

Cigarette Access Behaviours among Underage Canadian Youth Smokers

by

Mary Vu

A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Science
in
Health Studies and Gerontology

Waterloo, Ontario, Canada, 2011

©Mary Vu 2011

AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Objective: The main objective was to examine characteristics associated with cigarette access behaviours among underage current youth smokers.

Methods: This cross-sectional study used self-reported data collected from 29,296 students in Grades 9 to 12 who participated in the 2008-09 Youth Smoking Survey (YSS), and data from the 2008-09 DMTI-EPOI (Enhanced Points of Interest) data file. Multilevel logistic regression analyses were used to jointly examine whether student characteristics and the number of tobacco retailers surrounding schools were associated with the odds of a current youth smoker accessing cigarettes from: (a) a retailer source, (b) a family member, and (c) a friend or someone else.

Results: Among underage current smokers, the majority reported usually buying their own cigarettes from a retailer (44.1%), and getting cigarettes from a friend or someone else (42.2%). Significant between-school random variation was identified for youth cigarette access from a retailer source, and from a friend or stranger. Males were more likely to buy their own cigarettes from a retailer (OR 2.08, 95% CI 1.74-2.48), whereas females were more likely to access cigarettes from a family member (OR 0.68, 95% CI 0.53-0.88), or a friend or someone else (OR 0.52, 95% CI 0.44-0.61). Binge smoking was associated with buying cigarettes from a retailer (OR 0.65, 95% CI 0.48-0.86). Youth with a smoking parent or guardian (OR 2.95, 95% CI 2.02-4.31) were more likely to get cigarettes from a family member. Youth who reported that they sometimes (OR 2.80, 95% CI 1.94-4.04), or usually or always (OR 3.15, 95% CI 2.17-4.58) share cigarettes with others was associated with accessing cigarettes from a friend or someone else. Each additional tobacco retailer surrounding a school was associated with an increased likelihood of youth purchasing their own cigarettes from a retailer (OR 1.04, 95% CI 1.01-1.07).

Conclusion: Tobacco point-of-sale restrictions are inadequate as youth can still procure cigarettes from both retailers and social sources. Future studies should explore beyond individual-level factors and examine what influences cigarette access behaviours in the broader school context. Such insight will inform the development of new school-level tobacco control initiatives that can more effectively prevent youth from acquiring cigarettes.

Acknowledgements

I would like to express my sincere gratitude to my supervisor, Dr. Paul McDonald, for his incredible guidance and insight. Through his teachings, Paul has shown me the importance of perseverance and confidence for growth in this journey. I am also indebted to Dr. Scott Leatherdale for connecting me with this research project. This thesis would not have been possible without his mentorship. Scott's philosophy on work-life balance enhanced my graduate experience. I would also like to thank Dr. Joel Dubin for his patience, encouragement, and extensive feedback integral for this work.

I am grateful to Dr. Rashid Ahmed, Robin Burkhalter, Mary Jean Costello, Susan Kaai, Dr. Janice Husted, Natasha Lane, and Jenna Voisin for providing invaluable statistical guidance and editing suggestions. Thank you to all of my colleagues in the HSG department for their friendship. To John Barr for his enthusiasm, kindness, and laughter. To Adam Cole, Shannon Freeman, Lirije Hyseni, and Peter Sae Yang who have always been there.

My utmost appreciation goes to the Propel Centre for Population Health Impact and the Youth Smoking Survey team for allowing me to work with the YSS and the DMTI-EPOI datasets. I gratefully acknowledge the support of an Ashley Studentship for Research in Tobacco Control from the Ontario Tobacco Research Unit, the Canadian Institutes of Health Research Training Grant in Population Intervention for Chronic Disease Prevention, and the Ontario Graduate Scholarship.

This thesis is dedicated to my parents Hung Manh Vu and Dao Thi Bui for their unwavering support of my educational pursuits.

Table of Contents

AUTHOR'S DECLARATION	ii
Abstract	iii
Acknowledgements	iv
Table of Contents	v
List of Figures	viii
List of Tables.....	ix
Chapter 1 Introduction.....	1
Chapter 2 Literature Review	3
2.1 Youth smoking in Canada	3
2.1.1 Health consequences of youth smoking	3
2.2 Youth access to cigarettes	4
2.2.1 Tobacco access legislation in Canada	4
2.2.2 Limitations of tobacco access restrictions	5
2.2.3 Interventions to reduce cigarette availability.....	7
2.3 Cigarette access behaviour among youth	11
2.3.1 Conceptual framework	11
2.3.2 Student-level characteristics	15
2.3.3 School-level characteristics	18
2.4 Contraband tobacco in Canada.....	19
2.4.1 Contraband cigarettes and youth smoking.....	20
2.4.2 Conceptual framework	21
2.4.3 Youth access to contraband cigarettes.....	24
Chapter 3 Study Rationale and Research Questions	25
3.1 Rationale.....	25
3.2 Study purpose and research questions	26
3.2.1 Study hypotheses	27
Chapter 4 Methodology	28
4.1 Introduction	28
4.2 Overview of the Youth Smoking Survey	28
4.3 Sample and participants.....	29
4.3.1 Sampling procedure.....	29

4.3.2	Participants.....	29
4.3.3	Study sample.....	30
4.4	Survey protocols.....	30
4.5	Data collection procedures.....	31
4.6	Measures.....	31
4.6.1	Response variables.....	31
4.6.2	Student-level explanatory variables for youth access to cigarettes.....	32
4.6.3	School-level explanatory variable.....	35
4.6.4	Stratification variable.....	36
4.7	Data analyses.....	37
4.7.1	Research Questions 1 &4: Descriptive statistics.....	37
4.7.2	Research Questions 2 & 5: Multiple logistic regression.....	38
4.7.3	Research Question 3: Multilevel logistic regression.....	39
4.7.4	Sensitivity analysis.....	41
Chapter 5	Results.....	42
5.1	Research Question 1.....	42
5.1.1	Student characteristics.....	42
5.1.2	School characteristics.....	47
5.2	Research Questions 2 and 3.....	52
5.2.1	From a retailer source.....	52
5.2.2	From a family member.....	53
5.2.3	From a friend or someone else.....	54
5.3	Research Question 4.....	58
5.3.1	Access to contraband cigarettes.....	61
5.3.2	Access to non-contraband cigarettes.....	62
5.4	Research Question 5.....	63
5.4.1	Access to contraband cigarettes.....	63
5.4.2	Access to non-contraband cigarettes.....	67
Chapter 6	Discussion.....	68
6.1	Summary and interpretation of the main findings.....	68
6.1.1	Youth access to sources of cigarettes.....	68
6.1.2	Tobacco retailer density and cigarette access.....	69

6.1.3 Importance of student characteristics	71
6.2 Summary and interpretation of the exploratory findings.....	73
6.2.1 Access to contraband cigarettes.....	74
6.2.2 Characteristics associated with access to contraband cigarettes.....	75
6.3 Study limitations and strengths	77
6.4 Implications for policy and programs.....	79
6.5 Implications for future research.....	82
Chapter 7 Conclusions.....	84
Appendix A Summary of studies examining sociodemographic characteristics.....	85
Appendix B Summary of studies examining behavioural characteristics	90
Appendix C Study hypotheses for Research Questions 2 and 5.....	93
Appendix D 2008-09 Youth Smoking Survey Questionnaire (Module B)	95
Appendix E YSS variables and coding definitions	102
Appendix F Calculation of Intraclass Correlation Coefficient	105
Appendix G Calculation of Proportional Change in Variance	106
Appendix H Results of youth access to non-contraband cigarettes.....	107
Appendix I Results of youth access to contraband cigarettes – Sensitivity analysis.....	112
Appendix J Results of missing response data – Sensitivity analysis.....	117
References	121

List of Figures

Figure 1. Bronfenbrenner’s Ecological Model.....	12
Figure 2. Bandura’s Social Cognitive Theory	14
Figure 3. Basic components of the Theory of Triadic Influence	15
Figure 4. Proportion of Canadian youth smokers in Grades 9 to 12 who usually get cigarettes, by sources of supply.....	42
Figure 5. Percentage of current youth smokers in Grades 9 to 12 accessing cigarettes from (a) a retailer, (b) a family member, (c) a friend or someone else, by region.....	46
Figure 6. Percentage of secondary schools in Canada by the number of tobacco retailer outlets within a 1-km radius of a school.	50
Figure 7. Percentage of current youth smokers in Grades 9 to 12 by the number of tobacco retailers within a 1-km of a school a smoking student attends.	50
Figure 8. Relative odds of a youth smoker in Grades 6 to 12 accessing cigarettes from a retailer, by number of tobacco retailers within 1-km of a school.....	53
Figure 9. Percentage of current youth smokers in Grades 9 to 12 in Ontario, Quebec, and Atlantic regions and source of supply, by type of cigarettes.	58
Figure 10. Hypotheses for cigarette access from a retailer	93
Figure 11. Hypotheses for cigarette access from a family member	93
Figure 12. Hypotheses for cigarette access from a friend or someone else	94

List of Tables

Table 1. Measures of contraband cigarettes for the current study based on Quebec's minimum legal prices for cigarettes and corresponding YSS response categories.....	37
Table 2. Measures of contraband cigarettes for the sensitivity analysis.....	41
Table 3. Descriptive characteristics for the sample of youth by current smoking status (grades 9 to 12), 2008-2009, Canada.	43
Table 4. Descriptive statistics for the sample of youth by cigarette access (grades 9 to 12), 2008-2009, Canada.....	48
Table 5. Multilevel logistic regression analyses examining characteristics associated with cigarette access behaviour (grades 9 to 12), 2008-2009, Canada.	56
Table 6. Descriptive statistics for the sample of youth who purchase contraband by cigarette access (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.....	59
Table 7. Multiple logistic regression analyses examining characteristics associated with cigarette access behaviour among youth who purchase contraband cigarettes (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.....	65
Table 8. Summary of literature examining sociodemographic characteristics associated with cigarette access.....	86
Table 9. Summary of literature investigating behavioural characteristics associated with cigarette access.....	91
Table 10. Study variables, their corresponding survey questions, and coding definitions for main analysis.....	102
Table 11. Study variables, their corresponding survey questions, and coding definitions for exploratory contraband analysis.....	103
Table 12. Proportional change in variance by the new model including student characteristics	106
Table 13. Descriptive statistics for the sample of youth who purchase non-contraband by cigarette access (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.....	108
Table 14. Multiple logistic regression analyses examining characteristics associated with cigarette access behaviour among youth who purchase non-contraband cigarettes (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.....	110
Table 15. Descriptive statistics for the sample of youth who purchase contraband by cigarette access (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.....	113

Table 16. Multiple logistic regression analyses examining characteristics associated with cigarette access behaviour among youth who purchase contraband cigarettes (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada	115
Table 17. Descriptive statistics for the sample of youth by missing responses (grades 9 to 12), 2008-2009, Canada.....	118
Table 18. Univariate logistic regression analyses examining characteristics associated with providing a missing response (grades 9 to 12), 2008-2009, Canada	120

Chapter 1 Introduction

Tobacco use is the primary cause of preventable illness and premature death, killing more than 37,000 Canadians annually (Makomaski Illing & Kaismerman, 1998). Since smoking is typically initiated and established during adolescence, preventing or delaying youth smoking is necessary to reduce tobacco-related health risks in later adulthood (Centers for Disease Control and Prevention [CDC], 1989). Despite the declines in Canadian smoking rates in recent years, youth tobacco consumption remains substantially high. In 2009, the smoking prevalence rate among youth aged 15 to 19 years was 13%, with the smoking rate for youth aged 15 to 17 unchanged at 10% since 2008 (Health Canada, 2010). The apparent plateau demonstrates the need for more effective tobacco control strategies for further reductions in youth smoking.

