 1.8% Other. Approximately half (47%) of the sample was married or living with someone, whereas 24.4% were never married, 20.2% were divorced, 4.8% were separated, and 3.6% were widowed. Among the sample, 4.2% never graduated from high school, 15.5% had a high school diploma or the equivalent, 28.6% completed some college, 10.1% graduated with a 2-year degree, 21.4% graduated with a 4-year degree, 7.1% completed some graduate or professional school, and 13.1% completed graduate or professional school. Additionally, 33.3% of the sample met criteria for a current or past depression diagnosis, 32.8% for a current or past anxiety diagnosis, and 32.3% received no diagnosis.

2.2. Procedure

Interested participants, who also met the initial requirements during a telephone screen, were scheduled to come in for a structured clinical interview to assess for the presence or absence of any Axis I condition (SCID-N/P; First, Spitzer, Gibbon, & Williams, 1994). Individuals who were deemed eligible after the screening/interview process were then scheduled to come in for a baseline appointment to complete various demographic, smoking, anxiety, and substance use assessments. After the baseline assessment, participants were randomly assigned to either a standard smoking cessation program or an anxiety-based management smoking cessation program. Treatment consisted of four 90-minute sessions with a trained therapist. Following the treatment phase, participants were followed up periodically over a 2 year period where they completed biochemical breath verification of smoking status and self-report questionnaires during sessions that lasted around 1 h. Informed consent was obtained from all participants and the study was approved by the university's Institutional Review Board. The study is registered on clinicaltrials.gov # NCT01753141.

2.3. Measures

2.3.1. Inventory of Depression and Anxiety Symptoms (IDAS)

The IDAS is a 64-item self-report questionnaire in which respondents were asked to read a list of feelings, sensations, problems, and experiences, and rate the degree to which each statement describes their feelings and experiences during the past two weeks (Watson et al., 2007). Ratings are made using a 5-point likert scale ranging from 1 (*not at all*) to 5 (*extremely*). The IDAS yields 10 specific symptom scales. In the current study, *suicidality* was measured using the IDAS — suicidality subscale, which is comprised of 6 items (e.g. "I had thoughts of suicide," "I hurt myself purposely"). *Depression* was measured using the IDAS general depression scale, which is a broader scale containing items overlapping with several other IDAS scales. *Anxiety* was measured by combining the three anxiety-relevant subscales (i.e. panic, social anxiety, and traumatic intrusions). Research has demonstrated that the IDAS subscales have good internal consistency, short-term stability, and convergent and discriminant validity (Watson et al., 2007).

2.3.2. Smoking cessation status

To determine the three different categories of smoking cessation status, i.e. those who (1) continuously quit smoking (successful quitters), (2) quit smoking but relapsed at some point (struggling quitters), and (3) who did not quit smoking (non-quitters) we utilized biochemically verified breath samples. Breath samples were taken at quit week,

one-week follow-up, two-week follow-up and one-month follow-up appointments. Expired air carbon monoxide levels were assessed with a Bedfont Scientific carbon monoxide monitor (Jarvis, Tunstallpedoe, Feyerabend, Vesey, & Saloojee, 1987). Detected values above the stated cutoff scores (3 ppm) were considered indicative of smoking within the past 24 h. The value of 3 ppm has been found to have the best combination of sensitivity and specificity in previous work on assessing smoking abstinence with a high degree of certainty (Javors, Hatch, & Lamb, 2005).

3. Results

3.1. Missing data, descriptive statistics, and preliminary analyses

The current data was taken from a large smoking cessation trial. There were 192 participants with information available ($N = 31$ for successful quitters, 62 for struggling quitters, and 99 for non-quitters). Cases were included as long as data was present for at least 1 measurement occasion. There was data available for 191 participants at baseline, 159 participants at quit week, 156 participants at week one, 142 participants at week two, and 126 participants at the one month follow-up. Overall, 88 participants had complete data across measurement occasions. Means, standard deviations, and correlations are presented in Table 1.

