Psychiatric diagnoses among quitters versus continuing smokers 3 years after their quit day

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ABSTRACT

Background: People with psychiatric disorders are more likely to smoke and smoke more heavily than the general population, and they suffer disproportionally from smoking-related illnesses. However, little is known about how quitting versus continuing to smoke affects mental health and the likelihood of developing a psychiatric diagnosis. This study used data from a large prospective clinical trial to examine the relations of smoking cessation success with psychiatric diagnoses 1 and 3 years after the target quit day.

Methods: This study enrolled 1504 smokers (83.9% white; 58.2% female) in a cessation trial that involved the completion of the Composite International Diagnostic Interview to assess psychiatric diagnoses and biochemical confirmation of point-prevalence abstinence at Baseline and Years 1 and 3.

Results: Regression analyses showed that, after controlling for pre-quit (past-year) diagnoses, participants who were smoking at the Year 3 follow-up were more likely to have developed and maintained a substance use or major depressive disorder by that time than were individuals who were abstinent at Year 3.

Conclusions: Quitting smoking does not appear to negatively influence mental health in the long-term and may be protective with respect to depression and substance use diagnoses; this should encourage smokers to make quit attempts and encourage clinicians to provide cessation treatment.

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1. Introduction

Cigarette smoking is strongly linked with psychopathology (Aubin et al., 2011). Smoking is especially prevalent among individuals with psychiatric disorders and some psychiatric disorders are related to both smoking heaviness and increased relapse likelihood (Aubin et al., 2011; Grant et al., 2004; Lasser et al., 2000; Piper et al., 2010). Clinicians who treat patients with mental illness all too rarely provide these patients with smoking cessation interventions (Hall, 2007; Lembke et al., 2007; Richter, 2006), despite evidence that such smokers are as motivated to quit smoking as are other smokers (McClave et al., 2010) and suffer disproportionately from smoking-related diseases (Schroeder and Morris, 2010).

While it is clear that smoking and psychopathology are strongly comorbid (Aubin et al., 2011), some aspects of their relationship remain relatively unexplored. For instance, it is unclear what smoking cessation, versus continued smoking, portends for the

future likelihood of mental illness. The evidence relating cessation to future trajectories of psychiatric symptomatology is very limited. The extant studies tend to: comprise small samples that are restricted to psychiatric populations (Baker et al., 2010); rarely assess or report formal diagnoses; and employ cross-sectional rather than longitudinal designs.

From the extant data and various theories of psychopathology, it is possible to argue that smoking cessation could either increase or decrease the incidence and/or severity of subsequent psychopathology. For instance, both clinicians and smokers have suggested that smoking cessation might deprive smokers of an important affective coping strategy and might, therefore, exacerbate mental illness or jeopardize sobriety from other additive substances (Aubin et al., 2011; Brandon and Baker, 1991; Hitsman et al., 2009; Johnson et al., 2010; Prochaska, 2011; Solway, 2011; Weinberger et al., 2010; Ziedonis et al., 2008). Research shows that nicotine withdrawal is stressful and exacerbates negative affect (Hughes, 2006; Piasecki et al., 2000), and cessation may exacerbate the symptoms of depression (Glassman et al., 2001; Pomerleau et al., 2000) and/or schizophrenia (Cole et al., 2010). There is also evidence that loss of reinforcement may induce or worsen depression (e.g., Lewinsohn, 1974; see Aubin et al., 2011 for a discussion of other possible mechanisms), which suggests

that cessation-related loss of smoking reinforcement could increase depression.

Conversely, some theories and data suggest that smoking cessation should either reduce psychopathology, or at least *not* worsen it. For instance, some evidence suggests that smokers with diagnosed psychopathology are able to quit smoking without significant increases in their psychiatric symptomatology (e.g., Baker et al., 2006, 2010; McFall et al., 2010; Schroeder and Morris, 2010). In theory, quitting smoking might reduce psychopathology through a variety of mechanisms. For instance, smoking could be considered a stressor, especially in light of the iterative cycles of withdrawal smokers experience between cigarettes (e.g., Hendricks et al., 2006). Therefore, ongoing smoking might result in affective dysregulation from which abstinent smokers would eventually recover (Parrott, 1994). Also, smoking may increase the likelihood that smokers are exposed to cues and opportunities that foster psychopathology (e.g., smoking may promote entry into social networks where other types of substance use and abuse are common) and quitting could reduce such exposure.