Given that youth access to cigarettes is a key contributing factor that perpetuates underage smoking, initiatives designed to prevent underage youth from acquiring cigarettes is a vital component of many tobacco control programs. In Canada, for instance, federal laws prohibit the sale of tobacco products to individuals under 18 years of age (Department of Justice, 2010). Despite such efforts, research suggests that existing access restrictions are largely ineffective (Stead & Lancaster, 2008). Aside from retailers, evidence has shown that youth commonly report accessing cigarettes from social sources, such as family members, friends, and strangers (Castrucci, Gerlach, Kaufman, & Orleans, 2002; Forster, Chen, Blaine, Perry, & Toomey, 2003). Additional research examining factors associated with youth cigarette access behaviours may provide new insight into the development of youth tobacco access programs and policies.

Government regulation of the retail environment from the sale of harmful consumer products is intended to restrict their consumption and subsequent health consequences (Chapman & Freeman, 2009). At present, the retailer location and distribution of tobacco retailers facilitate cigarette

acquisition among youth by making them readily available for uptake. Tobacco retailer outlet density, that is, the number of stores that sell tobacco has been shown to be associated with tobacco use in nearby schools and neighbourhoods, with higher tobacco outlet density in an area associated with an increased likelihood for smoking (Novak, Reardon, Raudenbush, & Buka, 2006). Preliminary evidence suggests that there is variability in terms of how youth smokers access cigarettes across schools (Leatherdale & Strath, 2007; Henriksen et al., 2008). However, substantially more research is needed to illuminate what characteristics within the school environment impact how youth obtain cigarettes.

The high taxation of tobacco products as a part of tobacco control strategies aims to discourage cigarette consumption. An appealing, less costly alternative to retailer cigarette brands among price-sensitive (Gruber, Sen, & Stabile, 2003; Hyland et al., 2005) youth smokers are contraband cigarettes – tobacco products without all applicable federal and provincial taxes (Royal Canadian Mounted Police [RCMP], 2008). In Canada, approximately 15,000 youth smokers in grades 5 to 12 reported that they usually smoke native (contraband) cigarettes (Leatherdale, Ahmed, Barisic, Murnaghan, & Manske, 2009). The prevention of youth from smoking contraband cigarettes requires a greater understanding of how youth access these illicit products.

The main objective of this research project was to examine whether student characteristics and tobacco retailer density in the school community were associated with how youth smokers usually access cigarettes from social sources (family members, friends or strangers), or if they buy their own cigarettes directly from retailers, using data from the National Youth Smoking Survey (YSS). This project also involved an exploratory analysis investigating the student characteristics associated with youth access to contraband cigarettes.

Chapter 2 Literature Review

2.1 Youth smoking in Canada

Although smoking rates in Canada have declined in recent years, youth tobacco use remains too high. In 2009, the smoking prevalence rate among youth aged 15 to 19 years was 13% (representing approximately 286,000 youth), and the smoking rate for youth aged 15 to 17 was unchanged at 10% since 2008 (Health Canada, 2010). About 7% of youth were daily smokers, consuming an average of 11.4 cigarettes per day, while 5% of youth smoked occasionally (Health Canada, 2010).

2.1.1 Health consequences of youth smoking

Youth who begin smoking at earlier ages have an increased likelihood of developing higher levels of nicotine addiction compared to youth who initiate smoking at older ages (CDC, 1989; Breslau, Fenn, & Peterson, 1993). Consequently, youth tobacco cessation attempts are often more difficult when smoking progresses beyond experimentation (Breslau, Fenn, & Peterson, 1993; Breslau & Peterson, 1996; Khuder, Dayal, & Mutgi, 1999). Smoking youth are more susceptible to health morbidities, both acute (e.g., respiratory conditions, reduced lung growth rate and function, increased coughing or wheezing) and chronic (e.g., cancers, chronic obstructive pulmonary disorder, and cardiovascular disease) if active smoking continues into adulthood (CDC, 1989). Smoking uptake is also associated with other unhealthy risk behaviours. Compared to non-smokers, smokers at young ages are more likely to have academic problems, engage in other types of substance use such as binge drinking and hard drug use, and engage in delinquent behaviour that may continue into late adolescence (Ellickson, Tucker, & Klein, 2001; White, Pandina, & Chen, 2002). Public policy efforts addressing youth tobacco use are crucial for preventing future tobacco-related health risks and the negative psychological impacts of smoking.

2.2 Youth access to cigarettes

Given that the ability for youth under the legal age to illicitly acquire cigarettes perpetuates youth tobacco use, a critical component of many tobacco control programs in Canada and the United States targets access to cigarettes (Corporate Research Group [CRG], 2010; United States Department of Health and Human Services [USDHHS], 1994; USDHHS, 2000). In an effort to prevent youth access to commercial sources of cigarettes, youth tobacco access regulations in Canada enforce age-related restrictions that prohibit retailers from providing or selling tobacco to underage youth.

2.2.1 Tobacco access legislation in Canada

Current youth tobacco access restrictions are enforced under the 1997 Federal Tobacco Act. Each province has their own regulations on the sale of tobacco products to youth beyond the minimum requirements set at the federal level. The enactment of the 1994 Tobacco Sales to Young Persons Act by the Canadian federal government enforces a prohibition on sales to youth (Department of Justice, 2010). Point-of-sale restrictions make it illegal for retailers to supply tobacco products to anyone under the age of 18, and such legislation may suspend tobacco sales of retailers for not more than one year for multiple violations of the Tobacco Act (Department of Justice, 2010). Other provinces have set different regulations from the federal level with respect to tobacco possession, restricted sales outlets, and required licenses. For instance, Ontario bans the sale of tobacco in pharmacies, healthcare, social service, childcare, and educational facilities (Ministry of Health Promotion, 2010), while tobacco retailers in the following four classes of trade were permitted to sell cigarettes in 2008: chain convenience stores, independent convenience stores, gas stores/kiosks, and grocery stores. Pharmacies in British Columbia, Alberta, Manitoba, and Saskatchewan were not tobacco-free in 2008 (Physicians for a Smoke-Free Canada, 2010).

2.2.2 Limitations of tobacco access restrictions

2.2.2.1 Measurement of retailer compliance rates

Health Canada annually assesses retailer behaviour towards youth tobacco access restrictions, reporting measures such as the retailer compliance rate – the percentage of retailers that refused to sell cigarettes to underage youth (CRG, 2009). In 2009, the national retailer compliance was reported to be 84.3% (CRG, 2009). However, compliance test protocols by Health Canada appear to be subject to methodological issues that may potentially overestimate findings. A standard compliance test protocol consists of an underage youth (15, 16, or 17 years old) visiting a tobacco retailer to attempt to purchase a 20 or 25 size package of name-brand cigarettes. When asked for their age, youth were instructed to be untruthful. However, they carried no identification, made no effort to disguise their appearance, and made no misleading statements other than if asked for their age. Once the youth test shopper left the retailer environment, an adult supervisor documents whether or not the retailer asked for proper identification as required by the law, as well as the age and sex of both the minor and the clerk in order to measure the influence of age and sex on retailer compliance.

The above measures used to test retailer compliance fail to incorporate key contextual elements related to successful purchases of cigarettes by youth. Empirical literature has found that youth may use fake identification when purchasing cigarettes, with studies showing that almost a quarter of youth reported doing so (DiFranza & Coleman, 2001; Klonoff, Landrine, Lang, Alcaraz, & Figueroa-Moseley, 2001). Furthermore, youth can still purchase tobacco even when legitimate identification is presented. For instance, research has found that sales of cigarettes were four times higher when youth presented identification compared to youth who did not show identification, possibly because clerks miscalculate age (Klonoff et al., 2001), assume youth are old enough to purchase cigarettes when they show identification (Klonoff et al., 2001), or continue to sell cigarettes illegally when youth manipulate them to do so (Klonoff & Landrine, 2004). The standard

methodology also ignores the ability for youth to flirt with clerks or dress to appear older (DiFranza, 2000). Evidence demonstrates that youth can deliberately purchase tobacco from clerks with whom they are familiar or even work as a clerk in order to purchase tobacco (DiFranza & Coleman, 2001; Klonoff & Landrine, 2003). Successful tobacco transactions may also be underestimated if test shoppers act differently from true underage purchasers (DiFranza, 2000). Together, these findings suggest that current compliance test protocols do not differentiate and integrate the various contexts in which youth employ cigarette acquisition strategies.

2.2.2.2 Limited evidence of effectiveness of retailer restrictions

A Cochrane systematic review conducted by Stead and Lancaster (2008) assessed the effectiveness of different tobacco retailer access interventions on illegal sales by youth and the prevalence of youth tobacco use. Such interventions ranged from education, law enforcement, community mobilization (e.g., media coverage), or a combination of these strategies. A literature search selected for controlled and uncontrolled studies with pre- and post-intervention evaluations on changes in retailer behaviour. Based on the 35 studies identified, enforcement activities (e.g., fines, suspensions) and community policies generally had an effect on improving retailer compliance, and access restrictions appeared to have differential effects on youth smokers depending on characteristics such as age and smoking status of youth. However, the authors concluded that retailer legislation alone is insufficient to impact youth smoking prevalence.

The evidence highlights that restrictions designed to impede youth cigarette access are inadequate at substantially reducing cigarette availability, and are thereby ineffective at reducing youth smoking. The lack of effectiveness may be primarily attributable to the fact that youth can circumvent retailer restrictions by procuring cigarettes from social sources, such as family members, friends, and strangers (Castrucci et al., 2002; Forster et al., 2003; Leatherdale, 2005; Leatherdale & Strath, 2007). Moreover, the number of tobacco retailers that continue to sell youth tobacco may be

high enough that retail access has not been sufficiently reduced (Friend, Carmona, Wilbur, & Levy, 2001). Research has also found the impact of point-of-sale restrictions on underage smoking prevalence is negligible unless retailer compliance approaches 100% (DiFranza, Celebucki, & Seo, 1998) because youth will travel to find noncompliant retailers. Youths' social sources and tobacco retailer density in relation to access are explored in greater detail in sections 2.3.2 and 2.3.3, respectively.

2.2.3 Interventions to reduce cigarette availability

Comprehensive tobacco control includes limiting the physical availability of tobacco products (Cohen & Anglin, 2008; Gartner & McNeill, 2009; Ontario Tobacco Research Unit, 2010; Ribisl, 2011). This section describes various interventions based on this premise, and their coinciding strengths and weaknesses.

2.2.3.1 Tobacco retailer licensure

Tobacco retailer licensure as a means to limit tobacco retailers has been proposed in several communities. Many American states and several provinces including Manitoba, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and Newfoundland require tobacco retailers to be licensed (Canadian Cancer Society, 2008). Retailers can have their tobacco sales licenses suspended or cancelled for violations including selling cigarettes to minors. Ontario does not have a mandatory tobacco retailer licensing system, although some municipalities require tobacco retailers to have a municipal tobacco retail license and pay a license fee (Canadian Cancer Society, 2008).

The lack of evaluations on tobacco retailer licensure should not overlook the potential of restricting the number of approved tobacco retailer licenses to reduce youth smoking. Research has found an association between higher tobacco retailer density and increased youth smoking (Novak et al., 2006), which suggests that fewer tobacco retailer outlets may decrease the amount of tobacco

products available to youth. High cost-prohibitive license fees may indirectly limit the number of retailers in an area (Institute of Medicine, 2007). Additional research is required to examine if tobacco retailer outlet density is associated with youth cigarette access behaviour.

2.2.3.2 Zoning and density regulations

Zoning regulations control general and location-specific property use in different zones or within a government's geographic boundaries to ensure certain activities remain in close proximity (e.g., housing and grocery stores), while other activities are separated (e.g., housing and factories) (Ashe, Jernigan, Kline, & Galaz, 2003). In the United States, conditional use permits (CUPs) are a specific type of zoning regulation for the government to determine where particular businesses can be located (Public Health Law & Policy, 2010). Although no state-wide law regulates the location of tobacco retailer outlets, five communities in California have implemented a model land use ordinance to regulate the location and operations of tobacco retailers developed by the Technical Assistance Legal Centre (TALC) (Public Health Law & Policy, 2010).

