Smoking Susceptibility Among Never-Smokers: Data From the 2006-07 National Youth Smoking Survey

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ABSTRACT

Objectives: The purpose of this study was to explore school and individual characteristics associated with smoking susceptibility among a nationally representative sample of Canadian youth who were never-smokers.

Methods: Using data from the 2006-07 Youth Smoking Survey, multi-level logistic regression modeling was used to examine if student-level and school-level characteristics were associated with smoking susceptibility among grade 9 to 12 never-smokers.

Results: In 2006, 88.2% of Canadian youth in grades 9 to 12 were considered never-smokers, of whom 28.2% (n=255,840) were considered to be susceptible to future smoking. Significant between-school random variation in smoking susceptibility was identified, although the school-level smoking rate was not significantly associated with the risk of an individual student being susceptible. At the student level, smoking susceptibility was associated with having a sibling who smokes, having 1 or 2 close friends who smoke, having ever used alcohol or marijuana, being female and being in grade 9. Parental smoking and exposure to smoking in a car or in the home were not significantly associated with smoking susceptibility.

Conclusion: One way to prevent smoking onset among youth is to interfere with the development of susceptibility to smoking in non-smoking youth population. We found that over 1 in 4 Canadian youth who were never-smokers in 2006 were considered susceptible to smoking in the future. Ongoing tobacco control prevention initiatives are crucial for reducing the prevalence of smoking susceptibility among non-smoking Canadian youth.

Key words: Smoking susceptibility; youth; youth smoking survey; multi-level modeling; social influences; alcohol use; drug use

La traduction du résumé se trouve à la fin de l'article.

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Starting smoking before 15 years of age is associated with increased risk of lung cancer,¹ and increased risk of breast cancer among females.² Despite the health risks of smoking, 14% of Canadian youth aged 15 to 19 were still considered current smokers according to the 2009 Canadian Tobacco Use and Monitoring Survey (CTUMS).³ Preventing youth smoking onset must remain a public health priority in Canada.

One way to prevent youth smoking uptake is to target prevention activities to the non-smoking youth who are at greatest risk for becoming future smokers.⁴ The concept of smoking susceptibility (defined as a lack of a firm commitment not to smoke among never-smokers) can be used to identify those at-risk youth.⁵ Evidence from various prospective studies suggested that non-smoking youth who are susceptible to smoking are over twice as likely to experiment with cigarettes compared to those who are non-susceptible.^{6,7} Considering smoking susceptibility has been shown to be modifiable through interventions,⁸ identifying susceptible non-smoking youth and understanding the factors associated with susceptibility is important for improving future smoking prevention programs.⁹

According to the Theory of Triadic Influence,¹⁰ smoking susceptibility can be influenced by factors from different levels of context: individual characteristics (e.g., sex, other risk behaviours), immediate social environment (e.g., friends and family) and broader social environment (e.g., school). Research has previously identified that characteristics from each of these levels of context are associated with susceptibility. For example, non-smoking youth are more likely to be susceptible if they are female,¹¹ or if they have friends or family members who smoke.^{12,13} Considering that

research has identified that youth smokers are more apt to use alcohol and/or marijuana¹⁴ and to be exposed to smoking in homes or in cars,¹⁵ it may also be informative to examine these characteristics in relation to susceptibility. Similarly, considering that research has identified that high-risk school environments (i.e., schools with a high prevalence of smoking) are associated with smoking onset,^{4,16,17} it may also be worthwhile to examine this school characteristic in relation to susceptibility. Thus, the purpose of this study is to examine the association between school and individual characteristics and smoking susceptibility of non-smoking youth.