Bearing in mind the limitations of cross-sectional research, the available evidence from such research on the impact of cessation on mental health yields a fairly consistent pattern in which current smokers report worse mental health than never-smokers or former smokers (Murphy et al., 2003). Virtually, no cross-sectional data show that quitters have more severe psychopathology than those who continue to smoke (Berlin et al., 2010). However, it is difficult to draw strong inferences from such findings. It might be that smokers with less severe psychopathology are the ones able to quit; i.e., quitting does not influence psychopathology, but rather severe psychopathology impedes quitting. If it could be established that smoking cessation does not negatively affect long-term mental health, such findings could be used to boost smokers' willingness to make quit attempts and clinicians' willingness to intervene with their patients who smoke.

The present research uses data from a large prospective clinical trial to examine the relation of smoking status with psychiatric diagnoses, as well as changes in affect, 1 and 3 years following smoking cessation treatment. Strengths of the trial include its longitudinal design with pre-cessation baseline assessments, the lengthy follow-up interval, the relatively large sample size, and the use of formal psychiatric diagnoses based on structured interviews. These data will allow us to explore whether successful quitters versus continuing smokers have different likelihoods of meeting criteria for psychiatric diagnoses in the 3 years following their target quit day and whether cessation influences self-reported positive and negative affect. These findings could inform theories that attempt to account for links between psychopathology and tobacco use (e.g., Aubin et al., 2011).

2. Method

2.1. Recruitment and inclusion/exclusion criteria

Participants were recruited in Madison and Milwaukee, WI, to participate in a comparative efficacy smoking cessation clinical trial. Recruitment methods included TV, radio, and newspaper advertisements, community flyers, and earned media (e.g., interviews, press releases). Inclusion criteria included smoking ≥10 cigarettes per day on average for the past 6 months and being motivated to quit smoking. Exclusion criteria included current use of any medications contraindicated for use with the study's smoking cessation pharmacotherapies (e.g., current use of monoamine oxidase inhibitors, bupropion, lithium, anticonvulsants, or antipsychotics); any history of psychosis, bipolar disorder, or an eating disorder (contraindications for bupropion); consuming six or more alcoholic beverages daily 6 or 7 days a week (again, a contraindication for bupropion); pregnancy or breastfeeding; and serious health conditions that would prevent participation in or completion of the study. This study received human subjects' approval from the University of Wisconsin Health Sciences Institutional Review Board, and was registered with clinicaltrials.gov as number: Clinical trial registration: Smoking Cessation Medications: Efficacy, Mechanisms and Algorithms: NCT00332644. For more details see Piper et al. (2010).

2.2. Procedure

Participants who passed a phone screen attended an information session and provided written informed consent. Next, participants underwent multiple screenings, including a medical history screening, vital signs assessment, and a carbon monoxide breath test and completed demographic, smoking history, the Positive and Negative Affect Scale (PANAS; Watson et al., 1988) and tobacco dependence questionnaires. At a subsequent baseline visit, participants completed the World Mental Health Survey Initiative version of the Composite International Diagnostic Interview (CIDI; Kessler and Ustun, 2004; World Health Organization, 1990). Finally, eligible participants were randomized to one of six treatment conditions: bupropion sustained release ($n = 264$); nicotine lozenge ($n = 260$); nicotine patch ($n = 262$); nicotine patch plus nicotine lozenge ($n = 267$); bupropion sustained release plus nicotine lozenge ($n = 262$), or placebo (five placebo conditions that matched the five active conditions; $n = 189$). All participants received six individual 10–20 min counseling sessions led by bachelor's-level case managers supervised by a licensed clinical psychologist. All medications were provided for 8 weeks after the target quit day except the nicotine lozenge, which was provided for 12 weeks after the target quit day (consistent with prescribing instructions). Randomization was conducted in a double-blind fashion using a blocked randomization scheme with blocking on gender and race (White versus non-White). At 1 and 3 years after the target quit day participants completed the CIDI interview, additional questionnaires, including the PANAS, and a smoking status assessment.

2.3. Measures

2.3.1. Smoking status. Participants provided a breath sample at all study visits to permit alveolar carbon monoxide (CO) analysis, using a Bedfont Smokerlyzer (Bedfont Scientific, Rochester, England). Cessation outcomes were defined as biochemically confirmed (CO < 10 ppm) 7-day point-prevalence abstinence at 1 and 3 years after the target quit day. We used the intent-to-treat principle such that smokers who did not provide outcome data were assumed to be smoking.