3.2. Latent growth curve models of anxiety, depression, and suicidality

Latent growth curve models were used to test the hypotheses regarding differences in initial levels and growth in anxiety and depression symptoms and suicidality in successful quitters, struggling quitters, and non-quitters. In all latent growth curve models conducted, baseline pretreatment status was used as a covariate to control for initial symptom levels and gender and age were entered as covariates. Gender was utilized as a covariate because of the higher rates of mood and anxiety disorders in women and because mood/anxiety psychopathology appears particularly relevant in smoking cessation outcomes for women (APA, 2000; Perkins, 2001). Age was entered as a covariate to control for the differential smoking cessation success rate by age (Osler & Prescott, 1998). Models were centered on the first week for which individuals were supposed to quit smoking to provide an estimate of whether groups were similar in initial levels of anxiety, depression, and suicidality. Growth curve models were fit using Mplus version 6 (Muthén and Muthén, 1998-2011) using Full Information Maximum Likelihood to account for missing data and the Yuan–Bentler scaled chi-square (Y–B χ^2) for adjustments to correct standard errors for non-normality and non-independence (Capron, Norr, Macatee, & Schmidt, 2013). The Y–B χ^2 statistic and other fit indices (i.e., comparative fit index [CFI], root mean square error of approximation [RMSEA]) were used to assess overall model fit. A non-significant Y–B χ^2 indicates that the overall test of model fit was acceptable as do a CFI value greater than or equal to .95 and a root mean square error of approximation below .06 (Capron, Norr, Zvolensky, & Schmidt, 2013). The Y–B χ^2 statistical significance test, the CFI, RMSEA, and the Bayesian information criterion (BIC) were used to compare models with varying constraints between groups (i.e., intercept and slope constraint). Lower BIC values indicate better model fit(Raftery, 1993). Because constrained models are more parsimonious than lesser constrained models, models with more constraints were accepted as providing better fit to the data when there was no difference between models as determined by the χ^2 statistical significance test.

Models were compared stepwise, first by comparing constraints between pairs of slopes and slopes across all groups to the fully unconditional model. In the event that models constraining all slopes to equality and constraining pairs of slopes to equality both fit better than the baseline model, these models were compared to determine if the model with all parameters constrained across groups fit as well as the

model with pairs of constraints across groups. The better fitting model was used as the baseline model for imposing varying levels of constraints on the intercepts between the groups.[1]

For suicidality, there was limited variance in the slope for the abstainer group. Therefore, group differences could not be examined using a model comparison approach. To overcome this limitation, an overall growth curve model was examined and group membership status was entered as a covariate in the model to determine if it significantly predicted the intercept or the slope.

We first tested our hypothesis that anxiety levels would remain stable post-treatment and that cessation status (i.e., abstainer, partial abstainer, non-abstainer) would not influence these levels. Constraining the slopes of the successful quitters and the struggling quitters to equality did not result in significantly worse fit than the fully unconstrained model. Constraining the slopes of the successful quitters and the non-quitters also did not result in significantly worse fit than the fully unconstrained model. Constraining all the slopes to equality did result in significantly worse model fit. Because the models were not nested, the BIC was compared between the two models that fit as well as the baseline model. The model with the slopes of the successful quitters and the non-quitters constrained to equality had a slightly lower BIC and was selected as the baseline model for comparing equality constraints across intercepts.

Constraining all the intercept values to equality across groups provided similar fit to the data as compared to the baseline model and the models with constraints imposed across pairs of groups. Therefore, the best fitting model of anxiety was determined to be the model for which all intercepts were constrained to equality and the slopes of the successful quitters and the non-quitters were constrained to equality.

Unstandardized parameter estimates and effects of predictor variables were examined by group for the best-fitting model of anxiety (see Table 2). There was significant variance for the intercept within each group, suggesting that there were significant differences between individuals in their initial level of anxiety symptoms. The slope parameter was not significant indicating that there was no growth across time on average within any of the groups. Further, the slope variance was not significant, indicating that this pattern was similar between individuals. Baseline levels of anxiety predicted initial levels and growth of anxiety symptoms for the struggling quitters and the non-quitters. There were no other significant predictors. Our hypotheses regarding anxiety were supported as the best-fitting model was one in which the intercepts were constrained to equality across groups and the slope parameters were not significant within group, indicating no growth in anxiety symptoms.

For depression, we hypothesized that there would not be significant differences in initial levels a growth in depressive symptoms for struggling quitters as compared to successful quitters and non-quitters. For the models, a non-significant negative residual variance in month one depression scores was fixed to zero. Constraining the slopes of all three groups to equality did not result in significantly worse fit as compared to the fully unconditional baseline model or as compared to the two models for which pairs of constraints were imposed across groups and this model was selected as the baseline model for constraining intercepts. Regarding intercept constraints, the model for which the intercepts were constrained to equality for the struggling quitters and the non-quitters fit as well as the baseline model. No other models fit as well and the model for which the slopes were constrained to equality and the intercepts for the struggling quitters and the non-quitters

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[1] Because multiple therapists ($N = 13$) administered the intervention, the necessity of modeling therapist effects was examined. Specifically, unconditional baseline models were examined to determine whether design effects (calculated based on the average cluster size and intraclass correlations [ICCs]) exceeded two, which would indicate nontrivial variance accounted for by therapist effects (Muthén & Satorra, 1995). Across anxiety, depression, and suicidality models, design effects did not approach this threshold for intercepts, slopes, and individual timepoints. Therefore, it was not necessary to model therapist effects in the analysis.