METHODS

Design

This study used nationally representative data collected from 41,886 grade 9 to 12 students as part of the 2006-07 Canadian Youth Smoking Survey (YSS).¹⁸ In brief, the target population con-

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Table 1. Descriptive Statistics for the Sample of Never-smoking Youth in Grades 9 to 12 by Smoking Susceptibility Status, Canada, 2006

Demographics		Susceptible Never-smokers (n=255,840)*	Non-susceptible Never-smokers (n=649,889)*
		%	%
Sex	Male	48.4	51.4
	Female	51.6	48.6
Grade	9	36.5	28.5
	10	28.3	26.4
	11	21.3	23.5
	12	14.0	21.6
Social Influences			
Parent/guardian smokes	Yes	36.0	32.9
	No	64.0	67.1
Sibling smokes	Yes	15.8	10.9
	No	84.2	89.2
Number of close friends who smoke	None	62.0	74.2
	1	14.8	11.3
	2	9.9	6.3
	3	3.9	3.1
	4	2.6	1.1
Number of days exposure to smoking in a car during the previous week	≥5	6.8	4.0
	0 days	78.8	81.3
	1-6 days	19.6	16.9
	All 7 days	1.6	1.8
Number of people smoking inside the home daily	None	83.5	85.3
	1 person	10.1	9.0
	≥2 people	6.4	5.7
Substance Use			
Ever tried marijuana	Yes	19.4	12.7
	No	80.6	87.3
Ever tried alcohol	Yes	79.3	61.7
	No	20.7	38.3

* Population estimate.

sisted of all young Canadian residents in grades 9 to 12 attending public and private secondary schools in 10 Canadian provinces. The YSS survey was administered to students during class time and participants were not provided compensation. Active information with passive consent was used to reduce demands on schools and to increase student participation rates. Detailed information on the 2006-07 YSS is available in print¹⁸ or online (www.yss.uwaterloo.ca).

Measures

Susceptibility among never-smokers was measured by asking students: "Do you think in the future you might try smoking cigarettes?", "If one of your best friends were to offer you a cigarette, would you smoke it?", and "At any time during the next year, do you think you will smoke a cigarette?" Consistent with Pierce and colleagues,⁵ students who answered 'definitely not' to all three questions were considered non-susceptible; they were considered susceptible to future smoking if they responded positively to at least one item. Respondents were also asked to report their sex, grade, if they have a parent or guardian who smokes, if they have a sibling who smokes, how many of their five closest friends smoke, the number of days they were exposed to smoking in a car during the previous week, the number of people who smoke inside their home daily, if they have ever tried marijuana, and if they have ever tried alcohol. For each school, we also calculated the school-level prevalence of students considered current smokers, where current smokers were defined as those who have smoked at least 100 cigarettes in his/her lifetime and have smoked in the 30 days preceding the survey.

Analyses

Descriptive analyses examining smoking susceptibility were performed according to demographic characteristics, social influences,

Figure 1. Smoking susceptibility among never-smokers in grades 9 to 12 by region of Canada, 2006-2007

substance use, and province. Since students (level 1) are nested within schools (level 2), we then conducted three different multi-level logistic regression models to examine school- and student-level factors associated with the odds of a never-smoker being susceptible to smoking. The first model was a null model to determine the school-level variance ($\sigma^2_{\mu_0}$) in the likelihood of being a susceptible never-smoker. The second model examined if susceptibility was associated with the school-level smoking rate and student-level social influences, controlling for sex and grade. The third model examined if student-level alcohol and marijuana use were associated with the odds of being susceptible, controlling for sex, grade and the school-level smoking rate. Survey weights were used in the descriptive analyses to adjust for non-response between provinces and groups, thereby minimizing any bias in the analyses caused by differential response rates across regions or groups. The statistical package SAS 8.02 was used for all analyses.¹⁹

RESULTS

In 2006, 10.2% (167,921) of Canadian youth in grades 9 to 12 were current smokers, 1.6% were former smokers, and 88.2% (1,452,041) were never-smokers. The prevalence of never-smoking was higher for females (89.9%) compared to males (86.7%) ($\chi^2=71.6$, $df=2$, $p<0.001$) and students in grades 11 and 12 were less likely to be never-smokers than students in grades 9 and 10 ($\chi^2=497.1$, $df=6$, $p<0.001$). Among the never-smokers, 28.2% (255,840) were considered to be susceptible to smoking and 71.8% (649,889) were considered non-susceptible to smoking. The mean school smoking rate was 11.5% (range, 0% to 53.8%). Descriptive statistics by smoking susceptibility among never-smokers are presented in Table 1.