At present, no evaluations regarding the effectiveness of these zoning regulations in California have been performed; however, evidence has shown that maintaining tobacco retailer outlets away from youth-oriented locations may reduce youth cigarette access. For instance, Leatherdale and Strath (2007) concluded that more tobacco retailers there are near a school was associated with an increased likelihood of youth smokers purchasing their own cigarettes. The alcohol domain may also provide insight into zoning and density regulations for tobacco. Empirical research has shown an association between alcohol outlet density and the increased likelihood of youth accessing alcohol from retailers despite access restrictions in place (Chen, Gruenewald, & Remer, 2009). The World Health Organization (2009) suggests that reducing the physical availability of alcohol through limitations on the number and placement of outlets will result in reductions in

alcohol-related problems. The feasibility and political acceptability of zoning and density restrictions to limit the number of new tobacco retailers requires greater discussion among stakeholders.

2.2.3.3 Youth tobacco possession laws

In Alberta, the Prevention of Youth Tobacco Use Act places a tobacco possession ban for persons under 18 years old with a penalty of up to \$100 if found guilty of smoking, consuming or possessing a tobacco product (Canadian Legal Information Institute, 2004). Nova Scotia applies a similar ban under the Smoke-Free Places Act for persons under 19 years old with a penalty of product confiscation (Nova Scotia House of Assembly, 2009). Purchase, Use, and Possession (PUP) laws are youth tobacco possession bans enacted by 32 American states (Wakefield & Giovino, 2003). Penalties range from a ticket to a fine, a court appearance, school suspension, denial of driver's license, or any combination of these. Municipal-level regulations may also include mandatory participation in an education or cessation program.

Although research suggests that possession bans are effective, the majority of evaluations analyzed American randomized controlled trials with serious limitations in the study design (Wakefield & Giovino, 2003). For example, a study conducted by DePaul University and United States National Cancer Institute assessed the effects of tobacco PUP laws on tobacco use patterns among students in 24 towns, which were randomly assigned into an experimental group and a control group (Jason et al., 2009). The experimental group consisted of both PUP law enforcement and reducing youth tobacco access from retailers, while the control group only involved reducing youth tobacco access from retailers. Findings revealed that the control group had a significantly greater increase in the percentage of youth who smoked 20 or more cigarettes per day compared to the experimental group. However, several limitations of the study are subject to concern. First, baseline participant smokers were more likely to be senior male students who had more smoking friends, thereby limiting the generalizability of the study results to the population of youth smokers. Second,

the study did not evaluate the impact of the ban on experimental or occasional youth smokers who make up a large proportion of youth smokers (Health Canada, 2009). Third, self-reported surveys used in the study are subject to self-desirability biases (e.g., youth may not admit their smoking behaviour), and may diminish the accuracy of the results. Finally, even when studies conclude that possession bans are effective, whether these have a long-lasting deterrent effect is uncertain.

One negative implication of youth possession bans is how punitive measures targeting youth make them appear responsible for their smoking behaviour, thus removing some of the onus from the tobacco retailer community. In other words, despite evidence demonstrating that youth can acquire cigarettes from retailer sources, possession bans would hold youth accountable for doing so, rather than the retailers who provided cigarettes. Given the favourability of possession bans among tobacco industry proponents and active support for them by the Ontario Convenience Stores Association (Canadian Convenience Stores Association, 2010), the value of this policy for the protection of youth health the its primary objective is questionable.

2.2.3.4 School-level interventions

School-based interventions designed to prevent youth tobacco use have been widely implemented. Almost all children can be reached through schools, and educational-type programming aligns with daily school activities (Thomas & Perera, 2006). A Cochrane systematic review assessed the effectiveness of school-based programs to prevent youth smoking initiation and concluded that while such programs show limited evidence of effectiveness, school-level interventions targeting high-risk groups may be valuable (Thomas & Perera, 2006). Although limited research has specifically evaluated school-level interventions intended to reduce cigarette availability, evidence showing differences in cigarette access behaviours between schools may inform new school-level tobacco interventions that incorporate approaches tailored to specific schools. These school-level considerations in relation to tobacco retailer density are explored in greater detail in section 2.3.3.

2.3 Cigarette access behaviour among youth

Research has identified numerous characteristics associated with how youth access cigarettes from: (a) a retailer source; (b) a smoking family member; and (c) a smoking friend or stranger (Castrucci et al., 2003; Forster et al., 2003; Leatherdale, 2005; Leatherdale & Strath, 2007). Indeed, 64% of Canadian youth who smoked in the last 30 days reported getting their cigarettes from social sources (Health Canada, 2008). Student-level characteristics are defined as sociodemographic and behavioural factors related to youth cigarette access, such as age, smoking status, and the frequency of sharing cigarettes with others. School-level characteristics are factors in the school environment that are related to youth cigarette access.

2.3.1 Conceptual framework

A substantial body of empirical research has identified student- and school-level characteristics associated with youth cigarette access behaviours. A theoretical basis for such observations is important to articulate the relationships, and to identify important constructs associated with youth cigarette access that have not been previously examined in research. Appropriate theories that draw an implicit notion of how youth access cigarettes include Ecological Theory, Social Cognitive Theory, and the Theory of Triadic Influence. The integration of individual level and multiple levels of external influence on health behaviour is a shared principle among these theories, which all postulate that health behaviour is a product of the dynamic relationship between sociodemographic and behavioural variables, as well as the physical and social environment (Glanz, Rimer, & Viswanath, 2008). The following section overviews the core principles of each theory and justifies why the Theory of Triadic Influence is the predominant perspective framing youth cigarette access behaviours.

2.3.1.1 Ecological Theory

Ecological Theory (ET) (Bronfenbrenner, 1979) suggests there are multiple levels of factors that influence health behaviour. Concepts that intersect across these levels including sociocultural factors and physical environments may apply to more than one level where they influence and interact with each other. Bronfenbrenner identifies a range of influential domains that may be pertinent towards understanding youth cigarette access behaviour: intrapersonal (e.g., age, gender), interpersonal (e.g., smoking family members, friends, strangers), organizational (e.g., the school environment), physical environment (e.g., the number of tobacco retailers), and policy (e.g., point-of-sale restrictions) (Figure 1).

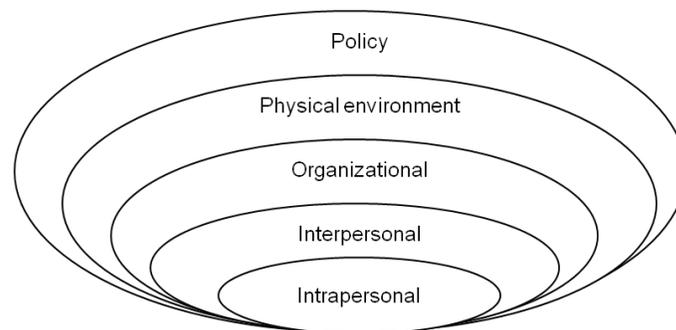


Figure 1. Bronfenbrenner's Ecological Model

The primary strength of ET is its recognition of using comprehensive, multilevel approaches to produce sustained, population-wide changes in health behaviour in contrast to single-level interventions (Glanz et al., 2008). Furthermore, ecological models are most powerful when they are tailored to specific health behaviours; however, developing an intervention to modify a particular health behaviour may not translate to changes in a similar behaviour (Glanz et al., 2008). For instance, implementing cigarette access restrictions alone may not reduce the overall prevalence of youth smoking. The primary limitations when applying ET to cigarette access behaviours include the lack of specificity in identifying important broader levels of influence and the poor clarification of

how variables interact across levels (Glanz et al., 2008). These weaknesses restrict ET's ability to inform the development of interventions. Given the various student- and school-level influences on youth access cigarettes as identified in the existing literature (sections 2.3.2 and 2.3.3), a specific understanding of these relationships is required.

2.3.1.2 Social Cognitive Theory

Social Cognitive Theory (SCT) (Bandura, 1986) contributes to ET by proposing that the person, environment, and behaviour continuously interact and influence each other through reciprocal determinism, resulting in individual and social changes. It recognizes how environments shape behaviour, how people alter and construct environments, and how people can achieve environmental changes (Figure 2). For example, the behaviour and characteristics of influential social models in the school or familial environment (e.g., smoking family members, friends, or strangers such as older peers) may have an impact on the behaviour, and characteristics of students within these environments to make them more prone to access cigarettes. Thus, both the characteristics of individuals and characteristics of the social environment surrounding them are important. Through SCT, a person develops a belief to perform behaviours that bring desired outcomes, a concept defined as self-efficacy.

Similar to ET, SCT provides a comprehensive framework for understanding factors that influence health behaviour to guide the design of interventions. However, Bandura mainly referred to social environments and rarely addressed the role of physical, community, or organizational environments in changing behaviour (Glanz et al., 2008), important elements to consider when examining youth cigarette access behaviours. SCT is also a broad theory and has not been rigorously tested compared to other health behavioural theories (Glanz et al., 2008).

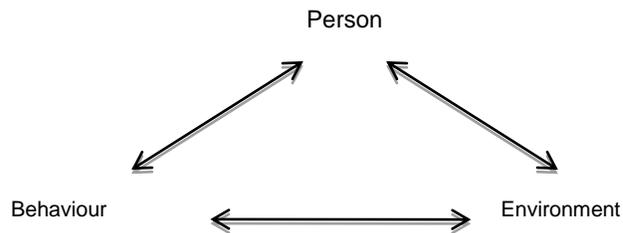


Figure 2. Bandura's Social Cognitive Theory

2.3.1.3 Theory of Triadic Influence

The Theory of Triadic Influence (TTI) (Flay, 1999) posits that youth access behaviour is influenced by a complex system of factors. Genetic and environmental factors underlying health behaviours are categorized into three “streams of influence”: individual characteristics (i.e., age, gender), characteristics in the social environment (smoking family members and friends), and sociocultural environment (e.g., the school community). These streams of influence are also arranged into levels of factors that represent their degree of correlation with the behaviour. Proximal factors are behaviour-specific and have direct effects on decisions/intentions to engage in that behaviour. Ultimate and distal factors in the broader environment, often less correlated with behaviour compared to proximal factors, have effects on multiple behaviours and are often the most difficult for any individual to change, but are likely to have an enduring impact if changed.

The TTI incorporates the person-behaviour-environment perspective of both ET and SCT; the additional advantage of TTI is the consideration of specific interactions between streams that increase or reduce both risk and/or protective factors (Flay, 1999). For instance, research has identified that smoking behaviour in elementary and secondary school is associated with the prevalence of smoking within the school (Leatherdale & Manske, 2005; Leatherdale, McDonald, & Brown, 2005; Sabiston et al., 2009). TTI reflects these associations and interactions in the broader environment to help guide

the development of effective targeted approaches to prevent youth cigarette access, and to provide more possible points of intervention.