Table 1
Means, standard deviations and correlations for anxiety and depression symptoms and suicidality.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. BL Anx	1														
2. QW Anx	.60	1													
3. W1 Anx	.62	.79	1												
4. W2 Anx	.56	.80	.88	1											
5. M1 Anx	.50	.69	.82	.88	1										
6. BL Dep	.69	.47	.47	.48	.51	1									
7. QW Dep	.38	.61	.58	.65	.66	.63	1								
8. W1 Dep	.36	.55	.62	.66	.64	.56	.84	1							
9. W2 Dep	.48	.54	.59	.63	.63	.61	.79	.81	1						
10. M1 Dep	.40	.48	.68	.67	.74	.67	.81	.75	.82	1					
11. BL Suic	.52	.27	.33	.27	.32	.57	.22	.20	.31	.26	1				
12. QW Suic	.33	.41	.35	.28	.30	.31	.45	.27	.27	.21	.42	1			
13. W1 Suic	.39	.39	.57	.55	.62	.35	.38	.38	.38	.38	.53	.73	1		
14. W2 Suic	.44	.34	.51	.44	.48	.40	.39	.33	.44	.35	.62	.61	.76	1	
15. M1 Suic	.38	.31	.53	.57	.63	.41	.58	.34	.37	.60	.37	.47	.56	.55	1
Mean	23.08	22.58	22.14	22.32	22.53	39.29	37.15	35.88	36.01	37.13	6.78	6.36	6.30	6.36	6.62
SD	6.73	6.20	6.03	6.85	7.82	12.21	11.29	10.04	11.01	12.63	1.61	1.03	.85	1.13	1.65

Note. BL Anx = Baseline Anxiety score. QW Anx = Quit-Week Anxiety score. W1 Anx = Week 1 Anxiety score. W2 Anx = Week 2 Anxiety score. M1 Anx = Month 1 Anxiety score. BL Dep = Baseline Depression score. QW Dep = Quit-Week Depression score. W1 Dep = Week 1 Depression score. W2 Dep = Week 2 Depression score. M1 Dep = Month 1 Depression score. BL Suic = Baseline Suicide score. QW Suic = Quit-Week Suicide score. W1 Suic = Week 1 Suicide score. W2 Suic = Week 2 Suicide score. M1 Suic = Month 1 Suicide score. SD = standard deviation.
All p's ≤ .05.

were constrained to equality was selected as the best fitting model. Fit statistics revealed that whereas this was the best fitting model, the model did not fit the data well (i.e., significant S–B χ^2, CFI = .90, RMSEA = .14).[2] Therefore, some caution should be taken when interpreting this model.

Unstandardized parameter estimates and effects of predictor variables were examined by group for the model in which the intercepts were constrained to equality for the struggling quitters and the non-quitters and the slopes were constrained to equality across groups (see Table 3). There was significant variance for the intercept within each group, suggesting that there were significant differences between individuals in their initial level of depression symptoms. The slope parameter was not significant indicating that there was no growth across time on average within any of the groups. The slope variance was significant, indicating that, for each group, there was significant variability between individuals in growth of depression symptoms. Baseline levels of depression predicted initial levels of depression symptoms for the struggling quitters and the non-quitters only. Baseline levels of depression predicted growth in depression symptoms for the successful quitters and struggling quitters only. There were no other significant predictors. These findings supported our hypotheses that there would be no differences in initial levels of depression or growth of depressive symptoms over time in struggling quitters as compared to the successful quitters and the non-quitters.

Growth curve analysis for suicidality was conducted by including quit group membership as a covariate in the model to determine the effect of group membership on initial status and growth in suicidality. It was hypothesized that there would be no growth in suicidality and that there would be no group differences both in initial level of suicidality and in growth. The model with quit group membership, baseline suicidality, age, and gender in the model provided excellent fit to the data (S–B $\chi^2 = 16.15$, $p > .05$, CFI = .98, RMSEA = .04). Model parameter estimates were examined to determine the importance of group classification (see Table 4). There was significant intercept variance indicating that individuals differed in their initial status of suicidality. The slope was not significant, indicating no growth. There were no significant predictors of either intercept or slope. This indicates, as hypothesized, that group status did not affect initial levels or growth of suicidality.