Females were more likely than males to be susceptible to smoking ($\chi^2=17.2$, $df=1$, $p<0.001$). Students in higher grades were less likely to be susceptible to smoking than students in lower grades ($\chi^2=203.4$, $df=3$, $p<0.001$). Youth with no close friends were less likely to be susceptible than youth with smoking friends ($\chi^2=275.4$, $df=5$, $p<0.001$). Youth who have ever tried marijuana ($\chi^2=145.0$, $df=1$, $p<0.001$) or alcohol ($\chi^2=701.4$, $df=1$, $p<0.001$) were more likely to be susceptible to smoking than youth who have not tried alcohol or marijuana. As illustrated in Figure 1, youth in Quebec and British Columbia were more apt to be susceptible to smoking than youth in Atlantic Canada, Ontario or the Prairies ($\chi^2=95.9$, $df=4$, $p<0.001$).

Table 2. Logistic Regression Analyses Examining Social Influences Associated With Smoking Susceptibility Among Never-smokers in Grades 9 to 12, Canada, 2006

		Adjusted Odds Ratio† (95% CI) Model 1 Susceptible vs. Non-susceptible
Student-level Characteristics		
Sex	Female	1.00
	Male	0.82 (0.74-0.92)*
Grade	9	1.00
	10	0.79 (0.69-0.91)*
	11	0.64 (0.55-0.74)*
	12	0.49 (0.42-0.58)*
Parent/guardian smokes	No	1.00
	Yes	0.99 (0.86-1.13)
Sibling smokes	No	1.00
	Yes	1.58 (1.35-1.85)*
Number of close friends who smoke	None	1.00
	1 or 2	1.91 (1.67-2.19)*
	≥3	1.76 (1.47-2.10)*
Number of days exposure to smoking in a car during the previous week	All 7 days	1.00
	1-6 days	1.42 (0.88-2.28)
	0 days	1.28 (0.80-2.06)
Number of people smoking inside the home daily	None	1.00
	1 person	1.23 (1.00-1.50)
	≥2 people	0.89 (0.69-1.15)
School-level Characteristic		
School smoking rate	Each 1% increase	0.22 (0.04-1.37)

† Odds ratios adjusted for all other variables in the table.
* p<0.001.

Significant between-school random variation in smoking susceptibility was identified [$\sigma^2_{\mu 0}=0.18$ (0.03), $p<0.001$]; school-level differences accounted for 5.2% of the variability in the odds of being considered susceptible to smoking. This suggests that characteristics of the school that a non-smoking student attends are associated with his/her risk of being susceptible to smoking in the future.

The adjusted odds ratios examining if school- and student-level social influences are associated with smoking susceptibility are presented in Table 2. The odds of a never-smoker being susceptible to smoking increased if the student had a sibling who smokes (OR 1.58, [95% CI 1.35-1.85]), or if the student had 1 or 2 close friends (1.92, [1.67-2.20]) or 3 or more close friends (1.75, [1.47-2.09]) who smoke. Conversely, the odds of a never-smoker being susceptible to smoking decreased if the student was male (0.83, [0.74-0.93]), or in grade 10 (0.79, [0.69-0.91]), grade 11 (0.64, [0.55-0.75]) or grade 12 (0.50, [0.42-0.58]). Parental smoking, exposure to smoking in a car or in the home, and the prevalence of smoking at the school were not significantly associated with the odds of being susceptible to smoking.