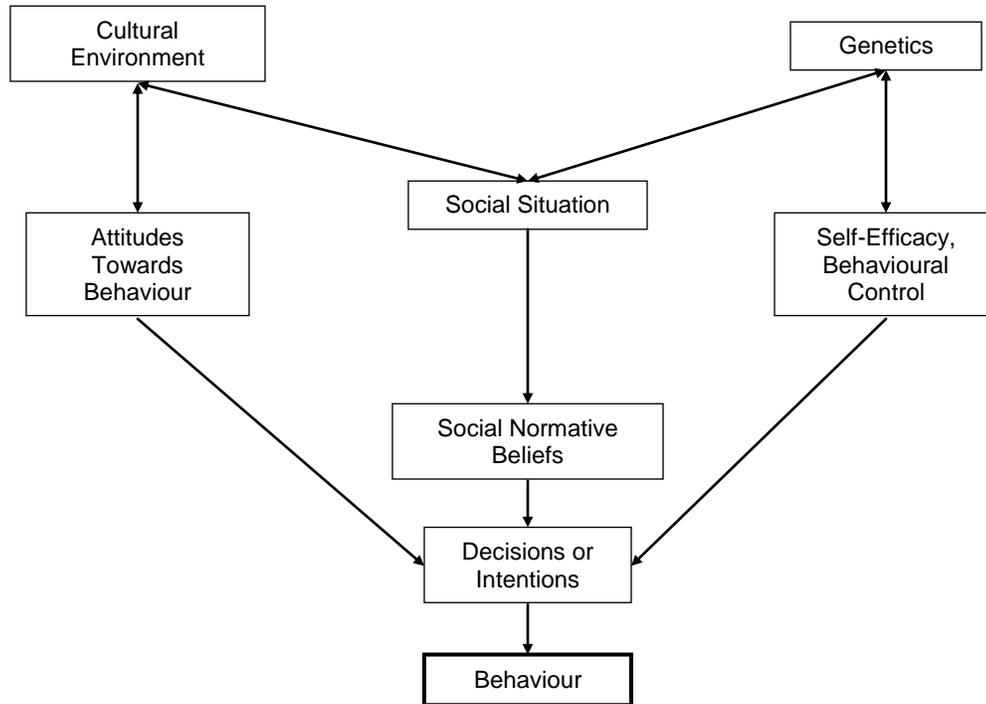


Figure 3. Basic components of the Theory of Triadic Influence

2.3.2 Student-level characteristics

2.3.2.1 Sociodemographic characteristics

Empirical research has found that variability in cigarette access behaviours based on the sociodemographic characteristics of youth. Youth who are older are more likely to purchase their own cigarettes from a retailer compared to younger youth (Castrucci et al., 2002; Forster et al., 2003; Harrison, Fulkerson, & Park, 2000; Hughes, Hughes, Atkinson, Bellis, & Smallthwaite, 2010; Jones, Sharp, Husten, & Crossett, 2002; Leatherdale, 2005; Leatherdale & Strath, 2007). Male youth are also more likely to buy their own cigarettes, while female youth more frequently report accessing cigarettes through social sources (Castrucci et al., 2002; Forster et al., 2003; Harrison et al., 2000;

Jones et al., 2002; Kaestle, 2009; Leatherdale, 2005; Leatherdale & Strath, 2007). Research has also identified a link between amount of spending money and youth accessing cigarettes directly from retailers (DiFranza, Savageu, & Fletcher, 2009; Katzman, Markowitz, & McGeary, 2007).

Social influences, such as family members, friends, and strangers, are also important. For instance, youth with more smoking friends are apt to obtain cigarettes from social sources (Hughes et al., 2010) since youth with smoking friends often share cigarettes with one another (DiFranza & Coleman, 2001). Youth smokers are also more likely to obtain cigarettes from social sources if they have smoking family members (Hughes et al., 2010; Milton et al., 2008). Strangers may also act as a source of cigarettes for youth (Foster et al., 2003; Robinson & Amos, 2010), primarily by purchasing cigarettes for them when asked (DiFranza & Coleman, 2001). For example, an older smoking student may provide cigarettes to younger students. In general, youth surrounded by people who smoke more likely to obtain cigarettes from social sources rather than purchasing cigarettes directly from a retailer.

While these findings are mostly population-based and are consistent across surveys, multiple cross-sectional assessments and measures, the findings were not without limitations. Variations in the definitions of measures such as cigarette access are inconsistent across studies and, consequently, may have influenced the reported estimates. The majority of the findings reviewed were based on studies conducted in the United States, which may limit the generalizability of the results to underage smoking youth in Canada due to differences in American local and state access policies. A summary of studies examining sociodemographic characteristics are detailed in Appendix A.

2.3.2.2 Behavioural characteristics

Behavioural characteristics related to how youth access cigarettes have also been examined empirically. In terms of smoking status, daily smokers are more likely to access their cigarettes from

retailer sources, while occasional smokers more frequently report accessing their cigarettes from a social source (Castrucci et al., 2002; Croghan, Aveyward, Griffin, & Cheng, 2003; Leatherdale, 2005; Leatherdale & Strath, 2007; Widome, Forster, Hannan, & Perry, 2007). These findings are consistent across studies which have employed different definitions measuring youth smoking status. The frequency of smoking is associated with cigarette access, with youth who smoke fewer cigarettes per day being more likely to acquire cigarettes from social sources compared to youth who purchase their own cigarettes (Castrucci et al., 2002; Harrison et al., 2000; Leatherdale & Strath, 2007). Youth who reported that their usual source of cigarettes was from a retailer also reported greater perceived ease of access in obtaining cigarettes compared to smokers who used other sources of cigarettes (McCarthy et al., 2009). Store clerk behaviour has also been found to be associated with youths' successful purchases of cigarettes (Klonoff & Landrine, 2004).

Youth co-morbid substance use is common, with few youth reporting only having ever smoked a whole cigarette without also having tried alcohol or marijuana, or having ever smoked a whole cigarette and ever tried marijuana without also having tried alcohol (Leatherdale, Hammond, & Ahmed, 2008). A U.K.-based study assessed the relationship between youth cigarette access and their alcohol consumption based on a sample of students aged 15 to 16, and found that students who binged on alcohol more than once a week almost ten times more likely to smoke compared than those that never binged (Hughes et al., 2010). Although these studies provide strong evidence of risk behaviours related to youth smokers, research relating alcohol and marijuana use with how youth access cigarettes is lacking. While it is conceivable that youth may be more likely to access tobacco if they are able to access other illicit or age-restricted substances, the extent of these associations is unknown. A summary of studies examining behavioural characteristics are described in Appendix B.

2.3.3 School-level characteristics

A paucity of research has examined school-level characteristics associated with youth cigarette access despite findings that suggest tobacco retailer density may impact youth smoking regardless of retailer access restrictions in place. Novak et al. (2006) investigated whether tobacco retailer density was related to the prevalence of youth cigarette smoking among a sample of youth aged 11 to 23 years. After controlling for potentially confounding neighbourhood characteristics such as neighbourhood poverty, the authors found that a higher tobacco retailer density was associated with a 20% increase in the odds of youth smoking. Although the study findings are limited in generalizability as it was conducted in a single city, it lends support for the link between retailer density and youth smoking.

Three studies on tobacco retailer density based on the school context have been conducted. A Canadian study by Leatherdale and Strath (2007) examined how the number of tobacco retailers surrounding the school was associated with the odds an underage smoking youth: (a) usually buy their own cigarettes; (b) usually get a stranger to buy their own cigarettes; or (c) usually get their cigarettes from friends. The sample consisted of data collected from 20,297 students in grades 9 to 12 attending 29 secondary schools in Ontario, and the number of tobacco retailers within a six-block radius of each school was measured. Findings suggests that the more tobacco retailers there were within the community surrounding the school, the more likely underage smokers were to report that they usually buy their own cigarettes, and the less likely they would use others to buy their cigarettes. While the main study could not examine tobacco retailer outlet density outside Ontario, nor could analyze potential interaction effects between retailer density and student characteristics, the strength of the study findings warrants further exploration among representative samples of schools and tobacco retailers.

Although not specific to youth access to cigarettes, Henriksen et al. (2008) examined the relationship between youth smoking and the density and location of tobacco retailer outlets near schools, and found differences in youth smoking prevalence between schools located in neighbourhoods with more than five retailers versus schools without any retailers. Similarly, McCarthy et al. (2009) found that the density of retailers near schools was associated with students who were established smokers (i.e., have smoked one cigarette in the last 30 days preceding the study and not having smoked at least 100 cigarettes); however, the study did not find an association between retailer density and youth cigarette access from a store, in contrast to findings by Leatherdale and Strath (2007). Nonetheless, with preliminary evidence of school-level differences in cigarette access, and since youth spend up to 25 hours per week at school where they can be influenced by school smoking programs and policies and other social influences (i.e., other students) (Leatherdale et al., 2005; Sabiston et al., 2009), these findings suggest that the school environment may be a potential target to considerably impact youth cigarette acquisition.

2.4 Contraband tobacco in Canada

Contraband cigarettes, as defined by RCMP, refer to the unlawful sale of any tobacco product “that does not comply with the provisions of all applicable federal and provincial statutes,” such as the non-payment of taxes applied to all tobacco products, or illegally manufactured cigarettes without markings (RCMP, 2008). Contraband cigarettes are appreciably less expensive compared to legal brands of cigarettes sold by retailers. For instance, in Ontario, a bag of 200 contraband cigarettes may cost \$6 to \$10 (Imperial Tobacco Canada, 2007; Imperial Tobacco Canada, 2011; RCMP, 2008) compared to an equivalent carton of cigarettes that on average sold for \$74.57 in 2009 (Non-Smokers’ Rights Association, 2011). These illegal cigarettes appear to be an attractive alternative for price-sensitive smokers who tend to seek less expensive cigarettes (Gruber et al., 2003; Hyland et al., 2005). Such prices, however, undermine high tobacco taxation policies, a public health strategy that

has been shown to reduce tobacco consumption in Canada (Meier & Licari, 1997; Azagba & Sharaf, 2011). In addition to public health challenges, contraband cigarettes have been responsible for significant losses in tax revenues, costing Canada an estimated \$500 million (Auditor General of Ontario, 2008). Thus, leading public health organizations such as Public Health Ontario and the Smoke-Free Ontario Scientific Advisory Committee have called for enhanced measures for the prevention and control of illegal cigarettes.

According to the RCMP (2008), the four major sources of contraband cigarettes include: (1) illegally manufactured products on the First Nations territories in Canada and the U.S.; (2) counterfeit tobacco products and other brands illegally entering Canada, primarily from China through shipping ports; (3) legally manufactured cigarettes in Canada exempt from federal and provincial tobacco taxes approved for sale only in First Nations communities to a First nations person; and (4) tobacco products from other criminal activities, e.g., cigarettes stolen from convenience stores and cargo. Contraband cigarettes mostly originate from unlicensed cigarette factories located in the First Nations territories of the Akwesasne and St. Regis along the Canadian and American borders, Kahnawake in Quebec, and Six Nations and Tyendinaga in Ontario (RCMP, 2008).

2.4.1 Contraband cigarettes and youth smoking

In Canada, approximately 15,000 (9.3%) youth smokers in grades 5 to 12 usually reported smoking native cigarettes (Leatherdale et al., 2009). About one quarter of youth smokers aged 15 to 19 (72,000) purchased discount-brand cigarettes in the past six months, 19% (53,000) purchased cigarettes from a First Nations' reserve, and 5% (15,000) purchased cigarettes that may have been smuggled (CTUMS, 2009). Several studies have also identified an association between youth smoking native cigarettes and higher cigarette consumption (Callaghan, Veldhuizen, Leatherdale, Murnaghan, & Manske, 2009; Leatherdale et al., 2009).

The affordability of contraband cigarettes for youth is a cause for concern. Previous research has found that youth are particularly sensitive to price, with cigarette prices associated with youth smoking initiation (Tauras et al., 2005), youth smoking prevalence (Ross & Chaloupka, 2003; Waller, Cohen, Ferrence, Bull, & Adlaf, 2003), and average cigarette consumption (Liang & Chaloupka, 2002). Contraband cigarettes are a less costly alternative compared to cigarettes sold by retailers and contribute to youth smoking. Current retailer restrictions aimed at preventing youth access to cigarettes are especially hindered by the emerging contraband tobacco market. Research suggests that youth resort to social sources, such as family and friends, for cigarettes as retailer access restrictions strengthen (Hughes et al., 2010). Considering the rise of contraband cigarette smoking among youth and the ability for youth to undermine retailer restrictions, a better understanding of how youth access contraband cigarettes is required to decrease the prevalence of youth tobacco use.

2.4.2 Conceptual framework

In light of the empirical findings that suggest different characteristics are associated with how youth access contraband cigarettes, two theories offer a conceptual framework for understanding these relationships: the Theory of Supply and Demand, and the Diffusion of Innovations Theory.