2.3.2. World mental health survey initiative version of the CIDI. The CIDI (Kessler and Ustun, 2004; World Health Organization, 1990) is a structured clinical interview administered with Computer Assisted Personal Interviews (CAPI), Version 20 by trained study personnel certified by a CIDI trainer. The CIDI modules provided both past-year diagnoses (i.e., within the past 12 months) as well as lifetime diagnoses (i.e., ever in the participant's lifetime, including in the past-year) for Depression, Mania, Panic Disorder, Social Anxiety Disorder (SAD), Generalized Anxiety Disorder (GAD), Alcohol Abuse and Dependence/Drug Abuse and Dependence, and Attention Deficit Disorder (ADD). The CIDI used in this research did not allow assessment of current psychiatric illness (e.g., occurring within the past 2 weeks; cf. First et al., 1998). Therefore, a smoker with a past-year diagnosis may or may not have been experiencing clinically significant symptoms at the time of the interview.

2.4. Analytic plan

Analyses were conducted using Predictive Analytics SoftWare (PASW) Statistics version 18.0 (SPSS Inc., Chicago, IL, USA). Logistic regression was used to examine the relation between smoking status (quit = 1 versus smoking = 0) and psychiatric diagnoses at Years 1 and 3 (diagnosis = 1 versus no diagnosis = 5). Linear regression was used to conduct similar analyses using negative and positive affect as the dependent variables. We analyzed diagnoses separately and then, to increase power, we created composite diagnostic categories by combining panic attack, GAD, and SAD to form an anxiety disorders category and combining alcohol and drug abuse or dependence disorders into a substance use disorder (SUD) category.

We also examined how diagnoses changed over time and how those changes were related to smoking status. Multinomial logistic regression was used to examine whether smoking status was related to differences in five diagnostic transition categories over three time points (Baseline, Year 1, and Year 3) with those with no past-year diagnosis across all three time points serving as the reference group. The likelihood of having no past-year diagnosis across all three time points was compared against the likelihood of having: (1) a past-year diagnosis at all three time points; (2) no past-year diagnosis at baseline but developing and maintaining a past-year diagnosis by Year 3 (i.e. no diagnosis at baseline, but diagnosis at Year 1 and Year 3, or diagnosis only at Year 3); (3) a baseline past-year diagnosis that resolved by Year 3 (i.e. a baseline diagnosis but no diagnosis at Year 1 and Year 3, or a diagnosis at baseline and Year 1 but not at Year 3); or (4) a fluctuating diagnosis (i.e. no past-year diagnosis at baseline and Year 3 but a past-year diagnosis at Year 1; or a past-year diagnosis at baseline and Year 3 but no past-year diagnosis at Year 1). Assessment of the relation between smoking status and diagnostic transitions was conducted separately for major depression, SUD, and anxiety diagnoses.