Because data for this study was collected as part of a smoking intervention, growth curve models were also examined to determine whether these results were robust to the intervention. All analyses were examined with treatment condition (i.e., anxiety-based management smoking cessation program [treatment] or standard smoking cessation program [control]) as a covariate. There were 17 participants in the treatment condition and 14 participants in the control condition for the abstainer group, 32 participants in the treatment condition and 30 participants in the control condition for the partial abstainer group, and 50 participants in the treatment condition and 49 participants in the control condition for the non-abstainer group. There were no significant effects of treatment condition across anxiety, depression, and suicidality models. There were few other differences when including treatment condition. Regarding model constraints for anxiety, the best-fitting model was one for which all non-significant slopes were equal across groups instead of just between the abstainers and non-abstainers. For depression, all intercepts were equal across groups, instead of just between the partial abstainers and non-abstainers. There were no other differences in results when treatment condition was included.

3.3. Examination of effects of anxiety diagnosis on intercepts and slopes

Diagnostic information regarding anxiety psychopathology was available for all participants in the sample. Individuals were assessed for all anxiety disorders. The anxiety disorders subgroup had individuals diagnosed with every anxiety disorder except agoraphobia (i.e. panic disorder, social phobia, specific phobia, obsessive compulsive disorder, post-traumatic stress disorder, anxiety disorder not otherwise specified). To examine whether there were intercept and slope differences between individuals diagnosed with an anxiety disorder, these values were extracted from the latent growth curve models, and mean differences between those diagnosed with an anxiety disorder were examined within group (i.e., successful quitters, non-quitters, struggling quitters). There were 55 individuals in the anxiety disorder subgroup. For successful quitters, there were 9 individuals (23%) diagnosed with an anxiety disorder. There were no differences in intercept and slope values across levels of anxiety symptoms, depression symptoms, and suicidality by diagnosis for the successful quitters. For struggling quitters, there were 23 individuals (37%) diagnosed with an anxiety disorder. There were no differences in intercept and slope values across levels of anxiety, depression, and suicidality for struggling quitters.

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[2] We attempted to rectify model fit by including a quadratic slope term. Although this did result in significantly better fit indices, a model with a quadratic function did not fit significantly better than the linear model.

Table 2
Unstandardized parameters by group for the best-fitting latent growth curve model of anxiety.

	Successful quitters		Struggling quitters		Non-quitters	
	Unstandardized parameters	SE	Unstandardized parameters	SE	Unstandardized parameters	SE
Intercept	22.58***	.53	22.58***	.53	22.58***	.53
Intercept variance	17.11*	7.44	22.66*	10.61	15.01***	4.37
Slope	−.26	.15	.27	.22	−.26	.15
Slope variance	.61	.58	.35	.71	.24	.38
Covariance	−.08	1.30	1.67	1.49	1.64	.99
Intercept predictors						
Baseline anxiety	.24	.19	.48**	.16	.65***	.11
Age	.03	.07	−.03	.04	.03	.04
Gender	−2.04	1.23	−.16	1.13	.51	.78
Slope predictors						
Baseline anxiety	.05	.05	.13**	.04	−.07***	.02
Age	−.01	.03	.01	.01	−.01	.01
Gender	.57	.56	.08	.33	.28	.20

Note.
*** $p \leq .001$.
** $p \leq .01$.
* $p \leq .05$.

For non-quitters, there were 23 individuals (23%) diagnosed with an anxiety disorder. Individuals in this group diagnosed with an anxiety disorder had initial levels of anxiety symptoms of 25.73 ($SD = 6.01$) which was significantly greater than initial levels of anxiety symptoms ($M = 22.38, SD = 5.75$) for those without an anxiety disorder diagnosis ($F = 5.89, p = .02$). There were also mean differences in initial levels of depression symptoms for those diagnosed with an anxiety disorder ($M = 42.46, SD = 11.46$) compared to those not diagnosed with an anxiety disorder ($M = 36.51, SD = 9.56; F = 6.21, p = .01$). There were no other within-group significant differences.

3.4. Examination of effects of past or current depression diagnosis on intercepts and slopes

Diagnostic information regarding major depressive disorder (MDD) also was available for all participants in the sample. Mean and slope differences were examined in a similar fashion to how they were examined for anxiety psychopathology (i.e., within groups and across the entire sample). There were 64 individuals in the depression subsample. The vast majority of individuals in the current/past depression subgroup had past depression (94%). For successful quitters, there were 9 individuals (23%) diagnosed with current or past MDD. There were no differences in intercept and slope values across levels of anxiety symptoms, depression symptoms, and suicidality by diagnosis for the successful quitters. For struggling quitters, there were 24 individuals (39%)