2.4.2.1 Theory of Supply and Demand

According to the Theory of Supply and Demand, in a free market the forces of supply and demand generally push prices at which the quantity supplied is equal to the quantity demanded (Baumol & Blinder, 2008). Changes in either demand or supply result in changes in the amount of goods sold, price changes, or both (Mastrianna, 2009). In the context of tobacco, supply refers to the quantity of tobacco products available for purchase, and demand refers to the consumer desire for tobacco products that ultimately drives him/her to purchase cigarettes. Price elasticity of demand is a measure of sensitivity or responsiveness of quantity demanded to a change in price, and price

elasticity of supply is a measure of the sensitivity or responsiveness of quantity supplied to a change in price (Mastrianna, 2009). Tobacco taxation policies are founded on the principles of Supply and Demand. When there is greater elasticity of demand, an increase in the price of cigarettes deters consumers from purchasing tobacco and, as a result, they reduce their consumption. In terms of contraband cigarettes, there is greater elasticity of supply: increased demand for cigarettes drives prices up and, in response, the quantity of contraband cigarettes supplied increases, causing prices to fall.

A strong point of the Theory of Supply and Demand is its consideration of the price sensitivity of adult and youth smokers that influence decisions to access contraband cigarettes. Aside from price, this theory also recognizes that the demand for one product may be affected by the change in the price of another (Mastrianna, 2009). For instance, the demand for contraband cigarettes increases as the costs of commercial sources of cigarettes rise, which may impact access to contraband cigarettes. However, a major limitation of this theory is its failure to identify potential underlying sociodemographic and behavioural characteristics associated with access to contraband cigarettes other than price. As previously mentioned, comprehensive approaches may best address tobacco issues; thus, influencing price alone to tackle access to contraband cigarettes according to this theoretical perspective may be insufficient.

2.4.2.2 Diffusion of Innovations Theory

The Diffusion of Innovations Theory refers to the introduction of new ideas into communities (Rogers, 2003). Diffusion is defined as the process by which an innovation is communicated through certain channels over time among members of a social system; innovation refers to an idea, practice, or object that is perceived to be new according to an individual. Characteristics of an innovation that affect the success and speed of diffusion include their relative advantage over other products, their compatibility with the intended users' values, their complexity, their trialability (i.e., trying the

innovation before deciding to adopt it), and their observability. Individuals are characterized according to the time it takes for adoption to occur, with different settings that can enhance or impede the adoption process.

Access to contraband cigarettes corresponds with the constructs of the diffusion model. Contraband cigarettes may be considered contagious, transmitting through routes such as friendship networks, neighbourhoods, and institutional settings such as schools (Ferrence, 2001). Previous research has identified characteristics associated with access to contraband cigarettes (Leatherdale, Ahmed, & Vu, 2010), which act as determinants of diffusion. The relative advantage of contraband cigarettes is their reduced cost compared to premium-brand cigarettes. The accessibility of contraband cigarettes from smoking social influences such as smoking parents and friends coincides with compatibility – the parental and peer acceptance of contraband cigarettes. The widespread availability of contraband cigarettes facilitates the ease that youth can obtain contraband cigarettes, as with trialability. Finally, smoking parents and friends support the observability of contraband cigarettes by making access and use of contraband cigarettes visible and easily identifiable among youth smokers.

The strength of the Diffusion of Innovations theory over the Supply and Demand model is its consideration of individual and contextual characteristics that may potentially influence how youth access contraband cigarettes, and is thus more consistent with existing research. While the Diffusion theory is prone to individual blame bias (the tendency to hold individuals responsible for their problems), the public health community has recognized that broader environmental determinants can influence youth (Glanz et al., 2008). Nonetheless, under this theoretical framework, the identification of attributes associated with contraband cigarette access among youth can help researchers and policymakers identify more points of intervention to curtail contraband cigarette consumption.

2.4.3 Youth access to contraband cigarettes

To the best of the researcher's knowledge, one study has specifically examined how youth access contraband cigarettes (Leatherdale et al., 2011). Based on a nationally representative sample of youth in Grade 9 to 12 who reported that their usual brand of cigarettes was contraband, male youth and youth with many smoking friends were more likely buy contraband cigarettes from a store, while parental smoking and youth who were heavy smokers (i.e., smoked more than 11 cigarettes per day) were more likely to access contraband cigarettes from a family member. On the other hand, male youth, parental smoking, and heavy smokers were less likely to get contraband cigarettes from a friend or stranger. Interestingly, youth who reported frequently sharing cigarettes more likely accessed contraband cigarettes from a friend or stranger. Overall, it appears that many underage youth smokers were able to access contraband cigarettes from retailer sources and that smoking parents are major sources of contraband cigarette provision for youth, findings that warrant further study.

Chapter 3 Study Rationale and Research Questions

3.1 Rationale

In 2007, the Federal Tobacco Control Strategy (FTCS) led by Health Canada set a target objective to reduce the smoking prevalence of Canadian youth (aged 15 to 17) from 15% to 9% by 2011 (Health Canada, 2009). However, cigarette acquisition among youth is a major impediment to meeting the FTCS goal since it perpetuates youth smoking. The ability for youth to circumvent point-of-sale restrictions designed to prevent access to cigarettes by shifting to social sources for cigarettes, such as family members, friends, and strangers, demonstrates a need for the development and implementation of tobacco access strategies that extend beyond addressing retailer behaviour. A paucity of research examining how youth access contraband cigarettes, and how tobacco retailer density (i.e., the number of tobacco retailers) in the school community influences cigarette access has left these unclear.

Using a nationally representative dataset of Canadian youth smokers, the current study will help expand the current knowledge of youth cigarette access behaviours in several ways. First, elucidating relationships at both the student-level and school-level will provide insight for the federal government to enhance its current tobacco access policies targeting retailer compliance. Second, characterizing youth access to contraband cigarettes will inform current strategies addressing contraband issues to ultimately assist the RCMP in improving policy implementation and enforcement against illegal tobacco products. Finally, this research will provide a unique opportunity to link existing data systems in order to explore how aspects of the built environment may affect youth access to cigarettes. This novel approach will contribute to a more comprehensive understanding about issues of retailer density to address tobacco uptake in the school community.

Such insight will inform public health monitoring and surveillance strategies for researchers and policymakers evaluating the effectiveness of tobacco access interventions.

3.2 Study purpose and research questions

The primary purpose of this research was to investigate if student characteristics and the number of tobacco retailers surrounding schools were associated with different youth cigarette access behaviours, using data from the 2008-09 Youth Smoking Survey. The current study also conducted an exploratory analysis on the relation between student characteristics and youths' usual sources of contraband cigarettes.

The specific research questions addressed were the following:

1. What is the prevalence of underage youth smokers in Canada who report usually accessing their cigarettes from a retail source, a family member, and a friend or someone else?
2. Among underage youth in Canada who are current daily or occasional smokers, what sociodemographic and behavioural characteristics are associated with whether they report usually accessing their cigarettes from a retailer source, a family member, and a friend or someone else?
3. Controlling for student-level characteristics, is tobacco retailer outlet density surrounding schools associated with whether youth report usually accessing their cigarettes from a retailer source, a family member, and a friend or someone else?
4. What is the prevalence of underage youth smokers in Canada accessing *contraband* cigarettes from a retail source, a family member, and a friend or someone else?

5. Among underage youth in Canada who are current daily or occasional smokers, what sociodemographic and behavioural characteristics are associated with whether they report usually accessing their *contraband* cigarettes from a retailer, a family member, and a friend or someone else?

3.2.1 Study hypotheses

1. The prevalence estimates of youth smokers in Grades 9 to 12 accessing cigarettes from a retailer source, a family member, and a friend or someone else will be similar to estimates reported by the 2009 CTUMS data (Health Canada, 2010) and the published literature as discussed in the previous chapter: a greater proportion of youth smokers access cigarettes from social sources (family members, friends, and strangers) compared to those who buy cigarettes from a retailer will be found.
2. The hypothesized student-level characteristics associated with accessing cigarettes from a retailer source, a family member, and a friend or stranger are specified in Appendix C.
3. The density of tobacco retailer outlets surrounding schools will be associated with the increased odds of a youth smoker accessing cigarettes from a retailer, a family member, and a friend or someone else, controlling for student-level characteristics.
4. The prevalence estimates of youth smokers accessing contraband cigarettes from a retailer source, a family member, and a friend or someone else will be similar to estimates reported by Leatherdale et al. (2011).
5. The hypothesized student-level characteristics associated with accessing contraband cigarettes are specified in Appendix C.

Chapter 4 Methodology

4.1 Introduction

The current study was a secondary analysis of the 2008-09 Youth Smoking Survey (YSS) for respondents in Grades 9 to 12 in Canada. Student-level data from the YSS were linked to the DMTI Spatial Inc.'s Enhanced Points of Interest (EPOI) dataset containing information on the number of tobacco retailer density outlets surrounding schools within a 1-km radius, a school-level characteristic. Multilevel logistic regression analyses were conducted to examine the school- and student-level characteristics associated with the odds of a current youth smoker accessing cigarettes from: (a) a retailer source, (b) a family member, and (c) a friend or someone else. An exploratory analysis was also conducted to investigate the student-level characteristics associated with youth access to contraband cigarettes.

4.2 Overview of the Youth Smoking Survey

The YSS is a nationally representative, classroom-based survey distributed across schools in the ten Canadian provinces, a survey allows for the cross-sectional examination of changes in student smoking behaviour, social and demographic factors, attitudes and beliefs about smoking (University of Waterloo, 2009). The primary purpose of the YSS is to provide benchmark data on the national prevalence rates of tobacco use among students in grades 6 to 12.

Design aspects of the YSS are appropriate for examining youth cigarette access behaviours. The YSS provides nationally representative population-based data, thus allowing for the generalizability of the study findings to the target population. In addition, the YSS includes survey items that measure constructs specific to cigarette access that rarely are addressed in health monitoring surveys (Statistics Canada, 2010). For these reasons, YSS data are suitable for analyzing this study's research questions.

4.3 Sample and participants

4.3.1 Sampling procedure

The 2008-09 YSS uses a multistage stratified clustered design with schools as primary sampling units and students as secondary sampling units. Each province was stratified into relatively homogenous regions. Within each provincial sampling frame, stratification was classified by: 1) health region smoking rate (“low”, “high” and, for Ontario, “GTA”); and 2) type of school (elementary or secondary). Crossing these stratifications formed six strata for Ontario and four in the other provinces. The sample of schools was selected systematically within each stratum in each province with probability proportional to school size. This method of selection ensured that school size had no influence on the selection of students into the sample. All students in the selected classes were surveyed within each school.

Assigning the school sample into strata accounts for the size of the provinces and clustering of the student sample in schools. This stratification is a statistical technique commonly incorporated into sample design to reduce random error (Rossi, Wright, & Anderson, 1983). In contrast, a truly randomized sampling design where students from a pooled sample of schools are randomly selected may produce more biased estimates of attributes of the student population.

4.3.2 Participants

The target population of the YSS was Canadian youth attending private, public, and Catholic schools enrolled in grades 6 to 12; youth residing in the three Territories were excluded from coverage, as were youth living in institutions (e.g., mental institutions) or on First Nations reserves, and youth attending special schools (e.g., schools for visually-impaired or hearing-impaired individuals) and military bases. All ten Canadian provinces participated in the study.

4.3.3 Study sample

The study sample in this project is comprised of a nationally representative sample of youth smokers enrolled in secondary school (grades 9 to 12). Only secondary school students who were current daily or occasional smokers were examined in this study for two reasons. First, built environment data on tobacco retailer outlet density to link to the YSS were only available for secondary schools. Second, since a greater proportion of students who are current smokers are older (CDC, 2010; Paglia-Boak et al., 2009), this evidence suggests that fewer students in elementary school are smokers compared to youth attending secondary school. The inclusion of elementary students and less frequently smoking youth (e.g., one puff) in the sample may potentially bias the associations between youth smokers and cigarette access behaviours toward null findings. As such, these students were excluded from the sample. For the analysis of youth access to contraband cigarettes, the sample only included current youth smokers in grades 9 to 12 residing in Ontario and Quebec because of their proximity to the First Nations territories illegally manufacturing cigarettes, and the Atlantic provinces (New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador) where contraband cigarettes are predominantly supplied by these reserves (RCMP, 2008).