In the above analyses, we controlled for diagnosis in the past 12 months to address the possibility that a smoker might currently be symptomatic or vulnerable to an increase in psychiatric symptoms, given their recent diagnosis. We also conducted the same analyses controlling for lifetime diagnosis and with and without controlling for smoking cessation treatment condition. We did not control for all variables that differed significantly among diagnostic groups so as not to partial out variance in the naturally occurring diagnostic groups that was intrinsic to the nature
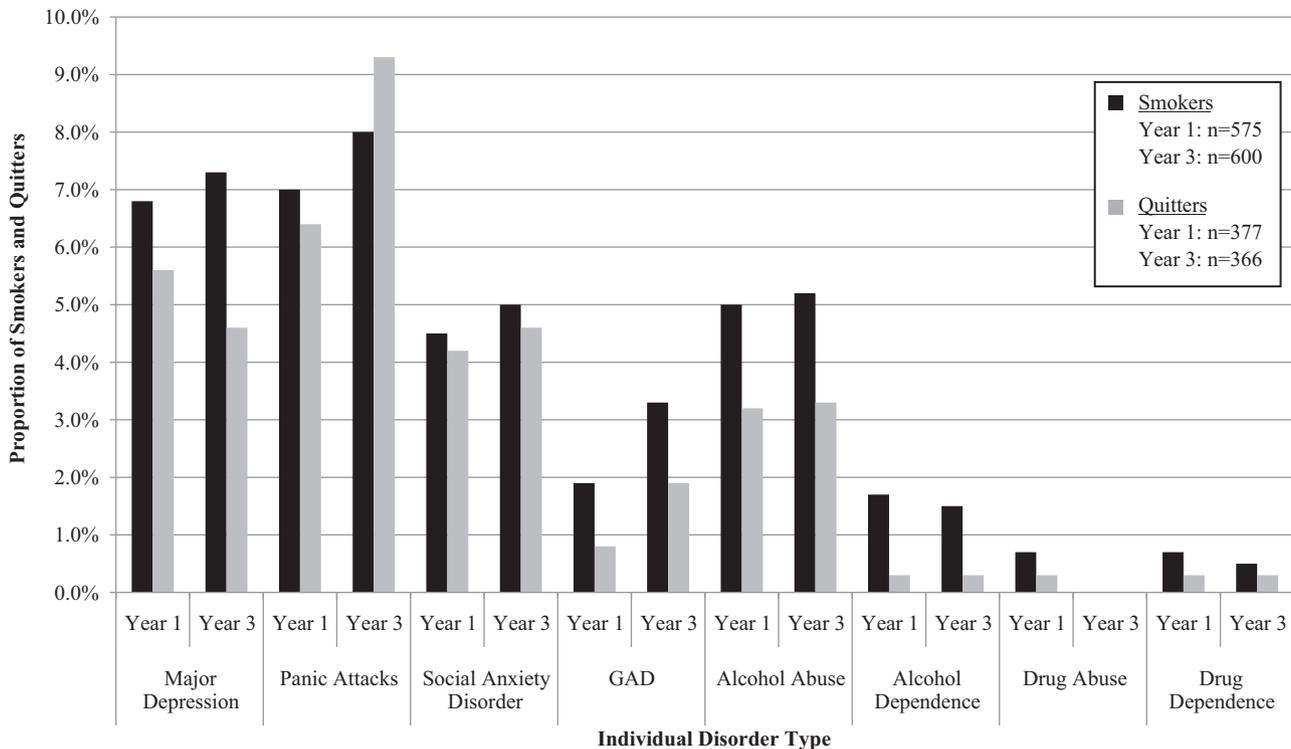
Note. Participants may have more than one diagnosis at any time point.

Fig. 1. Individual disorder diagnoses in past 12 months by smoking status.

of the diagnoses examined (Cohen et al., 2003). For instance, we opted not to statistically control for comorbid psychiatric diagnoses, given that controlling for other comorbidities could parse out meaningful variance associated with psychiatric disorders (due to symptom overlap between diagnoses). Such an approach would limit our ability to detect meaningful relations between psychiatric diagnoses and smoking outcomes. Further, we believed that the most clinically relevant and most easily interpreted outcome was new diagnoses, not diagnosis likelihood with comorbidity statistically controlled. It is clearly the case that comorbidity was common however (i.e. in the current sample we found that 45.4% of the original 1504 participants met diagnostic criteria for two or more non-tobacco use diagnoses in their lifetime; Piper et al., 2010).

3. Results

3.1. Participants

Of the 1504 participants randomized into the study, 1470 (58.2% women) completed the CIDI interview at baseline, and only data from these 1470 participants were analyzed for this paper. The majority of participants were White (84.0%); 13.4% were African American, and 2.6% reported being another race; 2.8% reported parents of Hispanic origin. At baseline, 44.6% of participants were married, 5.6% reported less than a high school education, 23.6% had a high school education, and 70.8% had more than a high school education. On average, participants were 44.72 (SD = 11.13) years old and smoked 21.43 (SD = 8.94) cigarettes per day. Additional study details, including the CONSORT diagram, are reported in a separate article (Piper et al., 2010).

### 3.2. Frequency of psychiatric diagnoses

Of the 1470 participants who completed the CIDI interview at baseline, 952 of the 1034 who returned at Year 1 completed the CIDI at Year 1, and 966 of the 1001 who returned for Year 3 follow-up completed the Year 3 CIDI (participants may have declined the

CIDI and there were a few technical issues that resulted in lost data). Therefore, we had 92–97% completion of the CIDI among participants who attended the follow-up visits; however, only 65–66% of the original 1470 participants completed follow-up CIDI interviews.

At baseline, there were 1106 (75.2%) who met criteria for a psychiatric diagnosis ever in their lifetime (including in the past year). Among those with a lifetime diagnosis, 815 (73.7%) were diagnosed with an SUD, 579 (52.4%) with an anxiety disorder, and 259 (23.4%) with major depression. At baseline, 332 participants (22.6% of the Baseline sample) received a past-year psychiatric diagnosis, 174 (18.3% of those completing the Year 1 CIDI) received a past-year diagnosis at Year 1, and 183 (18.9% of those completing the Year 3 CIDI) received a past-year diagnosis at Year 3. Chi-square analyses revealed that baseline past-year diagnoses of depression, anxiety or SUD were unrelated to cessation status at Year 1 and Year 3.