diagnosed with current or past MDD. Individuals in this group diagnosed with MDD had significantly higher initial levels of suicidality ($M = 6.48, SD = .89$) compared to those not diagnosed with MDD ($M = 6.09, SD = .31$). Individuals in this group diagnosed with MDD had significantly higher anxiety symptom slopes (M slope = .63, $SD = 1.25$) compared to those not diagnosed with MDD (M slope = .04, $SD = .57; F = 6.38, p = .01$). Individuals in the group diagnosed with MDD also had significantly higher depression symptom slopes (M slope = 1.14, $SD = 2.02$) compared to those not diagnosed with MDD (M slope = .001, $SD = 1.35; F = 7.09, p = .01$). For non-quitters, there were 31 individuals (31%) diagnosed with current or past MDD. Individuals in this group diagnosed with MDD had significantly higher initial levels of depression symptoms ($M = 41.14, SD = 36.41$) compared to those not diagnosed with MDD ($M = 36.41, SD = 9.96; F = 4.68, p = .03$). Depression, anxiety and suicidality scores across all time points for the depression and anxiety subgroups are displayed in Table 5.

3.5. Clinical significance of increases among past or current depression diagnosis subgroup

To examine the clinical significance of the increases in anxiety and depression symptoms experienced by the past/current depression subgroup, we utilized Wunderlich, Bronisch, and Wittchen (1998) two-fold criterion for clinically significant change. The first aspect involves

Table 3
Unstandardized parameters by group for the best-fitting latent growth curve model of depression.

	Successful quitters		Struggling quitters		Non-quitters	
	Unstandardized parameters	SE	Unstandardized parameters	SE	Unstandardized parameters	SE
Intercept	33.24***	1.60	37.89***	.92	37.89***	.92
Intercept variance	33.24*	13.27	65.33**	23.72	59.59***	14.91
Slope	.12	.19	.12	.19	.12	.19
Slope variance	2.23*	.88	3.01**	1.17	3.24***	.87
Covariance	.97	2.28	−5.02*	2.32	−1.77	2.76
Intercept predictors						
Baseline depression	.33	.20	.39*	.17	.64***	.10
Age	.07	.08	−.05	.09	.03	.07
Gender	−.44	2.18	−1.69	1.83	−.23	1.73
Slope predictors						
Baseline depression	.06*	.03	.08*	.04	.01	.03
Age	.003	.03	.01	.03	.01	.02
Gender	.03	.72	.60	.63	.13	.43

Note.
*** $p \leq .001$.
** $p \leq .01$.
* $p \leq .05$.

Table 4
Latent growth curve model estimates predicting suicidality by cessation status group membership and covariates.

	Unstandardized parameters	SE
Intercept	6.15[***]	.09
Intercept variance	.47[**]	.18
Slope	.07	.04
Slope variance	.004	.02
Covariance	−.01	.04
Intercept predictors		
Quit status	.11	.06
Baseline suicidality	.23	.14
Age	.001	.004
Gender	.02	.13
Slope predictors		
Quit status	−.06	.03
Baseline suicidality	.05	.04
Age	−.002	.002
Gender	.10	.06

Note.
[***] $p \leq .001$.
[**] $p \leq .01$.

calculating a post-treatment cut-off point which makes it more likely an individual is a member of either a dysfunctional or functional distribution. Second, a reliable change index (RCI) is calculated to determine whether the magnitude of change for a given client is statistically reliable [see Wunderlich et al. (1998) for formula]. Based on these criteria, only 1 participant of the 64 in the past/current depression diagnosis subgroup met for a clinically significant increase in mood or anxiety symptoms. This participant met for a clinically significant increase in both mood and anxiety symptoms (quit week IDAS depression = 38; month one follow-up IDAS depression = 64; RCI depression = 3.86; quit week IDAS anxiety total = 23, quit week IDAS anxiety total = 36; RCI anxiety = 2.9).

4. Discussion

This study was focused on elucidating the effects of (1) successful smoking cessation and (2) struggling to achieve smoking cessation on anxiety, depression, and suicidal ideation. The results of the current study demonstrate that successful quitters did not show significant changes in depression, anxiety, or suicidal ideation over a one-month period. These findings are consistent with previous literature that examined outcomes of smoking cessation and found no significant short-term increases in psychopathology (Berlin et al., 2010; Bomyea et al., 2013; Lambert et al., 2004). Additionally, the majority of extant research on mental health outcomes of smoking cessation examines depression or history of depression. First, we extended previous findings in this area by showing that successful quitters in our depression subgroup (94% history of MDD) did not experience short-term increases in psychopathology. Next, we extended this area by examining the effect of smoking cessation in individuals with and without current anxiety disorder diagnoses. As expected, anxiety disorder status did

Table 5
Mean scores on psychopathology assessments across time points.

