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Trends in adult exposure to secondhand smoke in vehicles: Findings from the 2009–2012 Canadian Tobacco Use Monitoring Survey

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ABSTRACT

Introduction: A growing number of jurisdictions have implemented smoke-free vehicles when children are present due to the substantial health effects of secondhand smoke (SHS). Prior studies on the prevalence of SHS exposure in vehicles have mainly focused on adolescents. This study examined the prevalence and socio-demographic correlates of SHS exposure in vehicles among Canadian adults.
Methods: A repeated cross-sectional data on youth and adult data were drawn from the 2009–2012 Canadian Tobacco Use Monitoring Survey ($n = 58,195$). Multivariable logistic regression analysis was used to examine the socio-demographic correlates of exposure to SHS in vehicles.
Results: Overall, 19% in 2009 and 18% in 2012 of adults reported SHS exposure in vehicles in the past month. Disparities in the SHS exposure prevalence were observed, with a higher SHS exposure among current smokers, former smokers, males, younger adults, living in a household with smoking-related exposure, and those with less education. The multivariable analyses showed significant associations between socio-demographic characteristics and SHS exposure. Higher odds SHS exposure was found for those younger (aged 20–24, OR = 16.27, CI = 11.09–23.88; 25–44, OR = 6.12, CI = 4.14–9.06; 45–64, OR = 2.79, CI = 1.95–4.02) compared to those aged 65 and over. Likewise, those with less education had greater odds of SHS exposure.
Conclusions: Findings suggest that adults SHS exposure is high, especially for young adults and those with less education. Adult passengers may need protection from SHS given that no level of SHS exposure is safe.

1. Introduction

Smoking bans in public spaces have increased in many countries in recent years owing to the well-documented health effects of tobacco use, including exposure to secondhand smoke (SHS; U.S. Department of Health and Human Services (USDHHS), 2006). A significant number of preventable deaths each year are associated with SHS exposure (World Health Organization (WHO), 2009; Öberg et al., 2011). The U.S. National Cancer Institute defines SHS as the mixture of the smoke given off by a burning tobacco product and the smoke exhaled by a smoker (USDHHS, 2004). SHS is a class A carcinogen for which no level of SHS exposure is considered safe (U.S. Environmental Protection Agency (USEPA), 1992; USDHHS, 2006). Aside from the risk of cancer, SHS has been associated with many adverse health effects, including cardiovascular disease, ear problems, respiratory problems, sudden infant death syndrome and more acute asthma in children (USDHHS, 2006; USEPA, 1992).

Smoking in vehicles has been shown to produce high tobacco concentrations, particularly due to the confined space in which the smoke is circulated (Northcross et al., 2014; Semple et al., 2012; Sendzik et al., 2009; Jones et al., 2009; Ott et al., 2008; Rees and Connolly, 2006; Vardavas et al., 2006). For example, Semple and colleagues (2012) found that fine particulate matter ($PM_{2.5}$), an indicator of SHS concentrations, was high in vehicles where smoking occurred and significantly exceeded the WHO recommended air quality guidelines. Smoking bans in vehicles when children are present have been implemented in all Canadian provinces but Quebec (see Table 1; Reid et al., 2015). Some U.S. states (Arkansas, California, Louisiana, Maine, Oregon, Vermont and Utah (American Nonsmokers, 2015)), as well as parts of Australia and United Kingdom have introduced similar smoking bans in vehicles (Canadian Cancer Society, 2014; Action on Smoking and Health, 2015). Prior studies on the prevalence of SHS exposure in vehicles have mainly focused on adolescents and high school aged youths (e.g. King et al.,

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2012; Kabir et al., 2009; Leatherdale et al., 2008; Leatherdale and Ahmed, 2009). The current study presents annual data from the 2009–2012 Canadian Tobacco Use Monitoring Survey (CTUMS) to examine the prevalence and socio-demographic correlates of SHS exposure in vehicles among Canadian adults. This is particularly important given that a limited number of jurisdictions have implemented legislation that protects all passengers, including adults. To my knowledge, Mauritius is currently the only country with smoking bans in vehicles carrying any passenger (International Tobacco Control Project, 2012).

2. Methods

2.1. Data

Briefly, CTUMS is an annual cross-sectional household survey of Canadians aged 15 and over. CTUMS primarily collects information about the attitudes and behaviors of adults with respect to tobacco use, as well as corresponding socio-demographic variables. The survey excludes those living in institutions, and Canadians living in the Northern Territories (Yukon, Nunavut and Northwest Territories). CTUMS is based on a two-phase stratified random sampling framework. In the first phase, households are sampled from telephone numbers using a random digit dialing methodology. Individuals are selected in the second stage based on household composition, with an equal representation of respondents in each of ten Canadian provinces. For consistency, analysis of the current study was restricted to those aged 20 and over for all provinces given that existing smoke-free car law varies across provinces in the age range considered (see Table 1). Ethics review was not required given that this research relied exclusively on anonymous secondary survey data.

2.2. Measures

2.2.1. Dependent variable. Secondhand smoke exposure was assessed by asking: "The next questions are about exposure to secondhand smoke in places other than your own home. Secondhand smoke is what smokers exhale and the smoke from a burning cigarette. In the past month, excluding your own smoking were you exposed to secondhand smoke inside a car or other vehicle?" SHS exposure in vehicles, a dichotomous variable was defined as respondents who reported yes to SHS exposure in the last month, and zero otherwise. Previous research has shown a strong association between self-reported exposure to SHS and biomarkers of nicotine (Okoli et al., 2007; Prochaska et al., 2015).