As shown in Table 3, even when controlling for sex and grade, the odds of a never-smoker being susceptible to smoking increased if the student had ever used marijuana (1.43, [1.33-1.55]) or alcohol (2.61, [2.41-2.82]) relative to students who have never used marijuana or alcohol.

DISCUSSION

Smoking susceptibility is a strong predictor of smoking initiation in youth as it is an early precursor in the sequence of cognitive changes that ultimately leads to experimentation with smoking.⁵⁻⁷ As such, the measure of susceptibility can be used to identify high-risk non-smoking youth before smoking onset occurs. One way to prevent smoking onset among youth is to interfere with the devel-

Table 3. Logistic Regression Analyses Examining Substance Use Associated With Smoking Susceptibility Among Never-smokers in Grades 9 to 12, Canada, 2006

		Adjusted Odds Ratio† (95% CI) Model 2 Susceptible vs. Non-susceptible
Student-level Characteristics		
Ever use marijuana	No	1.00
	Yes	1.44 (1.32-1.57)*
Ever use alcohol	No	1.00
	Yes	2.61 (2.42-2.81)*

† Odds ratios adjusted for all other variables in the table and controlling for sex, grade and the school smoking rate.
* p<0.001.

opment of susceptibility to smoking in the non-smoking youth population. In this study we identified that in 2006, more than 1 in 4 Canadian youth who were never-smokers were considered susceptible to future smoking; representing over 255,000 Canadian youth in grades 9 to 12. This suggests that ongoing tobacco control primary prevention initiatives are crucial for preventing smoking onset among non-smoking Canadian youth.

Consistent with previous research,¹¹ we identified that smoking susceptibility among never-smokers varied significantly across schools. However, unlike previous research that had identified an association between the school-level prevalence of smokers at a school and the risk of smoking onset and progression,^{16,17} we did not identify an association between the school-level prevalence of smoking at a school and the likelihood of a never-smoker at that school being susceptible. Although it cannot be determined with these cross-sectional data, it may be due to the strong association between close-friend smoking and smoking susceptibility,^{7,11,20} or it may also be due to the impact that school-level smoking social models may have on smoking onset^{4,16,17} (i.e., students who may have been susceptible had already tried smoking due to their high-risk school environment). Regardless, our finding that significant between-school variability exists suggests that additional research is required to identify the school-level characteristics that explain this variability. Such insight would be valuable for developing school-based interventions to create school environments that do not promote smoking onset.

As expected, non-smoking youth with smoking friends or smoking siblings were more likely to be susceptible to future smoking than those with no smoking friends. However, we did not find a significant association between parental smoking and exposure to smoking in the home and cars and susceptibility to smoking. As suggested by previous research, youth appear more motivated to comply with the behavioural norms of their peer group rather than of their parents.²¹ For instance, smoking friends can expose youth to the immediate positive social outcomes associated with smoking,¹² making them more apt to consider trying smoking.²² Consistent with research on more advanced smoking behaviour,^{14,23} we also identified that smoking susceptibility was associated with ever using alcohol and/or marijuana. Considering these are also behaviours which often occur within peer groups, it may be important future research to develop a better understanding of the link between smoking onset and alcohol and marijuana use, and to examine the benefits of using a more comprehensive multi-substance approach to youth smoking prevention programming.¹⁴

Age and sex were also associated with smoking susceptibility. Consistent with previous studies,^{12,13} we found that females were more likely to be susceptible to smoking than males. Although it cannot be determined with these cross-sectional data, it is likely related to the increased prevalence of young females starting to smoke compared to males.²⁴ Likewise, students in older grades were less apt to be susceptible to smoking, probably as a function of smoking onset occurring as students move to higher grades.²⁴

Limitations

Although the response rate was high and the data were weighted to help account for non-response, the findings are nevertheless subject to sample bias. In addition, the findings likely reflect some under-reporting for tobacco use, as is common in survey research.²⁵ It should also be noted that the cross-sectional nature of the design does not allow for causal inferences. Data pertaining to school-level tobacco control prevention programs and policies were not available, limiting our ability to identify the characteristics of schools that are associated with increased susceptibility.