At Year 1, among the 952 participants with CIDI data, 575 (60.4%) were currently smoking and 377 (39.6%) were abstinent. The most common individual psychiatric diagnosis within the past year was panic attack (n = 64, 6.7%); 40 (7.0%) smokers and 24 (6.4%) quitters had panic attacks (see Fig. 1). Past-year anxiety disorder was the most common composite diagnostic category at Year 1 with 99 (10.4%) participants diagnosed with an anxiety disorder in the last 12 months; 62 (10.8%) smokers and 37 (9.8%) quitters had a past-year anxiety disorder at Year 1 (see Fig. 2).

At Year 3, among the 966 participants with CIDI data, 600 (62.1%) were currently smoking and 366 (37.9%) were abstinent. Within the past year, panic attack was the most common individual diagnosis (n = 88, 8.5%); 48 (8.0%) smokers and 34 (9.3%) quitters were diagnosed with past-year panic attack at Year 3 (see Fig. 1). As in Year 1, anxiety diagnosis were the most common composite diagnostic category with 120 participants (12.4%) diagnosed with a past-year anxiety disorder at Year 3, of which 74 (12.3%) were smokers and 46 (12.6%) were quitters (see Fig. 2).
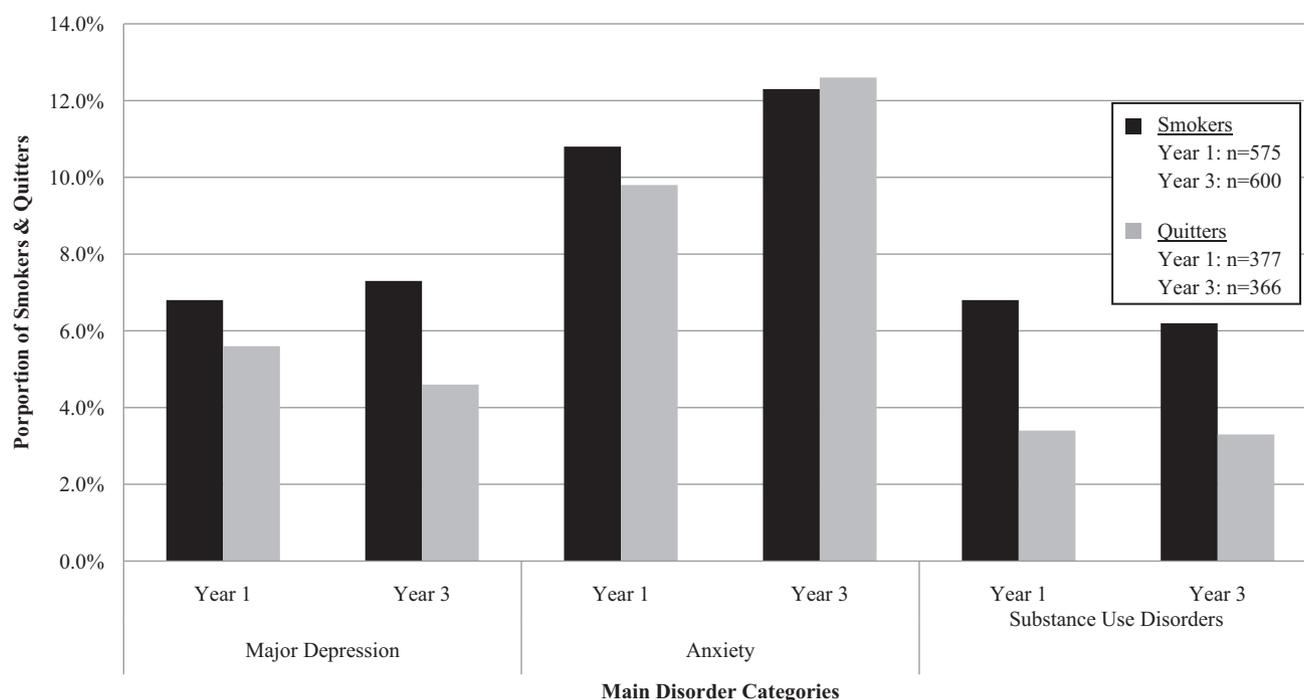
Note. Participants may have more than one diagnosis at any time point.

Fig. 2. Main disorder category diagnoses in past 12 months by smoking status.

