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## Psychiatry Research

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# Depression status as a predictor of quit success in a real-world effectiveness study of nicotine replacement therapy

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## ARTICLE INFO

## Article history:

Received 20 May 2014

Received in revised form

9 December 2014

Accepted 14 December 2014

Available online 24 December 2014

## Keywords:

Tobacco dependence

Smoking

Depression

Treatment

Nicotine replacement therapy

## ABSTRACT

To provide population-level evidence of the role of current depression on smoking cessation treatment success, we conducted a secondary analysis of data obtained from a large cessation study conducted in over 13,000 smokers. On the basis of self-reported history of depression diagnoses at baseline, participants were divided into four mutually exclusive groups: current/recent depression, recurrent depression, past depression and no depression history. Cessation outcomes were compared among the four groups at 6-month follow-up. Of the 6261 individuals who were consented and attempted to be contacted for follow-up, 4648 (74.2%) had no diagnostic history of depression, 591 (9.4%) had a past history of depression, 759 (12.1%) had a current/recent depression diagnoses, and 263 (4.2%) had recurrent depression (both current and history). Those with recurrent depression were significantly less likely to quit smoking compared to those with no history of depression. In unadjusted analyses, recurrent depression was associated with significantly lower odds of quitting compared to those with either no history or a past history of depression. Current/recent depression was also associated with poorer quit outcomes compared to those with no history of depression. Depressed smokers may benefit from more individualized, in-person approaches to smoking cessation.

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## 1. Introduction

Smoking is the number one cause of preventable death and disease with approximately five million attributable deaths per year worldwide (WHO, 2009). It is projected that by 2030, 8.3 million deaths per year will be tobacco-related (Mathers and Loncar, 2006). While over 40% of smokers in the United States attempt to quit each year, less than 9% are successful for 3 months or longer; this decreases further to less than 6% among those with low levels of income and education (NCI, 2010), and those with comorbid depressive illness are even less likely to successfully quit (Glassman et al., 1990).

A significant proportion of smokers have co-occurring mental health disorders (Lasser et al., 2000). Approximately 30% of individuals with mental health disorders are daily smokers (Grant et al., 2004). Individuals with a history of mental illness are more likely to initiate smoking (Rohde et al., 2003), are approximately twice as likely to

smoke, and be more severely tobacco dependent (Farrell et al., 2001; John et al., 2004).

One of the most common mental health conditions among smokers is a current or past history of depression with approximately 60% of individuals with a history of depression either current or past smokers (Lasser et al., 2000). It is not known whether smoking initiation occurs prior to or follows the onset of depressive symptoms; however, genetics research points to a shared etiology (Tsuang et al., 2012). Individuals with a past history of depression are more likely to progress to daily smoking (John et al., 2004) and a history of daily smoking has also been shown to significantly increase the risk of major depression (Breslau et al., 1998). As well, depression has been cited as the most common antecedent prior to relapse during smoking cessation (Shiffman, 1982).

In a recent systematic review and meta-analysis of smoking cessation trials and depression (Gierisch et al., 2012), 16 unique RCTs were identified in the literature, but only three recruited participants with current depression and many of the identified papers were of subgroup analyses of study subjects with a positive history of depression. One of the key questions the authors of this review attempted to address was “Are there differential effects of

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smoking cessation strategies by depression status (i.e. history positive vs. current depression)?” They identified only two studies with sufficient information. One study did not show any difference in outcome by depression status (Evins et al., 2008) and the other study showed that mood management information improved cessation rates in history positive smokers but not currently depressed smokers (Munoz et al., 1997).

A recent study (Piper et al., 2010) with over 1500 smokers participating in a clinical trial showed that internalizing disorders (i.e., anxiety and mood disorders) were related to poorer cessation outcomes after 8 weeks of pharmacotherapy and behavioral counseling but did not predict abstinence at 6 months. Most treatment intervention studies exclude those with current depression and the few that have included participants with current depression typically have small sample sizes (Hall et al., 2006; Vickers et al., 2009; MacPherson et al., 2010). As such, there is a paucity of empirical evidence of the effect of current depression on smoking cessation in treatment intervention studies. This study is one of the only ones to examine this on a large-scale. The sample in the present study is representative of the smoker population in Ontario interested in making a quit attempt (Reid et al., 2014) and as such includes individuals with psychiatric diagnoses including depression, thus allowing for the evaluation of the real-world effect of depression diagnoses on smoking cessation treatment outcomes using Nicotine Replacement Therapy (NRT).

The objective of the current study was to examine whether current, recurrent or past depression differentially impacts quit rates using data collected from a large population-based sample of over 6000 smokers motivated to quit who called in to a toll-free number to receive a 5-week supply of NRT through the mail. The overall outcomes of this study have been reported previously (Zawertailo et al., 2013). This paper reports on the findings from a secondary analysis of the data where we hypothesized that a current diagnosis of depression (with or without a history of past depressive episodes) would be a strong and significant predictor of abstinence at 6-month follow-up.

## 2. Methods

### 2.1. The STOP program NRT giveaway

In January 2006, the Smoking Treatment for Ontario Patients (STOP) program invited smokers across Ontario, Canada interested in making a quit attempt to call a toll-free number to receive a 5-week supply of nicotine replacement therapy (patches or gum) free of charge. An automated voice system screened caller eligibility, provided study information, and obtained consent. A live agent then completed telephone-based, computer-guided, brief assessment based on the North American Quitline Consortium minimal dataset (Campbell et al., 2007). Between January and March 2006, 13,143 eligible smokers were couriered a kit containing 5 weeks of NRT (patch or gum) and self-help materials. See Zawertailo et al. (2013) for further details regarding the methodology and main outcomes.