4.4 Survey protocols

The YSS student questionnaire was divided into two modules (Module A and Module B). Module B questionnaires, which contained drug and alcohol questions excluded in Module A, were completed by all eligible grades 7 to 12 classes, and provided the data for this study (Appendix D). Student questionnaires were administered by classroom teachers. Students were surveyed in their classrooms during one class period, and participants were not provided compensation. A site coordinator or data collector trained on the coordination and/or implementation of a school data collection was present at the main office of each school during the collection period. The survey typically required 30 to 40 minutes to complete. Eight to 10 weeks after data collection, all schools

received an individualized *School Feedback Report* as well as an honorarium of \$100 and thank you materials for participation. Ethics approval was granted by the University of Waterloo Office Of Research Ethics and by the school board ethics committees.

4.5 Data collection procedures

Data collection of the 2008-09 YSS was conducted from December 2008 to June 2009 with school board recruitment beginning in October 2008. Board and school permission were obtained before the YSS was implemented. For secondary schools (e.g., 9-12 in ON, 8-12 in BC, and Secondaire I-V in QC), active information (i.e., a information-permission letter describing the study) with passive consent were used to reduce demands and to increase student participation rates. The letter informed parents about the survey and requested parents to call a toll-free number or inform the school if they refused their child's participation. Detailed information on the 2006-07 YSS data collection protocols are available elsewhere (Health Canada, 2011).

4.6 Measures

Please refer to Appendix E for a complete list of the dependent and independent variables that were analyzed in the current study.

4.6.1 Response variables

Current smokers, those who have smoked at least 100 cigarettes in their lifetime and have smoked in the 30 days preceding the survey, were asked "Where do you usually get your cigarettes?" Selections included: I do not smoke; I buy them myself at a store; I buy them from a friend or someone else; I ask someone to buy them for me; my brother or sister gives them to me; my mother or father gives them to me; a friend or someone else gives them to me; I take them from my mother, father or siblings; I buy them from a First Nations Reserve; and "other". Students were restricted to providing one response.

Consistent with the literature (Leatherdale, 2005; Leatherdale & Strath, 2007), the above options were recoded into three different behavioural measures to correspond with sources youth usually use to acquire cigarettes. The first measure, *Cigarette access from a retailer*, was re-coded as: 1 = I buy them myself; 0 = all others. The second measure, *Cigarette access from a family member*, was recoded as: 1 = my brother or sister gives them to me, my mother or father gives them to me, I take them from my mother, father or siblings; 0 = all others. The third measure, *Cigarette access from a friend or someone else*, was recoded as: 1 = I buy them from a friend or someone else, I ask someone to buy them for me, a friend or someone else gives them to me; 0 = all others. Respondents who chose “I do not smoke” were excluded from the analyses since the variability was not expected to be detected among non-smoking youth who attempted to access cigarettes, as previously mentioned in section 3.3.3.

4.6.2 Student-level explanatory variables for youth access to cigarettes

Information was collected on the sociodemographic and behavioural characteristics of respondents, specified below. Categories were collapsed based on the variability of responses, and from methodologies used in previous research.

4.6.2.1 Sociodemographic characteristics

Sociodemographic measures included grade (9, 10, 11, 12), sex (male, female), spending money per week (\$0 to \$20, \$21 to \$40, \$41 to \$100, More than \$100), aboriginal status (Aboriginal, non-Aboriginal), smoking parent or guardian (yes, no), smoking older sibling (yes, no or I do not have siblings), and the number of close friends who smoke (0, 1 to 2, 3 or more). Geographic region was categorized as Atlantic Canada (New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador), Quebec, Ontario, Prairies (Alberta, Saskatchewan, Manitoba), and British Columbia.

For the exploratory analysis examining youth access to contraband cigarettes, the following sociodemographic characteristics were collapsed based on the variability of responses and according to methods used by Leatherdale et al. (2011): grade (9 or 10, 11 or 12), spending money per week (\$0 to \$20, \$20 or more), and the number of close friends who smoke (fewer than 5 friends, more than 5 friends).

4.6.2.2 Behavioural characteristics

Current smoking status. Daily smokers were defined as current smokers who reported smoking at least one cigarette per day for each of the 30 days preceding the survey. Occasional smokers were defined as current smokers who reported smoking at least one cigarette during the 30 days preceding the survey but have not smoked every day.

Average number of cigarettes per day. Respondents were asked to report, “Thinking back over the last 30 days, on the days that you smoked, how many cigarettes did you usually smoke each day?” (a few puffs to 1, 2-3, 4-5, 6-10, 11-20, 21-29, 30 or more). Consistent with previous research (Leatherdale et al., 2011), categories were recoded into: 1 = 11-20, 21-29, 30 or more; 0 = a few puffs to 1, 2-3, 4-5, 6-10.

Perceived ease of cigarette access. Respondents were asked to report, “Do you think it would be easy for you to get cigarettes if you wanted to smoke?” (yes, no).

Frequency of sharing cigarettes with others. Respondents were asked to report, “When you smoke, how often do you share a cigarette with others?” (I do not smoke, never, sometimes, usually, always). Categories were recoded into: 0 = never, 1 = sometimes, 2 = usually or always.

Store clerk suggested a cigarette brand. Respondents were asked to report, “Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?” (I did not buy cigarettes from the store in the last 6 months, yes, no). Categories were recoded into: 0 = no; 1 = yes.

For analyses, this measure was reported only for youth who accessed cigarettes from a retailer source as youth smokers were not assumed to encounter a store clerk when acquiring cigarettes from a family member, and a friend or someone else. Thus, the response “I did not buy cigarettes from a store in the last 6 months” was excluded.

Ever tried marijuana. Respondents were asked, “How often did you use marijuana or cannabis?” (I have never used marijuana, I have used marijuana but not in the last 12 months, every day, 4 to 6 times a week, 2 or 3 times a week, once a month, less than once a month). To determine ever use of marijuana among youth, these selections were re-coded into: 1 = I have used marijuana but not in the last 12 months, every day, 4 to 6 times a week, 2 or 3 times a week, once a month, less than once a month; 0 = I have never used marijuana.

Ever binge drink. Respondents were asked, “In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?” (I have never done this, I did not have 5 or more drinks on one occasion in the last 12 months, daily or almost daily, 2 to 5 times a week, once a week, 2 to 3 times a month, less than once a month). To determine youth who ever binge drink, these selections will be recoded into: 1 = daily or almost daily, 2 to 5 times a week, once a week, 2 to 3 times a month, less than once a month; 0 = I have never done this, I did not have 5 or more drinks on one occasion in the last 12 months.

Binge smoker. With evidence of binge smoking among youth smokers (Cancer Institute New South Wales, 2010), the variable was derived by linking current smoking status and the response to the survey question, “Average number of whole cigarettes smoked on the days that the respondent smoked” (0 whole cigarettes smoked, 1-36 whole cigarettes smoked). A youth smoker was considered a binge smoker if he/she was a current occasional smoker and smoked more than 10 whole cigarettes when they smoked (*Binge smoker*). A youth smoker was not considered a binge smoker if he/she a

current occasional smoker and smoked 10 or fewer whole cigarettes when they smoked (*Not a binge smoker*). Setting 11 cigarettes as a cut-off measure for binge smoking is consistent with previous research that heavier, daily smokers consume 11.4 cigarettes on average per day (Health Canada, 2011).

4.6.3 School-level explanatory variable

Number of tobacco retailer outlets surrounding a school. The 2008-09 DMTI-EPOI (Enhanced Points of Interest) data file and student-level data of all provinces from the 2008-09 YSS were linked to identify the number of tobacco retailers surrounding a school. EPOI data provide the location of tobacco retailers (business). Consistent with previous research (Pouliou & Elliot, 2010), the process of identifying and linking the DMTI-EPOI data to the YSS student-level data involved three steps: (1) geocoding the address for each YSS school; (2) creating 1-km circular buffers (i.e., bounded areas surrounding each school in which the number of tobacco retailers were quantified); and (3) linking the quantified school-level data for each school to the student-level data from each school. Arcview 3.3 (ESRI, 2002) software was used to geocode the school addresses using its built-in coordinate system with the location of schools, and to create the 1-km buffers using tools to examine how many tobacco retailers fall within these buffers. Consistent with previous research (McCarthy et al., 2009), a 1-km buffer zone was representative of the distance youth may walk to reach a retailer from their school. The dataset provided the number of confirmed tobacco retailer outlets (under the heading “Tobacco”) and the number of unconfirmed outlets (“Maybe tobacco retailers”) surrounding schools. Due to limitations in data collection, some retailers could not be established as outlets that sold cigarettes on premises. EPOI data also included the density of pharmacies within a 1-km radius of a school. Since British Columbia, Alberta, Saskatchewan, and Manitoba did not ban the sale of tobacco products in pharmacies when data collection for the 2008-09 YSS occurred (Physicians for a Smoke-Free Canada, 2010), pharmacies in these provinces were also included in the analyses.

4.6.4 Stratification variable

Contraband cigarette access. This new variable was derived by linking the following questions: “Thinking about the last time you bought cigarettes in the last 12 months, what did you buy?” and “Thinking about the last time you bought cigarettes in the last 12 months, about how much did you pay for each single cigarette, pack, bag, or carton?”

Youth smokers who purchased a 20 to 25 pack or a carton of 200 cigarettes below the legal purchase price were assumed to have accessed contraband cigarettes. Quebec charges the lowest amount of taxes on cigarettes compared to the other provinces (Coalition for a Smoke-Free Nova Scotia, 2011), and consequently has lower average prices of cigarettes compared to the other provinces (Non-Smokers’ Rights Association, 2011). In Quebec, the minimum retail selling prices for cigarettes cannot be lower than the total tax applicable (excise duty and the tobacco tax, plus the GST calculated on the excise duty and tobacco tax), a measure unchanged since 2006 (Revenu Québec, 2010). Minimum retail prices listed on the Revenu Québec website were used to identify the YSS response categories corresponding to youth access to *contraband* cigarettes (Table 1). For the YSS question about the volume of cigarettes purchased, youth smokers who responded “A bag of 200 cigarettes” were also assumed to have accessed contraband cigarettes as these are typically sold in baggies (RCMP, 2008).

Youth smokers were estimated to have accessed *non-contraband* cigarettes if they purchased a 20 or 25 pack of cigarettes and paid at least the legal price for a pack (\$6.01 to \$20.00); and if they purchased a carton of 200 cigarettes and paid at least the legal price for a carton (\$45.01 to \$60.00; \$60.01 or more).

Table 1. Measures of contraband cigarettes for the current study based on Quebec's minimum legal prices for cigarettes and corresponding YSS response categories

Amount of cigarettes	Minimum retail selling price for legal cigarettes*	YSS response categories
A package of 20 cigarettes	\$3.92	10 cents to 50 cents, 51 cents to \$4.50, \$4.51 to \$6.00
A package of 25 cigarettes	\$4.91	10 cents to 50 cents, 51 cents to \$4.50, \$4.51 to \$6.00
A carton of 200 cigarettes	\$39.23	\$4.51 to \$6.00, \$6.01 to \$20.00, \$20.01 to \$45.00, \$45.01 to \$60.00

*Note: Legal purchase prices of cigarettes based on Quebec's tobacco tax requirements.

4.7 Data analyses

Survey weights were used to adjust for differential response rates across regions or groups. Since the sampling design of the YSS consists of stratification, two stages of selection, and unequal probabilities of selecting participants, these statistical adjustments must be accounted for by applying survey weights to the data. The purposes of using weighted data are to compute representative population estimates from the survey sample and to produce values that correspond to estimates produced by Health Canada. Ultimately, the sample should have the same distribution of characteristics as the population from which it was drawn. The statistical package SAS 9.2 was used for all analyses (SAS Institute, 2001). Potential clustering within schools was controlled for using various SAS procedures.