3.3. Cessation outcomes

Logistic regression was used to examine the relation between smoking status (quit versus smoking) and psychiatric diagnostic category at Year 1 and Year 3 separately, controlling for past-year diagnosis at baseline. Smoking at Year 1 was significantly associated with an SUD diagnosis in the first 12-months following the quit attempt ($Wald = 7.43$, $p = .006$, $OR = 2.62$, 95% $CI = 1.31–5.24$). Similarly, after controlling for past-year SUD diagnosis at baseline, smoking at Year 3 was significantly associated with a Year 3 SUD diagnosis ($Wald = 4.24$, $p = .04$, $OR = 2.04$, 95% $CI = 1.03–4.01$). Smoking status at Year 1 was not related to depression at Year 1, but the relation of smoking at Year 3 with risk of major depressive disorder at Year 3 approached significance, after controlling for past-year depression at baseline ($Wald = 3.29$, $p = .07$, $OR = 1.75$, 95% $CI = .96–3.19$). Anxiety diagnoses were not significantly related to smoking status at either Year 1 or Year 3.

Linear regression revealed that, after controlling for baseline affect, participants who were abstinent at Years 1 and 3 had significantly less negative affect (Year 1: $\beta = -0.20$, $p < .001$; Year 3: $\beta = -0.19$, $p < .001$) and significantly more positive affect (Year 1: $\beta = 0.15$, $p < .001$; Year 3: $\beta = 0.07$, $p < .01$).

Multinomial regression analyses showed that participants who were smoking at Year 3 were more than twice as likely to have developed and maintained an SUD diagnosis in the 3 years following the quit attempt (i.e., the likelihood of being diagnosed by at least Year 3 amongst those who had no past-year SUD diagnosis at baseline) than were those who quit smoking ($Wald = 5.15$, $p = .02$, $OR = 2.51$, 95% $CI = 1.13–5.56$). Similarly, Year 3 smokers were significantly more likely to develop and maintain major depression relative Year 3 abstainers ($Wald = 3.87$, $p = .049$, $OR = 1.97$, 95% $CI = 1.003–3.85$). Smoking status did not significantly predict transitions in anxiety diagnoses (see Table 1).

The aforementioned regression analyses were also run while controlling for tobacco cessation treatment condition. Similar effects were found, but the finding that smoking at Year 3 was significantly associated with the development and maintenance of major depression went from being significant ($p = .049$), to non-significant ($p = .052$). We also found similar results in the logistic analyses when we controlled for lifetime rather than past year diagnosis, with the exception that abstinence at Year 3 was only marginally related to SUD diagnoses at Year 3 ($p = .06$).

4. Discussion

This research provides no support for the notion that quitting smoking is associated with a decline in mental health during the first few years of abstinence, after controlling for pre-quit diagnoses within the year prior to the quit attempt. In fact, these results suggest that quitting smoking may reduce the risk of developing substance use disorders and major depression, as well as decrease negative affect and increase positive affect. These findings are consistent with other evidence that smoking cessation treatment and quitting smoking increase long-term abstinence from illicit drugs and alcohol (Kohn et al., 2003; Tsoh et al., 2011). Further, these results agree with previous findings that quitting smoking did not increase anxiety symptoms (Berlin et al., 2010; Hitsman et al., 2003).

Previous research has not shown a protective effect of cessation on the development of depression. In fact, some evidence from case reports indicates that smokers with a history of major depression (Vazquez and Becona, 1998), and even those without a history of major depression, may be more likely to have depressive episodes during smoking cessation (Bock et al., 1996; Stage et al., 1996). The results of the current prospective clinical trial, however, suggest that to the extent that cessation-related exacerbations of depression occurred, they did not manifest in increased rates of depression diagnosis over the first 3 years post-quit. In fact, as noted, successful quitters were less likely to develop depression than were continuing smokers.

Table 1
Frequency of diagnostic transition categories for three main disorder categories for smokers versus quitters at Year 3.