2.2.2. Independent variables. A number of socio-demographic variables were included in the analysis. Smoking status was used in a categorical form: current smoker, former smoker and never smoker as the reference group. Respondents were asked the following question, "At the present time, do you smoke cigarettes every day, occasionally or not at all?" Current smoker was defined as someone who smokes daily or occasionally. Former smoker represented a person who indicated 'not at all' but had smoked at least 100 cigarettes in his or her lifetime. Never smoker represented those who were former experimental smokers (indicated "not at all" and had not smoked at least 100 cigarettes in their lifetime) and lifetime abstainers (those who had never smoked cigarettes at all). Sex was captured by a dichotomous variable (male = 1, female = 0). Age had four categories: 20–24, 25–44, 45–64, and 65+ (reference category). Completed level of education was used as a categorical variable: less than secondary, secondary, college, and university (reference category). A dichotomous variable indicating smoking by household member was derived from a yes response to the question "Does anyone in your household smoke cigarettes?" Smoking inside home was derived from the question "How many people smoke cigarettes inside your home every day or almost every day? Include all family members and visitors". Responses with 1 or more people were classified as 'smoking inside home'. Household car ownership/lease status was derived from a 'yes' response to the question "Do you, or a member of your household, own or lease a motor vehicle? Include cars, pickup trucks, minivans, vans and SUVs?". Analysis also assessed the survey month of interview (March/April, May/June, July/August, September/October, November/December, and February as the reference category). Province of residence was included in the analysis, with British Columbia as the reference category.

Table 1
Current Canadian provinces smoke-free car laws.

Province	Applicable age	Date of implementation
Nova Scotia	<19	April 1, 2008
Ontario	<16	January 21, 2009
British Columbia	<16	April 7, 2009
Prince Edward Island	<19	September 15, 2009
New Brunswick	<16	January 1, 2010
Manitoba	<16	July 15, 2010
Saskatchewan	<16	October 1, 2010
Newfoundland & Labrador	<16	July 1 2011
Alberta	<18	November 13, 2014
Quebec[a]	<16	Pending

[a] Quebec is currently considering implementing a law that bans smoking in cars when a passenger is less than age 16.

2.3. Statistical analysis

Overall and sub-population SHS exposure prevalence, with 95% confidence interval were calculated for each year (estimates were checked for sample variability). Socio-demographic characteristics associated with SHS exposure in vehicles were examined using a multivariable logistic regression. The multivariable analyses assessed for the following variables: sex, age, smoking status, education, household car ownership/lease, household smoking status, home smoking restriction, province of residence, and survey month of interview. Separate analyses were also conducted for non-smokers. Fay-modified balanced repeated replication approach was used in the analysis to enable variance estimates to account for the complex survey design (Judkins, 1990). All analyses were carried out using Stata 14.0 (Stata Corp, College Station, Texas).

3. Results

The weighted sample characteristics of the overall sample are presented in Table 2, which showed that there were slightly more females (51%) than males (49%) and most respondents completed at least secondary education. The overall and sub-population SHS exposure prevalence (with 95% confidence interval [CI]) for each year are reported in Table 3. The analyses showed that the overall linear trend in SHS exposure was not statistically significant ($p = .102$). However, the proportion of adult reporting exposure to SHS in vehicles in the past month decreased from 19.2% (CI = 18.0–20.3) in 2009 to 17.8% (CI = 16.6–18.9) in 2010. The SHS exposure rate increased slightly from 2010 to 18.6% in 2011 (CI = 17.4–19.7) and decreased to 17.5% in 2012 (CI = 16.3–18.7). Not surprising, the SHS exposure pattern mirrors the Canadian smoking prevalence. Results from CTUMS showed that smoking prevalence for those aged 15 and over 17.5% in 2009, 16.7% (2010), 17.3% (2011) and 16.7% in 2012 (Reid et al., 2015). As expected, SHS exposure was significantly higher for current smokers. In each year, more than 46% reported being exposed to SHS in vehicles, with about 53% in 2011 (CI = 49.1–56.8). The prevalence of SHS exposure was consistently higher for males than females in each year. SHS exposure was highly prevalent among those aged 20–24. For example, about 44% (CI = 41.2–46.5) in 2009 and 41% (CI = 38.4–44.0) in 2012 reported SHS exposure in the past month. Those with less education had higher prevalence of SHS exposure, with more than 20% of those with secondary education or less reporting exposure to SHS. Results also show provincial variation in SHS exposure prevalence. The province of British Columbia had the lowest SHS exposure rate in each year.

Results from the multivariable logistic regression examining potential correlates of SHS exposure in vehicles are shown in Table 4. The results for the whole population are reported in Column 1 and analyses restricted to non-smokers are reported in column 2. Males were more likely to be exposed to SHS than females (adjusted odds ration [OR] = 1.44, CI = 1.18–1.76). Higher odds of being exposed to SHS were found for those younger (aged 20–24, OR = 16.27, CI = 11.09–23.88; 25–44, OR = 6.12, CI = 4.14–9.06; 45–64, OR = 2.79, CI = 1.95–4.02) when compared to those aged 65 and over. Smoking status was significantly associated with SHS exposure in vehicles. Both current smokers (OR = 2.49, CI = 1.81–3.43) and former smokers (OR = 1.59, CI = 1.23–2.06) had a higher likelihood of SHS exposure in vehicles compared to never smokers. Likewise, level of completed education was significantly associated with SHS exposure. Those with less education had higher odds of SHS exposure (less than secondary, OR = 1.93, CI = 1.36–2.74; secondary, OR = 1.82, CI = 1.39–2.38; college, OR = 1.43, CI = 1.05–1.95) compared to those with university