4.7.1 Research Questions 1 & 4: Descriptive statistics

Using student-level data, the prevalence of youth smokers accessing cigarettes from a retailer source, a family member, and a friend or someone else were found according to the various sociodemographic and behavioural characteristics described in Chapter 2. Initially, unweighted frequency distributions were calculated for survey responses as descriptive statistics, and were assessed to determine the appropriateness of collapsing response categories. Since Statistics Canada guidelines require a sample size of 30 or more responses for each estimate to be acceptable and

reliable (University of Waterloo, 2009), only corresponding weighted estimates are provided. Weighted chi-square statistics were then used to determine significant differences between responses of the student-level characteristics and responses for each type of cigarette access behaviour. Using school-level data, the mean prevalence and range of tobacco retailer outlets surrounding schools within a 1-km radius across Canada were found. The number of tobacco retailer outlets and corresponding number of students from the YSS attending these schools within proximity to tobacco retailers was then calculated. All descriptive statistics were analyzed using the FREQ procedure in SAS.

4.7.2 Research Questions 2 & 5: Multiple logistic regression

The purpose of multiple logistic regression is to describe the relationship between a binary response variable and a set of explanatory variables, while statistically adjusting for potential confounding effects of other independent variables that may compromise the findings. This statistical technique produces a fitted model that provides reasonably precise estimates of the mean response with a parsimonious set of independent variables, i.e., the least number of parameters possible (Hosmer & Lemeshow, 2000). Since the response variable in this study was a binary variable (i.e., each cigarette access measure was coded as 0 or 1), multiple logistic regression modeling was considered to be an appropriate statistical method to examine the direction and magnitude of associations. Specific to this study's research questions, multiple logistic regression assessed whether student-level characteristics would increase a model's capability to account for the variation in cigarette access.

The multilevel structure of the sample (students clustered within schools) results in correlated data, i.e., students within the same school are assumed to be correlated, which requires a more sophisticated model than a standard multiple logistic regression. One option is to use generalized linear mixed effects models (GLMMs), which involve dependent variables that are dichotomous and,

hence, are not normally distributed (Flom, McMahon, & Pouget, 2006). Fitting a linear model on data that violate normality assumptions may lead to incorrect results, a concept further explored in section 3.4.3. The CLASS statement and the NLMIXED procedure were used to address issues of modeling the non-normal correlated response data.

Univariate logistic regression analyses examined whether each student-level characteristic was associated with the odds of a student accessing cigarettes from a retailer source, a family member, and a friend or someone else, as conducted in the previous literature (Leatherdale, 2005; Leatherdale & Strath, 2007). The GLIMMIX procedure provided initial values for each explanatory variable, i.e., student-level characteristics, associated with cigarette access. Each estimate was then entered into the NLMIXED procedure for iterative calculations. Only significant variables at the $p < .05$ significance level were retained for further analyses. Subsequently, significant variables were collectively entered into GLIMMIX to compute initial estimates that were then entered into NLMIXED for the final model estimates.

4.7.3 Research Question 3: Multilevel logistic regression

Consistent with methods used in previous studies (Leatherdale & Strath, 2007; Henderson, Ecob, Wight, & Abraham, 2008; McCarthy et al., 2009; Lovato et al., 2010), multilevel modeling (MLM) was used to examine the amount of school-level variation in cigarette access associated with the school a smoking student attends as well as the student- and school-level characteristics related to cigarette access. MLM is a statistical technique used to analyze data with a multilevel structure, accounting for the variability associated with each level of nesting (Snijders & Bosker, 1999). The YSS sample consists of a basic 2-level structure where students at one level are nested within schools at the second level, a design that makes MLM appropriate for estimating the amount of variance in cigarette access at the student-level and at the school-level (Raudenbush & Bryk, 2002).

Standard multiple logistic regression analysis as discussed in section 4.7.2 assume that all observations are independent; however, nested data likely to share common characteristics among individuals constituting a group (Snijders & Bosker, 1999). For instance, students attending the same school are more similar to each other compared to students attending a different school. Violating the assumption of independent observations may underestimate the standard errors of model parameters, increasing the probability of committing a Type I error – detecting a significant difference when none exists (Snijders & Bosker, 1999). MLM accounts for differences between schools after adjusting for differences attributable to individual (student-level) characteristics. This statistical technique also provides a greater specification of complex theoretical relationships over single-level regression analyses alone (Snijders & Bosker, 1999), and thus develops models conforming to Theory of Triadic Influence, which frames this study.

In keeping with previous multilevel research studies (Leatherdale et al., 2005; Leatherdale & Strath, 2007), a three-step modeling procedure was used. Step 1 investigated whether between-school variability in cigarette access was significant ($p < .05$). The school-level variance term from Step 1 was used to calculate the intraclass correlation coefficient (ICC) for binary outcomes, an estimate that represents the proportion of the total variance in cigarette access that is due to differences across schools (Merlo et al., 2004). In Step 2, the association between tobacco retailer outlet density and cigarette access, controlling for between-school random variation, was assessed. Associations at the $p < .1$ significance level were retained for further analyses. In Step 3, student characteristics and tobacco retailer outlet density associated with cigarette access were determined. The least significant variables were removed individually until only significant ($p < .05$) variables remained, constituting the final model. Multicollinearity was not an issue in the analysis as the range of correlations between student- and school-level variables was below the 0.7 cut-off threshold that indicates a strong association (range .005 to .385) (Friis & Sellers, 2004).

4.7.4 Sensitivity analysis

4.7.4.1 Handling of missing and invalid data

In preliminary analyses, a log message in SAS indicated that response data were missing ($n = 18,154$), which may produce biased estimates. To determine the influence of missing response data, a sensitivity analysis was conducted based on whether a response was provided for the question, “Where do you usually get your cigarettes?” The design of the YSS questionnaire accounts for non-responses, where students who did not provide a response were coded as “Not stated” (Health Canada, 2010). The response “I do not smoke” was also considered to be an invalid response for this study because the sample was restricted to current youth smokers only. Students who provided a valid response were coded as *Non-missing*; those who responded “Not stated” or “I do not smoke” were coded as *Missing*. Weighted chi-square statistics were calculated to determine significant differences between responses to student characteristics and type of missing responses. Student characteristics that were significantly associated with *Missing* were subsequently entered into GLIMMIX and NLMIXED to obtain results that accounted for potential clustering effects within schools. To adjust for missing responses of explanatory variables, an additional category was coded for each student characteristic, comprised of both “I do not smoke” and “Not stated”. This category was deliberately excluded in the regression analyses in order to remove its potential impact on model estimation.

4.7.4.2 Price estimates for contraband access

A sensitivity analysis was also performed for youth access to contraband cigarettes using more discriminating categories for price. The categories removed are noted in Table 2 below.

Table 2. Measures of contraband cigarettes for the sensitivity analysis

Amount of cigarettes	Minimum retail selling price for legal cigarettes*	YSS response category removed
A package of 20 or 25 cigarettes	\$3.92	\$4.51 to \$6.00
A carton of 200 cigarettes	\$39.23	\$45.01 to \$60.00

*Note: Legal purchase prices of cigarettes based on Quebec's tobacco tax requirements.

Chapter 5 Results

5.1 Research Question 1

5.1.1 Student characteristics

Among Canadian students in Grades 9 to 12 in 2008-09, 11.7 % ($n = 193,456$) were current smokers and 86.7% ($n = 1,440,679$) were never smokers. Proportions of males and females that were current smokers were 58.7% ($n = 113,639$) and 41.3% ($n = 79,817$), respectively. Overall, 52.1% ($n = 100,746$) were daily smokers and 47.9% ($n = 92,710$) were occasional smokers. Among current youth smokers, the vast majority of youth smokers obtained their cigarettes from a retailer, a friend or someone else (Figure 4).

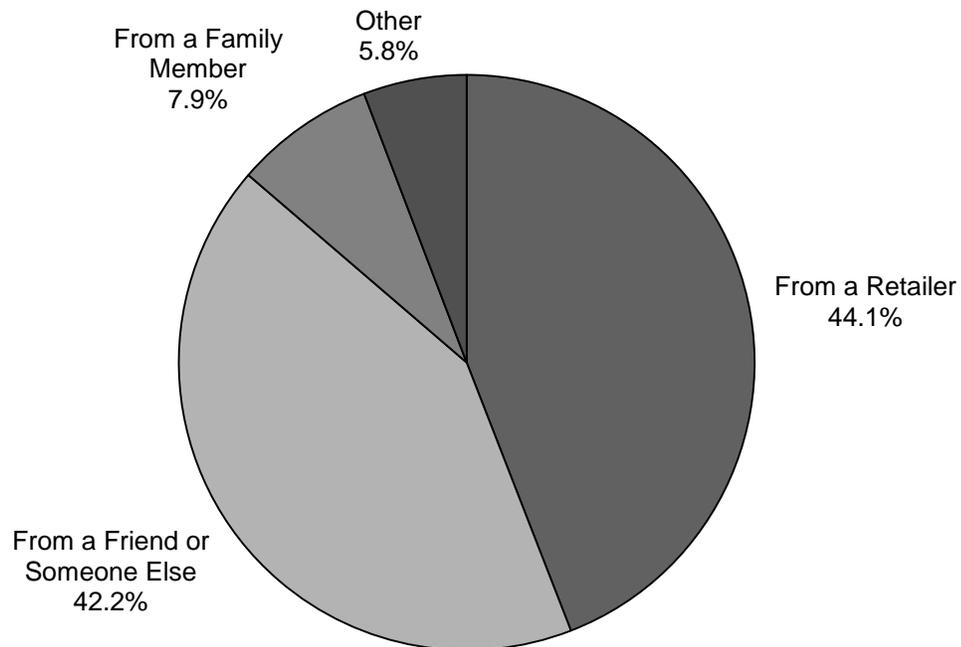


Figure 4. Proportion of Canadian youth smokers in Grades 9 to 12 who usually get cigarettes, by sources of supply.

Table 3. Descriptive characteristics for the sample of youth by current smoking status (grades 9 to 12), 2008-2009, Canada.

Parameter	Daily smokers % ^a , (n = 92,710)	Occasional smokers % ^a , (n = 100,746)	Chi-square	p-value
<i>Sociodemographic characteristics</i>				
Sex				
Female	42.9	39.5	$\chi^2(1) = 4.1$	0.0429
Male	57.1	60.5		
Grade				
9	15.1	15.6	$\chi^2(3) = 19.41$	<.0001
10	22.6	28.6		
11	29.7	26.8		
12	32.6	29.1		
Region				
Atlantic [†]	8.7	7.8	$\chi^2(4) = 10.7$	0.03
Quebec	21.6	20.9		
Ontario	35.4	38.2		
Prairies [†]	19.3	16.1		
British Columbia	15.0	51.1		
Aboriginal status				
Non-aboriginal	81.2	84.8	$\chi^2(1) = 8.2$	0.0042
Aboriginal	18.8	15.2		
Spending money per week				
\$0	7.4	9.7	$\chi^2(3) = 75.2$	<.0001
\$1 to \$20	16.9	28.3		
\$21 to \$100	39.0	34.6		
More than \$100	36.7	27.4		
Parent(s) smokes				
No	24.9	43.3	$\chi^2(1) = 133.4$	<.0001
Yes	75.1	56.7		
Sibling(s) smokes				
No or I have no brothers or sisters	51.5	62.3	$\chi^2(1) = 41.9$	<.0001
Yes	48.5	37.7		
Number of close smoking friends				
None	4.9	5.5	$\chi^2(2) = 33.3$	<.0001
1 to 2	12.3	19.0		
3 or more	82.8	75.5		

<i>Behavioural characteristics</i>					
Average number of cigarettes per day					
0 to 10 cigarettes	82.0	29.8	$\chi^2(1) = 917.1$	<.0001	
11 or more cigarettes	18.0	70.2			
Do you think it would be difficult or easy for you to get cigarettes if you wanted to?					
Difficult	4.2	3.4	$\chi^2(1) = 1.6$	0.209	
Easy	95.8	96.6			
When you smoke, how often do you share a cigarette with others?					
Never					
Sometimes	29.8	82.0	$\chi^2(2) = 63.6$	<.0001	
Usually or Always	70.2	18.0			
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?					
No	9.7	4.1	$\chi^2(1) = 21.5$	<.0001	
Yes	58.2	54.5			
	32.2	41.5			
Ever binge drink					
No	80.7	87.2	$\chi^2(1) = 1.7$	0.198	
Yes	19.3	12.8			
Ever tried marijuana					
No	6.8	5.6	$\chi^2(1) = 17.01$	<.0001	
Yes	93.3	94.4			
Binge smoked [§]					
No		7.7			
Yes	†	92.3	‡	‡	‡

