



## Private space second-hand smoke exposure and the mental health of non-smokers: A cross-sectional analysis of Canadian adults

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### HIGHLIGHTS

- ▶ We examine associations between SHS exposure and poor mental health in non-smokers.
- ▶ Exposure to SHS was measured in the respondents home and vehicle.
- ▶ SHS exposure was associated with anxiety, poor/fair mental health, and high stress.
- ▶ Associations were contextualized by gender, physical health, and smoking status.

### ARTICLE INFO

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### ABSTRACT

**Introduction:** The aim of this paper was to examine the association between exposure to second-hand smoke (SHS) among non-smokers, in the home and the vehicle, and poor mental health outcomes (mood disorder, anxiety disorder, poor/fair mental health, and high stress).

**Methods:** Data were drawn from the 2010 Canadian Community Health Survey, a representative sample of 62,909 Canadians 12 years and older. Measures of SHS exposure are drawn from self-reported daily or near daily exposure in the home or in the vehicle. Mental health indicators include self-reported diagnosed mood and anxiety disorders, and self-report measures of overall mental health and experiences of stress. Associations between SHS exposure and poor mental health among non-smokers were examined in a series of logistic regression models. Additional analyses stratified on respondent's smoking status, physical health, and gender.

**Results:** Analyses revealed that SHS exposure among non-smokers was associated with increased anxiety disorders, poor/fair mental health, and high stress, with no association to mood disorders. Stratified analyses demonstrated that associations between SHS and poor mental health are contextualized by respondent's gender, physical health, and smoking status.

**Conclusions:** Beyond changes to physical health, SHS exposure in private spaces was negatively associated with the mental health of non-smokers. Public health efforts to reduce SHS exposure in private spaces are warranted. Findings also reveal additional targets for decreasing and eliminating the societal burden of mental health disorders. Further research is needed to examine causality and to explore associations between SHS exposure and specific mental health outcomes.

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### 1. Introduction

In broadening our understanding of the underlying factors associated with poor mental health, the effects of smoking have emerged as an important area of research. This research has found strong associations between smoking and poor mental health outcomes. Smokers have been shown to be at an increased risk, relative to non-smokers, for major depressive disorder and other mood disorders (Boys et al., 2003; Breslau, Novak, & Kessler, 2004a; Brown, Lewinsohn, Seeley, &

Wagner, 1996; John, Meyer, Rumpf, & Hapke, 2004; Lyvers, Thorberg, Dobie, Huang, & Reginald, 2008; Pasco et al., 2008), anxiety disorders (Breslau & Klein, 1999; Breslau, Novak, & Kessler, 2004b; Cuijpers, Smit, ten Have, & de Graaf, 2007; Feldner, Babson, & Zvolensky, 2007; Isensee, Wittchen, Stein, Höfler, & Lieb, 2003; Lasser et al., 2000; Mykletun, Overland, Aarø, Liabø, & Stewart, 2008; Zvolensky, Feldner, Leen-Feldner, & McLeish, 2005), and stress-related disorders (Aronson, Almeida, Stawski, Klein, & Kozlowski, 2008; Lyvers et al., 2008; Morissette, Brown, Kamholz, & Gulliver, 2006; Parrott, 1999, 2004), though the mechanisms responsible for these associations are not always clear. Despite this work, little research has examined the impact of second-hand smoke (SHS) exposure on the mental health

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of non-smokers. The aim of this paper is to examine the association of exposure to SHS, either in the home or vehicle, on the mental health of non-smokers.

### 1.1. Second-hand smoke: health effects and policy responses

The U.S. National Institutes of Health defines SHS as the smoke emitted from the burning end of a cigarette, cigar, or pipe, along with a smoker's exhaled smoke (U.S. Department of Health and Human Services, 2004; United States Environmental Protection Agency, 1992), and has been shown to have a detrimental effect on everyone exposed (California Environmental Protection Agency, & Office of Environmental Health Hazard Assessment, 1997; Charney, Heninger, & Breier, 1984; Dome, Lazary, Kalapos, & Rihmer, 2010; Law et al., 2003; Matt et al., 2004; United States Department of Health and Human Services, 2006). Recognition of the negative effects of SHS exposure has resulted in the development of policies aimed at reducing exposure (Asbridge, 2004; United States Department of Health and Human Services, 1986), typically through restrictions on smoking in public spaces (Hopkins et al., 2001; Pierce, León, & IARC Working Group, & IARC Secretariat, 2008).

