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Research paper

Major depression and secondhand smoke exposure

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ABSTRACT

Background: Epidemiological studies have consistently linked smoking to poor mental health. Among non-smokers, some studies have also reported associations between secondhand smoke exposure and psychological symptoms. However, an association between secondhand smoke exposure and depressive disorders has not been well established.

Methods: This analysis used cross-sectional data from a series of 10 population surveys conducted in Canada between 2003 and 2013. The surveys targeted the Canadian household population, included a brief structured interview for past year major depressive episode (MDE) and included items assessing secondhand smoke exposure. We used two-stage individual-level random-effects meta-regression to synthesize results from these surveys.

Results: Over the study interval, about 20% of non-smokers reported substantial exposure to secondhand smoke. In this group, the pooled annual prevalence of MDE was 6.1% (95% CI 5.3–6.9) compared to 4.0% (95% CI 3.7–4.3) in non-smokers without secondhand smoke exposure. The crude odds ratio was 1.5 (95% CI 1.4–1.7). With adjustment for a set of potential confounding variables the odds ratio was unchanged, 1.4 (95% CI 1.2 – 1.6).

Conclusions: These results provide additional support for public health measures aimed at reducing secondhand smoke exposure. A causal connection between secondhand smoke exposure and MDEs cannot be confirmed due to the cross-sectional nature of the data. Longitudinal studies are needed to establish temporal sequencing.

1. Background

There is strong epidemiological evidence that smoking is a risk factor for mental disorders (Boden et al., 2010; Chaiton et al., 2015; Choi et al., 1997; Khaled et al., 2012; Munafo et al., 2008). A recent systematic review has also demonstrated improved mental health following successful smoking cessation (Taylor et al., 2014). The systematic review pointed out that effect sizes for smoking cessation resembled those of antidepressant treatment, suggesting a role for smoking cessation in the management of depressive disorders. Secondhand smoke exposure may also be a causal determinant of depression, with similar clinical implications. If an association exists, avoidance of secondhand smoke exposure may be a useful strategy for managing depressive disorders. It could, for example, be a target of family interventions or workplace accommodations. Also, from a public health perspective, this association would add further justification for actions designed to reduce exposure to secondhand smoke.

Only two studies have assessed the association of secondhand smoke exposure with depressive disorders. The Midlife Development in the United States Study (MIDUS), found that exposure to secondhand smoke, when it occurred both during childhood and adulthood but not with either alone, was associated with an elevated incidence of major depressive disorder (MDD) (Taha and Goodwin, 2014). The association persisted with adjustment for a set of potential confounding variables. Bandiera et al. reported an association between serum cotinine and symptoms of MDD among non-smoking 8–15 year old participants in the National Health and Nutrition Survey (Bandiera et al., 2011). Again, the association persisted with adjustment for a set of potential

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confounding variables. It should be noted that although the Bandiera et al. study assessed symptoms of MDD using an instrument based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (American Psychiatric Association, 1980), there were too few cases of MDD to analyze the data by diagnosis. Instead, mean symptom ratings were used in the analysis instead.

Nakata et al. (Nakata et al., 2008) assessed the association of secondhand smoke exposure (in occupational settings in Japan) with depressive symptoms, assessed using the Center for Epidemiologic Studies Depression Rating Scale. Among non-smokers, they found elevated odds ratios for both occasional (adjusted OR 1.63) and regular (adjusted OR = 1.92) exposure to secondhand smoke. The association persisted with adjustments for a set of covariates. In a study of high school freshmen in a rural Korean community (Kim et al., 2016) an association between regular (3–7 times per week) secondhand smoke exposure and Beck Depression Inventory scores was found in men, but not in women. The association was also observed when a cut-point of > 10 was used to create a binary classification of depressive symptoms. Both associations persisted with a set of covariate adjustments. While these associations were observed only in male adolescents, another Korean survey (also using the Beck scale) reported a similar association in adult women (Kim et al., 2015).

One web-based national study of Korean adolescents assessed the association using a single item to assess depression (Lee, 2014): "During the recent 12 months, have you ever felt so sad or hopeless almost every day for 2 weeks in a row that you stopped doing some usual activities?" This item yielded a 32.8% prevalence, much higher than expected for MDD. There was a stronger association in respondents reporting exposure to secondhand smoke 5 or more days per week (adjusted OR = 1.36) compared to those reporting exposure 1–4 days per week (adjusted OR = 1.22). This was interpreted as a dose-response relationship (Hill, 1965) supporting a causal interpretation. Another single-item study used pooled data from the Korean Health and Nutrition Examination Survey, a survey that included an assessment of secondhand smoke exposure and also included an item worded "In the past year, have you felt extremely sorrowful or despair for more than two weeks?" (Jung et al., 2015). A significant association was found in women, irrespective of their active smoking status. No association was found in men.