	Baseline	Quit week	Week 1	Week 2	Month 1
Anxiety subgroup					
Anxiety	25.69	24.70	24.29	24.95	26.09
Depression	45.54	41.02	39.56	39.02	41.80
Suicidality	6.97	6.56	6.48	6.56	7.06
Depression subgroup					
Anxiety	24.45	23.65	22.9	24.18	25.21
Depression	44.17	39.86	39.00	40.26	41.91
Suicidality	6.86	6.29	6.36	6.44	6.93

Note. Anxiety = Inventory of depression and anxiety symptoms anxiety scales; Depression = Inventory of depression and anxiety symptoms general depression scale; Suicidality = Inventory of depression and anxiety symptoms suicidality scale.

not affect depression, anxiety, or suicidal ideation after successful smoking cessation. Although these findings need to be replicated, the current results suggest that successfully quitting smoking cessation does not contribute to adverse mental health outcomes, even in clients with current psychopathology.

For those struggling to achieve smoking cessation, our results partially support the 'struggling quitters hypothesis' that unsuccessful quitters experience mood deterioration that is the result of disappointment with the failure of their quit attempt (Berlin et al., 2010). Consistent with the Berlin et al. (2010) findings, our results indicate that individuals with past depression who were unsuccessful in their quit attempt showed significant short-term increases in depression and anxiety. However, we did not find similar increases in suicidal ideation. This discrepancy may have been because Berlin et al. (2010) used a single-item method to assess suicidal ideation whereas we employed a multi-item measure that was psychometrically sound (Watson et al., 2007). Also, in contrast to the struggling quitters hypothesis, we did not observe any increases in psychopathology for the anxiety disorder group or the overall sample. This finding suggests that the struggling quitters hypothesis appears to be specific to those with depression and thus is consistent with past work (Dahl, 2004; Lambert et al., 2004; Wright et al., 2010; Yaworski et al., 2011). However, we found that only 1 participant out of 64 in the depressed subsample met criteria for clinically significant increase in mood or anxiety symptoms.

To extend the research on the struggling quitters hypothesis, we also included a non-quitters group (individuals who went through the smoking cessation program but chose not to quit). The struggling quitters hypothesis posits that increases in psychopathology occur because of disappointment with failed quit attempts and protracted withdrawal discomfort. This non-quitter group is interesting to examine because they likely had disappointment from attending a four-week treatment but not attempting to quit smoking, yet would not have experienced discomfort from protracted withdrawal symptoms. We did not find increases in depression, anxiety, or suicidal ideation among this group. This finding suggests that the protracted withdrawal discomfort and not disappointment may well be driving increases in mood and anxiety symptoms in the struggling quitters.

The present findings have implications for clinicians with clients who smoke and have elevated psychopathology. Possible concerns about the effect of quitting smoking on mental health problems is similar to the debate about alcohol among clinicians thirty years ago. Clinicians observed that a high rate of individuals started smoking after quitting alcohol. A "common sense" notion developed that attempting to have these individuals quit smoking would result in increased stress that could jeopardize their alcohol sobriety. Therefore, some clinicians were hesitant to support client's attempts to quit smoking (Novak, Burgess, Clark, Zvolensky, & Brown, 2003). However, empirical examination found that recovering alcoholics could successfully quit smoking without abandoning alcohol sobriety (Novak et al., 2003). Although these results need to be replicated for firm recommendations to be made, the current results suggest that clinicians working with clients who successfully quit smoking, like these alcohol clinicians, should support maintenance of cessation. Our results suggest that individuals who both have a history of depression and who are struggling to quit may expect increases in depressive and anxiety symptoms. However, it is extremely rare (in our sample there was only 1 case) for these increases to be clinically significant.

The results from our non-quitters group suggest that protracted withdrawal discomfort may contribute to post-cessation increased symptoms of depression and anxiety. Commercially available forms of nicotine-replacement therapy (NRT; e.g., patches, gum) have been found to reduce withdrawal discomfort and increase rates of smoking cessation (Buckner et al., 2011). Although NRT may be more successful for men than women (Killen, Fortmann, Newman, & Varady, 1990; Wetter et al., 1999), limiting NRT use in women is not advised because NRT is still effective, safe and available compared with non-NRT drugs

(Perkins, 2001). Therefore, recommending NRT for struggling quitters may be useful, especially for men. In addition, empirically supported therapies and medication for treating mood disorders may also be effective, particularly with female struggling quitters (Butler, Chapman, Forman, & Beck, 2006; Thase & Denko, 2008).