### 2.2. Sample

Subjects were eligible for participation if they were 18 years of age or older, smoked at least 10 cigarettes per day, were willing to make a quit attempt within 30 days, and were residents of the province of Ontario, Canada. The exclusion criteria were contraindications to NRT including pregnancy, lactation, recent heart attack or cardiovascular incident. Of 16,405 callers, 13,158 were eligible for participation in the study, and 13,143 received the intervention. Of these, 6261 were asked to consent to being contacted for 6-month follow-up. The current analysis is based on this subsample of 6261 participants. Of these participants, 5347 were able to be contacted at 6-month follow-up and 2601 (41.5% of baseline sample) completed the 6-month survey. A total of 4176 (66.7%) of the 6261 participants received a 5-week supply of nicotine patches and 2085 (33.3%) received a 5-week supply of nicotine gum.

### 2.3. Baseline measures

Participant demographic characteristics and a detailed smoking history were collected. Total annual household income (before taxes) was categorized into approximate quartiles:  $\leq$  \$20,000, \$20,001–40,000, \$40,001–80,000 and  $>$  \$80,000. Education level was divided into three categories: less than high school diploma, high school diploma, and some college/university or a college/university degree.

Participants were asked if they had ever been diagnosed with any of the following psychiatric disorders: depression, anxiety, bipolar disorder, schizophrenia, personality disorder, or attention deficit hyperactivity disorder (ADHD). Participants were also asked to indicate whether a diagnosis had occurred more than 1 year ago ('past') and/or within the past year ('current/recent'). Participants who reported both a current/recent and past diagnosis of the same disorder were categorized as having 'recurrent' illness. Participants who did not report any diagnosis were classified as having 'no history' of that psychiatric disorder.

Participants were asked to quantify alcohol intake over the past 12 months with the following response categories: none, 1–2, 3–5, 6–10,  $>$  10 drinks/occasion. Substance use within the past 30 days was assessed for the following: marijuana, cocaine, sedatives, opiates, or stimulants. Tobacco dependence was assessed using the Heaviness of Smoking Index (HSI) (Heatherton et al., 1989) yielding HSI scores ranging from 0–6, categorized as low (0–1), medium (2–4) or high (5–6) tobacco dependence.

Participants also reported number of previous quit attempts made and quit aids used in the past. Confidence in ability to quit smoking was assessed on a scale from 1 (very little confidence) to 10 (very confident) (Miller and Rollnick, 2002).

### 2.4. Outcome assessment

All outcomes were based on self-report data at the 6-month follow-up interview. The primary outcome was smoking status at the time of the follow-up interview. Participants were classified as having quit if when asked what changes they made to their smoking, the response option they selected was 'quit smoking', while those who selected 'no change', 'reduced number of cigarettes per day', or 'increased number of cigarettes per day' were considered not quit. Secondary outcome measures included: (i) making a serious quit attempt, defined as having stopped smoking intentionally for 1 day or longer, and (ii) 30-day point prevalence, defined as having not smoked at the date of the 6-month follow-up interview, even a puff, for at least the past 30 days.

### 2.5. Statistical analysis

Comparisons of baseline variables were made using ANOVA for continuous variables (with Tukey's HSD post-hoc comparisons) and  $\chi^2$  tests of association for categorical variables. Cases with missing values on baseline variables were deleted pairwise for bivariate analyses and listwise for multivariable analyses. Household income data was missing for 5.7% ( $n=358$ ) of the sample at baseline, and number of alcoholic drinks per occasion was missing for 2.3% ( $n=142$ ) of the baseline sample. Less than 1% of cases had missing data for age ( $n=1$ ) and level of education ( $n=16$ ). All other reported baseline variables had no missing data. Respondents and non-respondents lost to follow-up at 6-month follow-up were compared on each baseline characteristic in order to identify possible attrition bias. To address potential bias due to missing outcome data from loss to follow-up, analyses of outcome data were performed both on the data obtained from participants who responded to the follow-up surveys at each time point (complete case analysis) and using a single imputation method where non-respondents at follow-up were assumed to not have made a quit attempt and to still be smoking.

Logistic regression models were used to test the impact of baseline depression status on quit outcomes at 6-month follow-up after controlling for the following variables, selected a priori based on prior evidence of association with quit rates: type of NRT provided (Stead et al., 2008), age (Anda et al., 1990), sex (Anda et al., 1990; Weinberger et al., 2012), household income and educational level (Anda et al., 1990; Chaiton et al., 2009), HSI score (Chaiton et al., 2007; Khaled et al., 2011), level of confidence in ability to quit (Schnoll et al., 2011), alcohol and other substance use (Chaiton et al., 2009), history of anxiety diagnosis (Piper et al., 2010) and history of other psychiatric diagnoses (Aubin et al., 2012). In addition to main effects, two interactions were tested to determine whether the effect of history of depression diagnosis varied by sex (due to higher rates of depression among women) (Weinberger et al., 2012) or type of NRT given (patch and gum have different efficacies in clinical trials) (Stead et al., 2008). The logistic regression model compared those with no history of depression to each group that had received a diagnosis (past, current/recent, and recurrent). Three additional contrasts for each model were conducted to compare each type of diagnosis with each other: (i) past vs. current/recent depression, (ii) past vs. recurrent depression, and (iii) current/recent vs. recurrent depression. Logistic regression models were conducted with Stata 12 (StataCorp, 2007); all other analyses were conducted with SPSS 15.0 (SPSS, 2006). Level of significance was set at  $p < 0.05$ ; no adjustments were made for multiple comparisons.

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