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Research paper

Major depression and non-specific distress following smoking cessation in the Canadian general population

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ABSTRACT

Background: Outcome data from smoking cessation trials indicate that improvement in mental health occurs after smoking cessation. This suggests that smoking cessation should be a priority for mental health services. However, participants in such trials may not be representative of the general population. This study investigates changes in mental health following smoking cessation in a set of general population samples.

Methods: Data from a library of cross-sectional surveys conducted by Statistics Canada between 2001 and 2013 were included in this analysis. Survey estimates were pooled in order to increase precision. Associations between smoking (and smoking cessation), major depressive episodes (MDE) and non-specific distress (assessed using the K-6 scale) were evaluated using meta-analysis and meta-regression techniques.

Results: The annual prevalence of major depression was higher in daily (11.0%) than in never smokers (4.4%). The prevalence in former daily smokers was 5.1%. The prevalence of MDE and distress was elevated in those recently quitting but returned to baseline levels within one year.

Conclusions: After smoking cessation, indicators of mental health improve over time, especially in the first year. The findings support the idea that smoking cessation should be a part of the management of common mood and anxiety disorders. However, due to its observational nature this study in itself cannot confirm causality, sustained abstinence may be an effect of improved mental health rather than its cause.

Limitations: The cross-sectional nature of the constituent surveys does not allow causal inference. No biological measures (e.g. cotinine) were available.

1. Background

Smoking is a well-established risk factor for cardiovascular disease, lung disease and cancer, and for these reasons smoking cessation has been a target of primary prevention for decades (Office on Smoking and Health National Centre for Chronic Disease Prevention and Health Promotion, 2015). People with mental disorders often smoke (Lawrence et al., 2009), yet it is suspected that the problem is "largely ignored" in mental health treatment settings (Williams and Ziedonis, 2004). It is suspected that health professionals fail to prioritize smoking cessation because they are influenced by a belief, often held by smokers, that nicotine reduces negative emotions (Williams and Ziedonis, 2004). However, there is increasing evidence that smoking is a risk factor for mental health problems, especially depressive symptoms and disorders (Bakhshaie et al., 2015; Beal et al., 2014; Boden et al., 2010; Chaiton et al., 2015; Choi et al., 1997; Khaled et al., 2012; Luger et al., 2014; Munafo et al., 2008).

The mental health benefits of smoking cessation are becoming increasingly established. A recent meta-analysis documented improvement in mental health following successful smoking cessation (Taylor et al., 2014). This meta-analysis combined data from a variety of studies including cohort studies and secondary analyses of data from smoking cessation intervention trials. Effect sizes were calculated based on changes over time (which needed to be at least six weeks) in those who quit smoking and those who continued. Mental health was found to improve with cessation. The effect sizes associated with cessation were comparable to those typically reported for antidepressants in the treatment of mood and anxiety disorders (Taylor et al., 2014).

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Consistent with this, a recent analysis of depressive symptoms in a psychological treatment trial for smoking cessation reported a sustained decrease in symptoms following cessation, whereas those who relapsed had a sustained increase following an initial reduction in depressive symptoms (Rodriguez-Cano et al., 2016).

Within this growing literature there has been a lack of data from representative community samples. The aforementioned meta-analysis classified 11 of its 26 eligible studies as cohort studies and classified 7 of these as general population studies (meaning that they did not focus on psychiatric patients, pregnant women, patients with chronic conditions, post-surgical patients etc.). However, none used representative general population samples, being instead based on, for example, military veterans (Kinnunen et al., 2006), employees in a specific industry (Mino et al., 2000), school aged children followed into young adulthood (Chassin et al., 2002) or nurses (Sarna et al., 2008). All of the studies used ad hoc items, quality of life subscales or symptom rating-scales to assess mental health status.

It should be acknowledged that several community-based longitudinal studies have emphasized the complex nature of this association, for example, identifying the difficult problem of distinguishing confounding from intermediate variables (Chaiton et al., 2015). Some studies have emphasized the role of depression in undermining successful cessation as opposed to smoking being a determinant of depression (Shahab et al., 2015; Zvolensky et al., 2015). A previous study using a mixed clinical-community sample found patterns consistent with an etiological effect of smoking on subsequent depressive symptom ratings in a longitudinal sample of adolescent girls (Beal et al., 2014). This study used latent dual change scores analyzed by structural equation modeling to address the reciprocal nature of the association. Boden et al., also using structured equation modeling, found similar patterns in data from the Christchurch Health and Development Study (Boden et al., 2010).

The primary aim of this study was to determine whether mental health improves after smoking cessation in the general population. We hypothesized that current smokers and former smokers who had recently quit would have an elevated prevalence of MDE and elevated distress and also that this would diminish with increasing time since smoking cessation.