Nonetheless, many people are still exposed to SHS in the home, vehicle, and other private and public locations (Leatherdale & Ahmed, 2009). In 2007, it was reported that 7.3% of Canadian children, 13% of Canadian teenagers, and 8.7% of all non-smokers were regularly exposed to SHS in the home, while 8.1% of non-smokers reported SHS exposure in vehicles (Iribarren, Friedman, Klatsky, & Eisner, 2001; Jefferis et al., 2009; Statistics Canada, 2007). SHS exposure in the home or vehicle is particularly detrimental due to the size of the space and the often larger quantity of cigarettes consumed in those environments, producing higher air nicotine concentrations (Jones, Navas-Acien, Yuan, & Breyse, 2009; Leech, Wilby, & McMullen, 1999; Ott, Klepeis, & Switzer, 2008; Rees & Connolly, 2006). This has been noted in studies showing a larger decrement in health-related quality of life per hour of SHS exposure in a home location and in vehicles compared to a public or workplace location (Bélanger et al., 2008; Bridevaux et al., 2007; Riboli et al., 1990). While some Canadian jurisdictions (Ontario, British Columbia, Nova Scotia, and the Yukon) have implemented restrictions on smoking within a vehicle in the presence of a passenger under the ages of 16 or 19 years, instituting bans on smoking in the home have been harder to achieve (Green, Courage, & Rushton, 2003).

### 1.2. Second-hand smoke and mental health

As noted above, the detrimental effects of smoking on the mental health of smokers are well documented. Mood disorders (i.e. major depressive disorder), anxiety disorders (i.e. panic disorder and phobias), and stress have a higher incidence in smokers compared to non-smokers and former smokers. Given the chemical similarity between inhaled tobacco smoke and SHS it is only natural to suggest that non-smokers may experience deleterious effects of SHS on mental health similar to the acute effects of smoking on mental health observed in current smokers (Foulds et al., 1997).

The pathway(s) by which SHS may produce poor mental health are not entirely clear and likely varied. One possibility is that stress and poor mental health may arise as a consequence of the decreased physical functioning (e.g., reduced lung function) resulting from SHS exposure (Caldirola, Bellodi, Cammino, & Perna, 2004). The anxiogenic effect of nicotine consumption supports the concept of smoking as a risk factor for panic (Isensee et al., 2003; Srivastava, Russell, Feyerabend, Masterson, & Rhodes, 1991); SHS might be similarly anxiogenic. Other explanations point to genetics, where shared pathways link both poor mental health and a heightened sensitivity to the effects of smoking. For example, there is an observed genetic predisposition for some individuals to have lower levels of resting

intrasympaptic dopamine and a heightened release of dopamine due to smoking, which has also been linked to higher levels of depression (Bandiera et al., 2010); SHS exposure could similarly trigger this heightened release of dopamine in depression vulnerable individuals.

There is, however, only a small amount of research conducted on the mental health effects of SHS exposure. A well-designed study using data from the Scottish Health Survey (Hamer, Stamatakis, & Batty, 2010), found that SHS exposure, measured through cotinine, was associated with higher levels of psychological distress and future psychiatry illness in healthy adult non-smokers. This effect was demonstrated only among those exposed to high levels of SHS (defined as cotinine levels between 0.71 and 14.99 ug/L). Other studies of specific subpopulations have also noted positive associations. Two studies of women exposed to SHS found that compared to non-exposed women, those exposed reported poorer social functioning and lower health-related quality of life (Bridevaux et al., 2007; Sobotova, Liu, Burakoff, Sevcikova, & Weitzman, 2009). Meanwhile, a study of workers in rural Tokyo found an increase in the risk of depressive symptoms in non-smokers exposed in the workplace (Nakata et al., 2008). Finally, a small study of 170 mothers and their children found an association between mother's smoking, child's SHS exposure, and future depression and anxiety (Gatzke-Kopp & Beauchaine, 2007). More research is required, however, looking at SHS exposure, both in the home and in the vehicle, and a broad set of mental health outcomes that include specific disorders as well as overall mental health and well-being. Moreover, observed associations in previous studies need to be replicated in other jurisdictions, and with studies that include large representative samples from the general population.

The purpose of this study was to contribute to knowledge on the effects of SHS exposure on mental health outcomes. We evaluated the relationships between SHS exposure, either in the home or the vehicle, and four mental health outcomes: diagnosed mood and anxiety disorders, and self-reported high stress and overall general mental well-being. In addition to contributing to the broader literature on the health effects of SHS, documenting an association between SHS exposure and negative mental health outcomes has numerous public health implications, including identifying new targets that may be used to decrease the societal burden of mental health disorders and barriers to wellness, and enhancing current public health campaigns to target specific populations and to provide preventative care for those at high risk.

## 2. Methods

### 2.1. Data and sample

This study used data collected for the 2010 Canadian Community Health Survey (CCHS) Public Use Micro-data File. The CCHS is a household survey conducted with a nationally represented sample of 62,909 Canadian adults (age 12 years and older). Excluded are those living on Indian reserves and on Crown lands, institutional residents, full-time members of the Canadian Forces, and residents of certain remote regions. The survey provides health information for 126 regions in ten provinces/territories and is conducted by Statistics Canada in partnership with Health Canada and the Canadian Institute for Health Information. The survey assesses health status, healthcare utilization, and health determinants in a Canadian context.

The targeted sample was divided among the provinces according to the population size and number of health regions within the province. For each province, regions were divided into major urban centers, cities, and rural areas. The cities and rural areas were stratified on a geographical basis and then according to socio-economic characteristics. The final sample was then reached by using a systematic sampling of households using random digit dialing methods. Survey interviews were conducted using computer assisted interviewing (CAI) and lasted, on average, 30 min. The response rate was 71.5%.

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