There were some limitations in the current study. First, levels of current depression and suicidality in the current sample were low. Individuals with current depression may be experiencing anhedonia and anergia, which would make them unlikely to be motivated enough to join a multi-session smoking cessation treatment study. Future work in this area should utilize samples with higher levels of current depression and suicidality as they may be more reactive to successful or unsuccessful smoking cessation attempts. Second, the one-month follow-up period is somewhat brief. Although this follow-up allowed for us to see short-term changes in mood and anxiety symptoms, it would have been ideal to follow the trajectory of mood and anxiety symptoms longer. However, according the National Cancer Institute side effects of smoking such as increased anxiety and irritation peak within the first 1–2 weeks of smoking and usually last less than a month (Weems, Hammond-Laurence, Silverman, & Ferguson, 1997). Third, the present sample is comprised of adult smokers who volunteered to participate in a prevention intervention study for monetary reward. Thus, this sample of smokers may be at greater risk for smoking cessation difficulties or have greater motivation to quit smoking than the general smoking population. It will be important for researchers to draw as well from a non-treatment seeking sample to see if these findings extend to the larger smoking population. Likewise, the level of nicotine dependence in this sample was relatively low. To further enhance the generalizability of these results, it may be useful to replicate and extend the present findings to heavier smoking samples to evaluate if similar patterns emerge. Finally, the number of participants in each subgroup was not particularly large. These results should be replicated with larger samples of smokers with depression and anxiety to strengthen the conclusions drawn from this report.

Together, the present study represents a notable contribution to an important and somewhat controversial public health issue. The present findings suggest that the vast majority of individuals do not experience clinically-significant short-term changes in depression, anxiety, or suicidality after successfully quitting smoking or struggling to quit. However, more research attention should be paid to developing smoking cessation treatments specifically for those with mood psychopathology because it appears these individuals are both more likely to fail at smoking cessation and also more likely to experience deleterious mental health outcomes.

Contributors

Daniel Capron developed the manuscript idea and wrote the first draft of the manuscript. Nicholas Allan ran the analyses and wrote the final results section. Aaron Norr wrote the final methods section and consulted on the development of the manuscript. Dr. Zvolensky was the PI of the study and advised throughout, including editing the final manuscript. Dr. Schmidt advised throughout the study and contributed to the finished version of the manuscript.

Conflict of interest

All authors report no conflicts of interest.

References

Achenbach, T. M., & Edelbrock, C. (1989). *Manual for the youth self-report and profile.* University of Vermont, Department of Psychiatry.

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

Berlin, I., Chen, H., & Covey, L. (2010). Depressive mood, suicide ideation and anxiety in smokers who do and smokers who do not manage to stop smoking after a target quit day. *Addiction, 105*, 2209–2216.

Bomyea, J., Lang, A. J., Craske, M. G., Chavira, D., Sherbourne, C. D., Rose, R. D., et al. (30 August 2013). Suicidal ideation and risk factors in primary care patients with anxiety disorders. *Psychiatry Research, 209*(1), 60–65.

Borrelli, B., Niaura, R., Keuthen, N. J., Goldstein, M. G., DePue, J.D., Murphy, C., et al. (1996). Development of major depressive disorder during smoking-cessation treatment. *Journal of Clinical Psychiatry, 57*(11), 534–538.

Buckner, J.D., Zvolensky, M. J., Smits, J. A. J., Norton, P. J., Crosby, R. D., Wonderlich, S. A., et al. (2011). Anxiety sensitivity and marijuana use: An analysis from ecological momentary assessment. *Depression & Anxiety, 28*, 420–426 (1091–4269).

Butler, A.C., Chapman, J. E., Forman, E. M., & Beck, A. T. (2006). The empirical status of cognitive–behavioral therapy: A review of meta-analyses. *Clinical Psychology Review, 26*(1), 17–31. http://dx.doi.org/10.1016/j.cpr.2005.07.003.

Capron, D. W., Norr, A.M., Macatee, R. J., & Schmidt, N.B. (2013). Distress tolerance and anxiety sensitivity cognitive concerns: Testing the incremental contributions of affect dysregulation constructs on suicidal ideation and suicide attempt. *Behavior Therapy, 44*, 349–358.

Capron, D. W., Norr, A.M., Zvolensky, M. J., & Schmidt, N.B. (2013). Prospective evaluation of the effect of an anxiety sensitivity intervention on suicidality among smokers. *Cognitive Behaviour Therapy, 1–11*.

Dahl, R. E. (2004). Adolescent brain development: A period of vulnerabilities and opportunities. Keynote address. *Annals of the New York Academy of Sciences, 1021*, 1–22.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1994). *Structured clinical interview for DSM-IV disorders non-patient version.* New York: Biometrics Department, New York State Psychiatric Institute.

Jarvis, M. J., Tunstallpedoe, H., Feyerabend, C., Vesey, C., & Saloojee, Y. (1987). Comparison of tests used to distinguish smokers from nonsmokers. *American Journal of Public Health, 77*, 1435–1438.