CONCLUSION

Ongoing monitoring of smoking behaviours of students and school-level characteristics will help researchers to identify at-risk youth as well as schools that create high-risk environments for smoking onset. Considering the large number of Canadian youth considered at high risk for becoming future smokers, our results suggest that ongoing tobacco control primary prevention initiatives are crucial for reducing the prevalence of smoking susceptibility and preventing smoking onset among non-smoking Canadian youth.

REFERENCES

- Peto R, Darby S, Deo H, Silcocks P, Whitley E, Doll R. Smoking, smoking cessation and lung cancer in the UK since 1950: Combination of nutritional statistics with two case-control studies. *BMJ* 2000;321:323-29.
- Band PR, Le ND, Fang R, Deschamps M. Carcinogenic and endocrine disrupting effects of cigarette smoke and risk of breast cancer. *Lancet* 2002;360:1044-49.
- Health Canada. Canadian Tobacco Use Monitoring Survey, Wave 1 Results 2009. Ottawa, ON: Health Canada, 2010. Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_ctums-esutc_2009/w-p-1_sum-som-eng.php (Accessed Sept 22, 2010).
- Cameron R, Brown KS, Best JA, Pelkman CL, Madill CL, Manske SR, et al. Effectiveness of a social influences smoking prevention program as a function of provider type, training method, and smoking risk. *Am J Public Health* 1999;89(12):1827-31.
- Pierce JP, Choi WS, Gilpin EA, Farkas AJ. Validation of susceptibility as a predictor of which adolescents take up smoking in the United States. *Health Psychol* 1996;15(5):355-61.
- Jackson C. Cognitive susceptibility to smoking and initiation of smoking during childhood: A longitudinal study. *Prev Med* 1998;27(1):129-34.
- Unger JB, Johnson CA, Stoddard JL, Nezami E, Chou CP. Identification of adolescents at risk for smoking initiation: Validation of a measure of susceptibility. *Addict Behav* 1997;22(1):81-91.
- Meschack AE, Hu S, Pallone UE, McAlister AL, Gottlieb N, Huang P. Texas tobacco prevention pilot initiative: Process and effects. *Health Educ Res* 2004;19(6):657-68.
- Wilkinson AV, Waters AJ, Vasudevan V, Bondy ML, Prokhorov AV, Spitz MR. Correlates of susceptibility to smoking among Mexican origin youth residing in Houston, Texas: A cross-sectional analysis. *BMC Public Health* 2008;8:337.
- Flay BR, Petraitis J, Hu FB. Psychosocial risk and protective factors for adolescent tobacco use. *Nicotine Tob Res* 1999;1:S59-S65.
- Leatherdale ST, Brown SK, Cameron R, McDonald PW. Social modeling in the school environment, student characteristics, and smoking susceptibility: A multi-level analysis. *J Adolesc Health* 2005;37(4):330-36.
- Feighery E, Borzekowski DL, Schooler C, Flora J. Seeing, wanting, owning: The relationship between receptivity to tobacco marketing and smoking susceptibility in young people. *Tob Control* 1998;7(2):123-28.
- Kaufman NJ, Castrucci BC, Mowery PD, Gerlach KK, Emont S, Orleans T. Predictors of change on the smoking uptake continuum among adolescents. *Arch Pediatr Adolesc Med* 2003;156:581-87.
- Leatherdale ST, Ahmed R. Alcohol, marijuana, and tobacco use among Canadian youth: Do we need more multi-substance prevention programming? *J Prim Prev* 2010;31(3):99-108.
- Leatherdale ST, Ahmed R. Second-hand smoke exposure in homes and in cars among Canadian youth: Current prevalence, beliefs about exposure, and changes between 2004 and 2006. *Cancer Causes Control* 2009;20(6):855-65.
- Leatherdale ST, Manske SR. The relationship between student smoking in the school environment and smoking onset in elementary school students. *Cancer Epidemiol Biomarkers Prev* 2005;14(7):1762-65.
- Leatherdale ST, Cameron R, Brown SK, McDonald PW. Senior student smoking at school, student characteristics, and smoking onset among junior students: A multilevel analysis. *Prev Med* 2005;40(6):853-59.
- Health Canada. 2006-07 Youth Smoking Survey, Ottawa: Minister of Supply and Services Canada, 2008. Available at: http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/research-recherche/stat/survey-sondage_term-eng.php (Accessed October 30, 2008).
- SAS Institute Inc. The SAS system for windows. Cary, NC: SAS Institute Inc., 2001.
- Aloise-Young PA, Graham JW, Hansen WB. Peer influence on smoking initiation during early adolescence: A comparison of group members and group outsiders. *J Appl Psychol* 1994;79(2):281-87.
- Harris JR. Where is the child's environment? A group socialization theory of development. *Psychol Rev* 1995;102(3):458-89.
- Bandura A. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall, 2001.
- Bobo JK, Husten C. Sociocultural influences on smoking and drinking. *Alcohol Res Health* 2000;24(4):225-32.
- Health Canada. Canadian Tobacco Use Monitoring Survey, Wave 1 Results 2003. Ottawa: Health Canada, 2004.
- Bovet P, Viswanathan B, Faeh D, Warren W. Comparison of smoking, drinking, and marijuana use between students present or absent on the day of a school-based survey. *J Sch Health* 2006;76(4):133-37.