2. Methods

The study was based on a series of national surveys conducted by the Canadian national statistical agency, Statistics Canada under its Canadian Community Health Survey (CCHS) program (Statistics Canada, 2011). This program began in 2001 with a survey called the CCHS 1.1, followed by the CCHS 2.1 (conducted in 2003), CCHS 3.1 (conducted in 2005), CCHS 4.1 (conducted in 2007/08), the CCHS 2009/10 (based on data collected in those two years), the CCHS 2011/12, CCHS-MH (conducted in 2012) and the CCHS 2013.

Past year MDE was assessed in all but one of these studies using a short form version of the MDE module from the Composite International Diagnostic Interview Short Form (CIDI-SFMD) (Kessler et al., 1998). This instrument was developed using data from the National Comorbidity Survey in the US through identification of item subsets that were most predictive of diagnostic determinations made with the full-length the version of the CIDI. The short form is not as detailed as full CIDI but it has a similar branched structure, whereby respondents are required to endorse depressed mood or loss of interest, in keeping with contemporary diagnostic criteria (American Psychiatric Association, 2013) in order to be administered the remaining items. Additional branches for some items assess symptom severity. According to the original validation data (Kessler et al., 1998), individuals endorsing five or more symptom-based criteria have a 90% predictive probability of MDE. The requirement for 5 of 9 symptoms also provides approximate face validity in relation to the DSM-IIIR, IV and DSM-5 diagnostic criteria. The CIDI-SFMD was included as optional content in some of the CCHS surveys, meaning that it was not included in all 10 provinces in the country, even though the surveys themselves had a national scope. One survey, the CCHS-MH, used a Canadian adaptation of the World Mental Health CIDI (Kessler and Ustun, 2004; Pearson et al., 2013). The K-6 distress scale was also included as optional content in all of the CCHS surveys. At least moderate levels of past month distress (defined as a K-6 score of 7+) (Kessler et al., 2003) was used as an indicator of distress in the current analysis. This cut-point was chosen to be consistent with prior studies, e.g. (Pirraglia et al., 2011).

Smoking status was consistently assessed in these surveys using a module developed and field tested by Statistics Canada. The module includes a series of questions classifying smoking status in 6 categories: daily smokers, occasional smokers (sub-classified as former daily and always occasional smokers), former daily smokers (non-smoker now), former occasional smokers (non-smoker now) and never smokers (Statistics Canada, 2011). The latter category is defined by Statistics Canada as a person who has never smoked a whole cigarette. For former daily and former occasional smokers, which were grouped together in some parts of the current analysis, additional items asked how much time had passed since the respondent “quit completely”.

Sample sizes in these surveys ranged between 25,113 and 125,452. While some of the surveys included 12–14 year old respondents, only those 15 or over were included in the estimates presented here since the CIDI-SFMD and K-6 have not been validated in the 12–14 year age range. These surveys used stratified, multistage sample selection techniques, a design feature which must be accounted for in data analysis. The recommended procedure is to use a set of 500 replicate bootstrap sampling weights which are provided by Statistics Canada for this purpose. These weights and associated bootstrap technique account for the surveys’ design effects.

The statistical methodology used for synthesis of the data were the techniques of individual level meta-analysis and meta-regression, allowing greatly enhanced precision of stratified estimates. A “two stage” approach to meta-analysis was used (Rao et al., 2008; Thomas et al., 2014; Thomas and Wannell, 2009). This involves making estimates from individual surveys, including estimates that incorporate statistical adjustments for individual characteristics (using the recommended bootstrap variance estimation procedures), and subsequently combining these using meta-analytic weights calculated as the inverse of the estimates’ variance. This component of the analysis used the Stata 14 “metan” command (Stata Corporation, 2015). All analyses used random effect models. In analyses concerned with odds ratios, the meta-analysis was carried out using log odds ratios, and the resulting estimates were converted back to odds ratios for presentation in the results. In view of criticism of I^2 (Rucker et al., 2008) and the *a priori* decision to use random effects models, the Tau^2 statistic (an estimate of the between study variance) was used to quantify heterogeneity. Since the estimates arose from a series of surveys conducted over time one possible pattern of heterogeneity would be a secular trend in an estimated parameter. To assess this, meta-regression analyses with time as an independent variable and the estimated parameter as the dependent variable was used to test for secular trends. As no changes over time were identified, this aspect of the analysis is not further described. However, even though there were no secular trends in the odds ratios, the frequency of smoking did decline over time, as expected, and the prevalence of never smoking and former smoking status increased over time, as expected, see results section.

In a preliminary analysis, odds ratios were used to compare the annual prevalence of MDE in each of the types of smokers listed above, using the never smoked category as the referent for each odds ratio. Logistic regression was then used to determine the effect of potential confounding variables on the observed associations. The following variables were treated as potential confounders since they have been found to be associated with MDE in prior surveys (Patten et al., 2014): age, sex, education level, employment status, urban versus rural