Javors, M.A., Hatch, J. P., & Lamb, R. J. (2005). Cut-off levels for breath carbon monoxide as a marker for cigarette smoking. *Addiction, 100*, 159–167.

Killen, J.D., Fortmann, S. P., Newman, B., & Varady, A. (1990). Evaluation of a treatment approach combining nicotine gum with self-guided behavioral treatments for smoking relapse prevention. *Journal of Consulting and Clinical Psychology, 58*(1), 85.

Lambert, S. F., Cooley, M. R., Campbell, K. D.M., Benoit, M. Z., & Stansbury, R. (2004). Assessing anxiety sensitivity in inner-city African American children: Psychometric properties of the Childhood Anxiety Sensitivity Index. *Journal of Clinical Child & Adolescent Psychology, 33*, 248–259.

Muthén, L. K., & Muthén, B. O. (1998-2011). *Mplus User's Guide* (Sixth Edition). Los Angeles, CA: Muthén & Muthén.

Muthén, B. O., & Satorra, A. (1995). Complex sample data in structural equation modeling. *Sociological Methodology, 25*, 267–316.

Novak, A., Burgess, E. S., Clark, M., Zvolensky, M. J., & Brown, R. A. (2003). Anxiety sensitivity, self-reported motives for alcohol and nicotine use, and level of consumption. *Journal of Anxiety Disorders, 17*, 165–180.

Osler, M., & Prescott, E. (1998). Psychosocial, behavioural, and health determinants of successful smoking cessation: A longitudinal study of Danish adults. *Tobacco Control, 7*(3), 262–267. http://dx.doi.org/10.1136/tc.7.3.262.

Perkins, K. A. (2001). Smoking cessation in women: Special considerations. *CNS Drugs, 15*(5), 391–411.

Raftery, A. E. (1993). Bayesian model selection in structural equation models. In K. A. Bollen, & J. S. Long (Eds.), *Testing structural equation models* (pp. 163–180). Beverly Hills, CA: Sage.

Rapaport, M. H., Clary, C., Fayyad, R., & Endicott, J. (2005). Quality-of-life impairment in depressive and anxiety disorders. *American Journal of Psychiatry, 162*, 1171–1178.

Silverman, W. K., Fleisig, W., Rabian, B., & Peterson, R. A. (1991). Childhood anxiety sensitivity index. *Journal of Clinical Child and Adolescent Psychology, 20*, 162–168.

Silverman, W. K., Goedhart, A. W., Barrett, P., & Turner, C. (2003). The facets of anxiety sensitivity represented in the Childhood Anxiety Sensitivity Index: Confirmatory analyses of factor models from past studies. *Journal of Abnormal Psychology, 112*, 364.

Thase, M. E., & Denko, T. (2008). Pharmacotherapy of mood disorders. *Annual Review of Clinical Psychology, 4*, 53–91.

Watson, D., O'Hara, M. W., Simms, L. J., Kotov, R., Chmielewski, M., McDade-Montez, E. A., et al. (2007). Development and validation of the Inventory of Depression and Anxiety Symptoms (IDAS). *Psychological Assessment, 19*, 253–268.

Weems, C. F., Hammond-Laurence, K., Silverman, W. K., & Ferguson, C. (1997). The relation between anxiety sensitivity and depression in children and adolescents referred for anxiety. *Behaviour Research and Therapy, 35*, 961–966.

Wetter, D. W., Kenford, S. L., Smith, S. S., Fiore, M. C., Jorenby, D. E., & Baker, T. B. (1999). Gender differences in smoking cessation. *Journal of Consulting and Clinical Psychology, 67*(4), 555.

Wright, K. D., Asmundson, G. J., McCreary, D. R., Stewart, S. H., McLaughlin, E., Comeau, M. N., et al. (2010). Confirmatory factor analysis of the Childhood Anxiety Sensitivity Index: A gender comparison. *Cognitive Behaviour Therapy, 39*, 225–235.

Wunderlich, U., Bronisch, T., & Wittchen, H. U. (1998). Comorbidity patterns in adolescents and young adults with suicide attempts. *European Archives of Psychiatry and Clinical Neuroscience, 248*, 87–95.

Yaworski, D., Robinson, J., Sareen, J., & Bolton, J. M. (2011). The relation between nicotine dependence and suicide attempts in the general population. *Canadian Journal of Psychiatry-Revue Canadienne De Psychiatrie, 56*, 161–170.

Zvolensky, M. J., & Bernstein, A. (2005). Cigarette smoking and panic psychopathology. *Current Directions in Psychological Science, 14*, 301–305.