Disorder category	No diagnosis at all 3 time points			Diagnosis at all 3 time points			No diagnosis at Baseline but developed and maintained diagnosis by Year 3			Baseline diagnosis that resolves by Year 3			Fluctuating diagnosis		
	Total	Smoker	Quitter	Total	Smoker	Quitter	Total	Smoker	Quitter	Total	Smoker	Quitter	Total	Smoker	Quitter
Major depression	688 (87.6%)	411 (86.9%)	277 (88.8%)	7 (0.9%)	4 (0.8%)	3 (1.0%)	39 (5.0%)	27* (5.7%)	12* (3.8%)	20 (2.5%)	12 (2.5%)	8 (2.6%)	31 (3.9%)	19 (4.0%)	12 (3.8%)
Substance use disorders	686 (87.4%)	411 (86.9%)	275 (88.1%)	7 (0.9%)	4 (0.8%)	3 (1.0%)	29 (3.7%)	21* (4.4%)	8* (2.6%)	40 (5.1%)	19 (4.0%)	21 (6.7%)	23 (2.9%)	18 (3.8%)	5 (1.6%)
Anxiety	588 (74.9%)	355 (75.1%)	233 (74.7%)	18 (2.3%)	9 (1.9%)	9 (2.9%)	60 (7.6%)	36 (7.6%)	24 (7.7%)	67 (8.5%)	40 (8.5%)	27 (8.7%)	52 (6.6%)	33 (7.0%)	19 (6.1%)

Note: Percentages are based on the total number of participants in each group (total n = 785, smoker n = 473 and quitter n = 312).

* $p < .05$ for a significant difference between smokers and quitters relative to smokers and quitters in the "no diagnosis at all 3 time points" category.

If there is a causal relation between smoking cessation on the one hand, and a reduced likelihood of major depression and SUD diagnoses on the other hand, the current data do not implicate particular mechanisms for such effects. Prior research does suggest candidate mechanisms, however. For instance, smokers undergo repeated bouts of withdrawal exacerbations, including increased negative affect, due to even brief interruptions in smoking (Hendricks et al., 2006), and such iterative cycles of withdrawal and negative affect constitute a unique and significant stressor for smokers, which might cause affective dysregulation (e.g., Parrott, 1994). Presumably, prolonged abstinence would reduce such stress and dysregulation. In fact, a study of a subset of the current sample found that from pre-quit to Year 1 only participants who had quit smoking (versus those who continued to smoke) reported decreased restlessness and fewer stressful events (Schlam et al., 2012). Other possible mechanisms through which smoking status could influence depression onset or exacerbation include reduced worry or anxiety about the negative consequences of smoking (e.g., illness, the cost of cigarettes, the inconvenience of finding a place to smoke). Smokers might also suffer from concerns over negative social judgments made about them as smoking has become increasingly non-normative. Moreover, smokers report that repeated failures to quit are significant stressors (Berlin et al., 2010). (It should be noted that the previous four mechanisms would also apply to decreasing anxiety following cessation, although we did not find a cessation-related *decrease* in anxiety diagnoses over time.) Finally, continued smoking might foster depression because of nicotine's impact on physiologic pathways influencing affect regulation; e.g., repeated activation of the cholinergic–adrenergic pathways or serotonergic depletion (Aubin et al., 2011).

Regardless of the specific mechanism involved, a protective effect of cessation on depression complements other data on the beneficial effects of cessation on life adjustment and functioning. A recent cross-sectional study found 69% of ex-smokers report being happier now than when they were smoking, with only 3% of ex-smokers reporting they were happier when smoking (Shahab and West, 2009). Other research shows that smokers have a lower health-related quality of life than do nonsmokers or quitters (Strine et al., 2005; Wilson et al., 1999). A longitudinal study (Stewart et al., 1995) found that people who quit smoking for 6 months had higher levels of well-being, self-esteem, energy, and cognitive functioning than those who continued to smoke during the 6 months; the two groups did not differ in baseline (pre-quit) levels of these variables. It is important to bear in mind, though, that cessation may be related to a reduced likelihood of depression, but not through a protective mechanism. It may be that post-cessation depression triggers a relapse back to smoking, accounting for the observed association because those most vulnerable to depression relapsed due to their depressive symptoms. Future research is needed to establish the temporal ordering of smoking behavior and the onset of psychiatric symptoms to more clearly elucidate these relations.

As with the association between smoking and depression, the finding that successful quitters were less likely than continuing smokers to develop SUD diagnoses could be due to multiple factors. If the relation is indeed causal (quitting confers decreased SUD risk), one potential mechanism could be that quitting results in lifestyle changes that reduce exposure to non-tobacco agents or to cues associated with them. For instance, successful quitting may cause people to spend less time in social networks or contexts in which drinking or drug use is common. Another potential mechanism is that smoking may serve as a powerful cue for other drug use, and removing this cue allows people to gain greater control over their use of other agents. This mechanism is consistent with literature showing that smoking increases craving for alcohol (Acheson

et al., 2006; Piasecki et al., 2011). This cross-agent influence could occur for a variety of reasons. For instance, it could be due to overlap in dependence processes (Ait-Daoud et al., 2006) such as when smoking enhances the rewarding effects of and craving for alcohol and vice versa (Piasecki et al., 2011), or due to associative cueing.