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RÉSUMÉ

Objectifs : Analyser les caractéristiques scolaires et individuelles associées à la susceptibilité au tabagisme au sein d'un échantillon représentatif national de jeunes Canadiens n'ayant jamais fumé.

Méthode : À l'aide des données de l'Enquête sur le tabagisme chez les jeunes (2006-2007), nous avons utilisé la modélisation par régression logistique multiniveaux pour déterminer si des caractéristiques des élèves et des écoles étaient associées à la susceptibilité au tabagisme chez les jeunes de la 9^e à la 12^e année n'ayant jamais fumé.

Résultats : En 2006, 88,2 % des jeunes Canadiens de la 9^e à la 12^e année étaient considérés comme n'ayant jamais fumé; 28,2 % (n=255 840) de ces jeunes étaient jugés susceptibles de fumer plus tard. Nous avons observé des variations aléatoires significatives entre les écoles pour ce qui est de la susceptibilité au tabagisme, bien que le taux de tabagisme par école ne présente pas de corrélation significative avec le risque qu'un élève en particulier soit plus susceptible au tabagisme. Chez les élèves, la susceptibilité au tabagisme était associée aux faits d'avoir un frère ou une sœur qui fume, d'avoir un ou deux amis proches qui fument, d'avoir déjà consommé de l'alcool ou de la marijuana, d'être une fille et d'être en 9^e année. Le tabagisme parental et l'exposition au tabac en voiture ou à la maison ne présentaient pas de corrélation significative avec la susceptibilité au tabagisme.

Conclusion : L'un des moyens de prévenir le début du tabagisme chez les jeunes est d'entraver le développement de la susceptibilité au tabagisme dans la population des jeunes non fumeurs. Nous avons observé que plus d'un jeune Canadien sur quatre n'ayant jamais fumé en 2006 était considéré comme susceptible de fumer plus tard. Les initiatives permanentes de prévention du tabagisme sont d'une importance cruciale pour réduire la prévalence de la susceptibilité au tabagisme chez les jeunes Canadiens non fumeurs.

Mots clés : susceptibilité au tabagisme; jeunes; tabagisme chez les jeunes; analyse multiniveaux; influences sociales; consommation d'alcool; consommation de drogue