Several studies have evaluated associations between secondhand smoke exposure and non-specific psychological distress. Hamer et al. reported a cotinine-distress association in non-smokers, including a dose-response gradient (Hamer et al., 2010). An association with subsequent hospital admissions was also found, but only a minority of the admissions were for depression. One cross-sectional study explored a causal model in which secondhand smoke exposure and adoption of a healthy lifestyle were viewed as possible mediators between household smoking restrictions and improved psychological status (higher levels of well-being and lower levels of symptoms of psychological distress) (Pahl et al., 2011). A structural equation model was used in the analysis of the cross-sectional data set.

In summary, several studies have reported an association of secondhand smoke exposure with depressive disorders, depressive symptoms and non-specific distress. However, most of these studies have examined depressive symptoms rather than depressive disorders or have not used representative general population samples. The aim of this study was to replicate and substantiate the association between secondhand smoke exposure and MDE in a general population sample.

2. Methods

2.1. Data source

The study was based on a series of national surveys conducted in Canada called the Canadian Community Health Surveys (CCHS) (Statistics Canada, 2011). These included a 2003 survey called the CCHS 2.1, the CCHS 3.1 (conducted in 2005), CCHS 4.1 (conducted in 2007/08), CCHS 2009/10, CCHS 2011/12, and the CCHS 2013. Sample sizes ranged between 61,821 and 127,812. They all used stratified, multistage sampling techniques, a design feature which must be accounted for in the data analysis. The recommended procedure is to use a set of 500 replicate bootstrap sampling weights which are provided by Statistics Canada for the purpose of analysis. The sampling weights and bootstrap procedure ensure population representativeness and accurate estimation of standard errors.

2.2. Measures

Past year major depressive episodes (MDE) were assessed in these studies using a short form version of the MDE module, Composite International Diagnostic Interview Short Form (CIDI-SF) (Kessler et al., 1998), as did the MIDUS study described above. 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 by a full-length version of the CIDI. The short form is not as detailed as the full CIDI, but it has the same basic branched structure whereby respondents are required to endorse depressed mood or loss of interest, in keeping with contemporary diagnostic criteria. According to the original validation data (Kessler et al., 1998), individuals endorsing five or more symptom-based criteria have a 90% probability of MDE. The requirement for 5 of 9 symptoms occurring during the same 2-week period also provides approximate face validity in relation to DSM-IIIR, IV and DSM-5 diagnostic criteria. The CIDI-SF MDE Module was optional content in some of the surveys, meaning that it was not included in all provinces in the country, even though the survey was national in scope.

Current or past-year smokers were removed from all of the analyses reported here. Secondhand smoking status was consistently assessed in these surveys using a module developed and field tested by Statistics Canada. The items in this module assessing secondhand smoke exposure were: "Including both household members and regular visitors, does anyone smoke inside your home, every day or almost every day?"; "In the past month, were you exposed to secondhand smoke, every day or almost every day, in a car or other private vehicle?"; "In the past month, were you exposed to secondhand smoke, every day or almost every day, in public places (such as bars, restaurants, shopping malls, arenas, bingo halls, bowling alleys)?" An affirmative response in any one or more of these categories was taken as an indicator of exposure.

2.3. Statistical analysis

Odds ratios were used to compare the annual prevalence of MDE in respondents exposed, or not, to secondhand smoke. Logistic regression was then used to determine the effect of covariates on the observed associations. The following variables were treated as potential confounders since they were found to be associated with MDE in prior surveys (Patten et al., 2014): age, sex, education level, employment status, urban versus rural residential status, income (low income versus middle or high income according to total household income adjusted for household size and inflation), and whether the respondent was Canadian-born or born elsewhere. Due to evidence of a latitude gradient for MDE in Canada (Patten et al., 2017), latitude was also included as a (continuous) covariate.

An individual-level meta-analytic approach was used to pool estimates of the association across several cohorts of the CCHS. This approach allows greatly enhanced precision of finely stratified estimates. A "two stage" approach was used (Rao et al., 2008; Thomas et al., 2014; Thomas and Wannell, 2009). This involved deriving estimates from individual surveys using recommended bootstrap variance estimation procedures and subsequently combining these estimates using inverse variance weights. This component of the analysis used the Stata 14 (Stata Corporation, 2015) "metan" command. In analyses concerned