This research has several clinical implications. First, the findings should reassure smokers and clinicians who have concerns about the impact of smoking cessation on mental health. Quitting smoking does not appear to increase the rates of anxiety, depression or SUD diagnoses. In fact, cessation may actually reduce the likelihood of SUD and depression diagnoses. These findings could be used to educate smokers and clinicians and perhaps motivate quit attempts and the use of evidence-based treatment among these smokers. This message may be especially important for SUD patients and providers, given the culture of smoking among many SUD treatment programs, the frequent implicit acceptance of smoking, and the concern that quitting smoking could jeopardize sobriety.

These results must be interpreted in light of several limitations. First, while the overall sample is large, once groups are divided into specific diagnoses by cessation status, the cell sizes become relatively small, thereby limiting the power to detect some effects. For instance, it may be that quitters are less likely to develop major depression following cessation (4.6% of quitters developed depression at Year 3 compared to 7.3% of smokers), but sample size was small for this comparison ($n = 60$ and 61, respectively, for smokers with past-year depression at Years 1 and 3). Given these sample size issues, we did not examine the relation between quitting and the development of a new diagnosis versus the re-emergence of a previous disorder or whether multiple diagnoses may moderate the effects of cessation on subsequent mental health. Future research is needed to address these issues. Second, we examined the relation between quitting smoking and psychiatric disorders, but we cannot establish causation. It is not possible to assign people to quitting versus continued smoking outcomes and then determine who does and does not develop a new psychiatric diagnosis. Third, we did not have fine-grained temporal ordering of participants' psychiatric symptoms and smoking status over the course of the 3-year follow-up. That is, the data allowed a determination of smoking and diagnostic status at the end of a given year, but lacked the temporal ordering necessary to determine the timing of changes within a year (did symptom exacerbation precede smoking relapse or vice versa?). Therefore, these data do not permit unambiguous inference with regard to causal paths. Fourth, we did not correct for experiment-wise error and therefore, these findings should be viewed as exploratory. Fifth, participants in this study might not reflect smokers in the general population participants as they were motivated to quit and eligible to participate in a clinical trial. Further, smokers with some psychiatric diagnoses (e.g., heavy drinkers, a history of psychosis) were excluded from this research for safety reasons. Therefore any inferences drawn from this research must be restricted to those diagnoses actually assessed and analyzed. Sixth, we concentrated on diagnostic status in these analyses. While the use of formal diagnoses has some advantages, continuous measures of symptoms might be more sensitive to cessation effects. It may be that smoking status exerted additional effects that could have been detected with more sensitive assays. Future research should examine the relations of cessation with additional diagnoses (e.g., bipolar, post-traumatic stress disorder, obsessive–compulsive disorder, schizophrenia), and perhaps should supplement diagnostic measures with dimensional measures. Finally, while significant relations were found between cessation and reduced likelihood of a future psychiatric diagnosis, these effects tended to be modest in size.

5. Conclusions

This research, with its consequent limitations, suggests that quitting smoking does not result in negative mental health effects as indexed by increased risk of certain psychiatric diagnoses (anxiety, depression or SUD). In fact, these data indicate that quitting improves long-term mental health by reducing the risk of developing SUDs and major depression. These results may encourage smokers to make quit attempts, especially those who are concerned about the impact of smoking cessation on their psychiatric status and may also lead clinicians to more effectively motivate their patients who smoke to quit, including patients with psychiatric diagnoses.

Contributors

Drs.Piper, Fiore and Baker designed the study and wrote the protocol. Mr.Rodock, Dr. Piper and Dr. Baker managed the literature searches and summaries of previous related work. Dr. Piper and Mr. Rodock undertook the statistical analyses, in consultation with Drs. Cook, Schlam and Baker. Mr. Rodock wrote the first draft of the manuscript and all authors provided substantial contributions to manuscript development. All authors contributed to and have approved the final manuscript.

Conflict of interest

Megan E. Piper, Matthew Rodock, Jessica W. Cook, Tanya R. Schlamand Timothy B. Baker have no potential conflicts of interest to disclose. Over the last 3 years, Michael C. Fiore served as an investigator on research studies at the University of Wisconsin that were funded in part by Nabi Biopharmaceuticals. From 1998 to 2010, Dr. Fiore held a University of Wisconsin (UW) named Chair, made possible by a gift to UW from GlaxoWellcome.

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