^a weighted population estimate, # estimate not reportable due to small cell size ($n < 30$)

† New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland & Labrador

‡ Alberta, Saskatchewan, Manitoba

§ among current occasional youth smokers in Grades 9 to 12 only, † estimate not reportable; cannot compare with daily smokers

5.1.1.1 Sociodemographic characteristics

Descriptive statistics are presented in Table 4. The majority of males reported usually accessing their cigarettes from a retailer (67.5%) and from a friend or someone else (52.8%), whereas more females reported usually accessing cigarettes from a family member (52.7%) ($\chi^2 = 6.2$, $df = 2$, $p < .0001$) compared to males. Youth in older grades were more likely to report buying their own cigarettes from a store compared to youth in younger grades, while youth in Grade 10 were more likely to report accessing cigarettes from a friend or someone else (31.6%) compared to youth in Grade 12 (22.5%) ($\chi^2 = 179.2$, $df = 6$, $p = < .0001$). Youth with more spending money per week were more likely to report usually buying their own cigarettes compared with youth with no spending money, whereas youth with less spending money per week were more likely to report accessing cigarettes from a family member, a friend or stranger ($\chi^2 = 158.4$, $df = 6$, $p = < .0001$). The majority (89.9%) of youth smokers reported usually accessing cigarettes from a family member if they had a smoking parent or guardian ($\chi^2 = 64.6$, $df = 2$, $p = < .0001$). Sixty percent of youth smokers also reported accessing cigarettes from a family member if they had a smoking sibling ($\chi^2 = 32.2$, $df = 2$, $p < .0001$). Youth with three or more close friends who smoke were more likely to report accessing cigarettes from all sources compared to youth with fewer close smoking friends ($\chi^2 = 25.7$, $df = 4$, $p = < .0001$). The percentage of youth smokers accessing cigarettes from a retailer, a family member, and a friend or stranger, by region is shown in Figure 5.

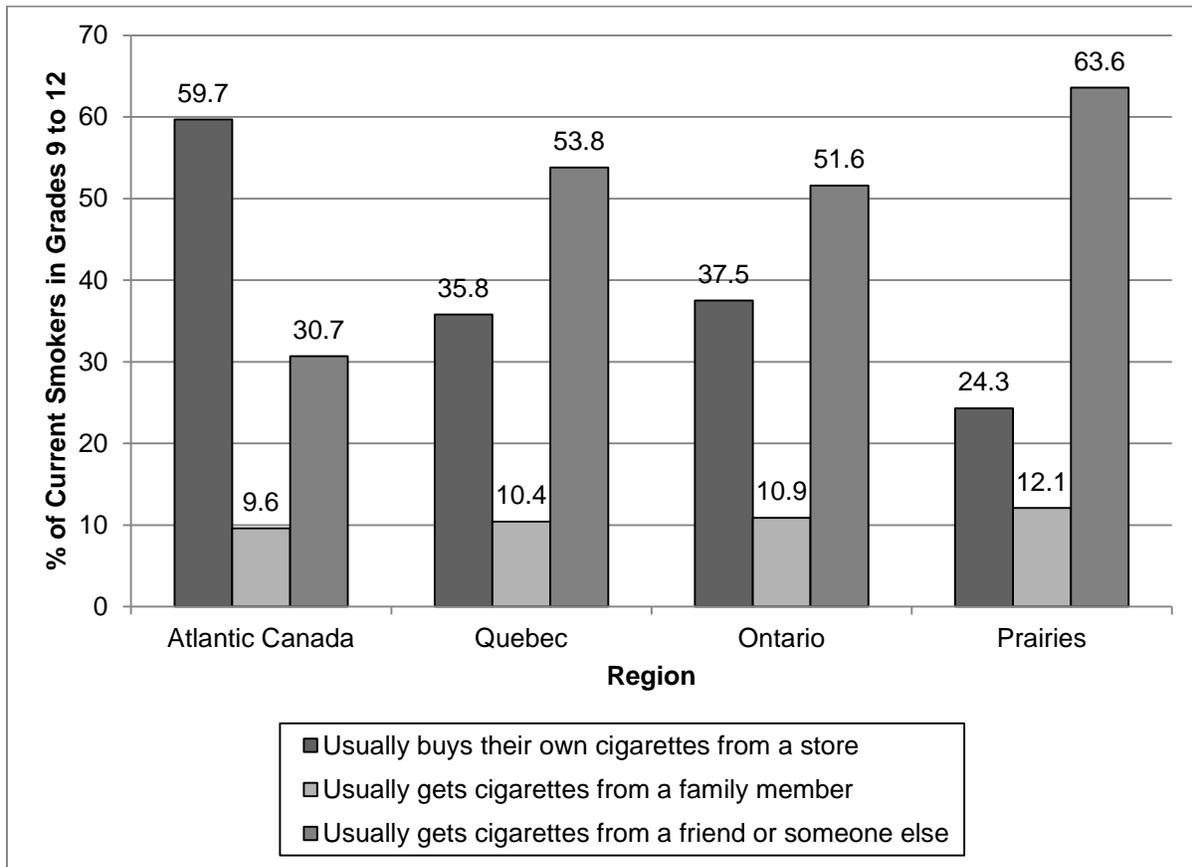


Figure 5. Percentage of current youth smokers in Grades 9 to 12 accessing cigarettes from (a) a retailer, (b) a family member, (c) a friend or someone else, by region.

5.1.1.2 Behavioural characteristics

Descriptive statistics for behavioural characteristics are also presented in Table 4. Daily smokers were more likely to report accessing cigarettes from a store (57.7%) or from a family member (70.4%) than occasional smokers, whereas occasional smokers were more likely to accessing their cigarettes from a friend or someone else (60.2%) ($\chi^2 = 122.8, df = 2, p = <.0001$). Youth who smoke 11 or more cigarettes per day were more likely to report accessing their cigarettes from a family member (57.7%) compared to those who smoke fewer cigarettes, while youth who smoke ten or fewer cigarettes per day were more likely to report getting their cigarettes from a store (54.2%) or from a friend or someone else (61.1%) ($\chi^2 = 2, df = 50.2, p = <.0001$). Youth smokers were more

likely to report accessing cigarettes from all sources if they perceived it was easy to get cigarettes ($\chi^2 = 32.4$, $df = 2$, $p = <.0001$). Similarly, youth smokers were more likely to access cigarettes from all sources if they reported that they sometimes share a cigarette with others compared to youth who share never share cigarettes and youth who almost always share cigarettes ($\chi^2 = 49.2$, $df = 4$, $p = <.0001$). Approximately 15% of youth smokers reported accessing cigarettes from a retailer if they encountered a store clerk who suggested a particular brand of cigarettes ($\chi^2 = 40.4$, $df = 2$, $p = .013$). The association between ever binge drinking and cigarette access was not significantly different ($\chi^2 = 0.263$, $df = 2$, $p = 0.954$). Youth who ever tried marijuana were more likely to access cigarettes from all sources compared to those who have never tried ($\chi^2 = 9.8$, $df = 2$, $p = .008$). Among occasional youth smokers, 16.5% reported accessing cigarettes from a store, 24.1% reported accessing cigarettes from a family member, and 35.2% reported accessing cigarettes from a friend or someone else ($\chi^2 = 56.6$, $df = 2$, $p = <.0001$).

5.1.2 School characteristics

The percentage of secondary schools in Canada by the number of tobacco retailers within a 1-km radius of a school is presented in Figure 6, and the percentage of current youth smokers surrounded by a specific number of tobacco retailers is shown in Figure 7. The median number of tobacco retailer outlets within a 1-km radius of a school known to sell cigarettes was to 3 (mean = 4.3; range = 0-63 retailers); the median number of unconfirmed tobacco retailer outlets was 3.6 (mean = 3.6; range = 0-81 retailers); and the median number of confirmed and unconfirmed tobacco retailer outlets was 7.9 (mean = 7.9; range = 0-144 retailers). Based on data of confirmed tobacco retailer outlets (Figure 7), 16.7% ($n = 32,261$) of current youth smokers in Grades 9 to 12 attended a school with one tobacco retailer outlet within a 1-km radius.

Table 4. Descriptive statistics for the sample of youth by cigarette access (grades 9 to 12), 2008-2009, Canada.

Parameter	Usually buys their own cigarettes from a retailer % ^a , (n = 72,632)	Usually gets cigarettes from a family member % ^a , (n = 12,999)	Usually gets cigarettes from a friend or someone else % ^a , (n = 69,648)	Chi-square	p-value
<i>Sociodemographic characteristics</i>					
Sex					
Female	32.5	52.7	47.2	$\chi^2(2) = 73.0$	<.0001
Male	67.5	47.3	52.8		
Grade					
9	8.9	23.6	18.2	$\chi^2(6) = 179.2$	<.0001
10	19.4	23.2	31.6		
11	29.0	27.6	27.7		
12	42.7	25.6	22.5		
Aboriginal status					
Non-aboriginal	88.3	83.1	82.1	$\chi^2(2) = 20.3$	<.0001
Aboriginal	11.7	16.9	17.9		
Spending money per week					
\$0	7.0	12.4	9.1	$\chi^2(6) = 158.4$	<.0001
\$1 to \$20	13.2	27.6	32.7		
\$21 to \$100	39.9	39.6	34.2		
More than \$100	39.9	20.4	24.0		
Parent(s) smokes					
No	35.6	10.1	37.6	$\chi^2(2) = 64.6$	<.0001
Yes	64.4	89.9	62.4		
Sibling(s) smokes					
No or I have no brothers or sisters	58.1	40.0	60.2	$\chi^2(2) = 32.2$	<.0001
Yes	41.9	60.0	39.8		
Number of close smoking friends					
None	3.7	10.6	5.2	$\chi^2(4) = 25.7$	<.0001
1 to 2	15.3	20.0	15.5		
3 or more	81.0	69.4	79.3		
<i>Behavioural characteristics</i>					
Current smoking status					
Occasional	42.3	29.6	60.2	$\chi^2(2) = 122.7$	<.0001
Daily	57.7	70.4	39.8		

Average number of cigarettes per day					
0 to 10 cigarettes	54.2	41.1	61.1	$\chi^2(2) = 50.2$	<.0001
11 or more cigarettes	45.8	58.9	35.9		
Do you think it would be difficult or easy for you to get cigarettes if you wanted to?					
Difficult	#	#	4.7	$\chi^2(2) = 32.4$	<.0001
Easy	98.3	91.8	95.3		
When you smoke, how often do you share a cigarette with others?					
Never	6.1	8.1	3.4	$\chi^2(4) = 49.2$	<.0001
Sometimes	62.6	54.6	53.2		
Usually or Always	31.3	37.3	43.4		
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?					
No	84.9	†	‡	‡	‡
Yes	15.1				
Ever binge drink					
No	6.4	7.0	6.4	$\chi^2(2) = 0.263$	0.954
Yes	93.6	93.0	93.6		
Ever used marijuana					
No	12.8	7.5	9.4	$\chi^2(2) = 9.8$	0.008
Yes	87.2	92.5	90.6		
Binge smoked §					
No	83.4	75.9	64.8	$\chi^2(2) = 56.6$	<.0001
Yes	16.6	24.1	35.2		

^a weighted population estimate, # estimate not reportable due to small cell size ($n < 30$)

† New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland & Labrador

‡ Alberta, Saskatchewan, Manitoba

§ among current occasional youth smokers in Grades 9 to 12 only

‡ variable applicable for cigarette access from a retailer only; see section 4.6.2.2

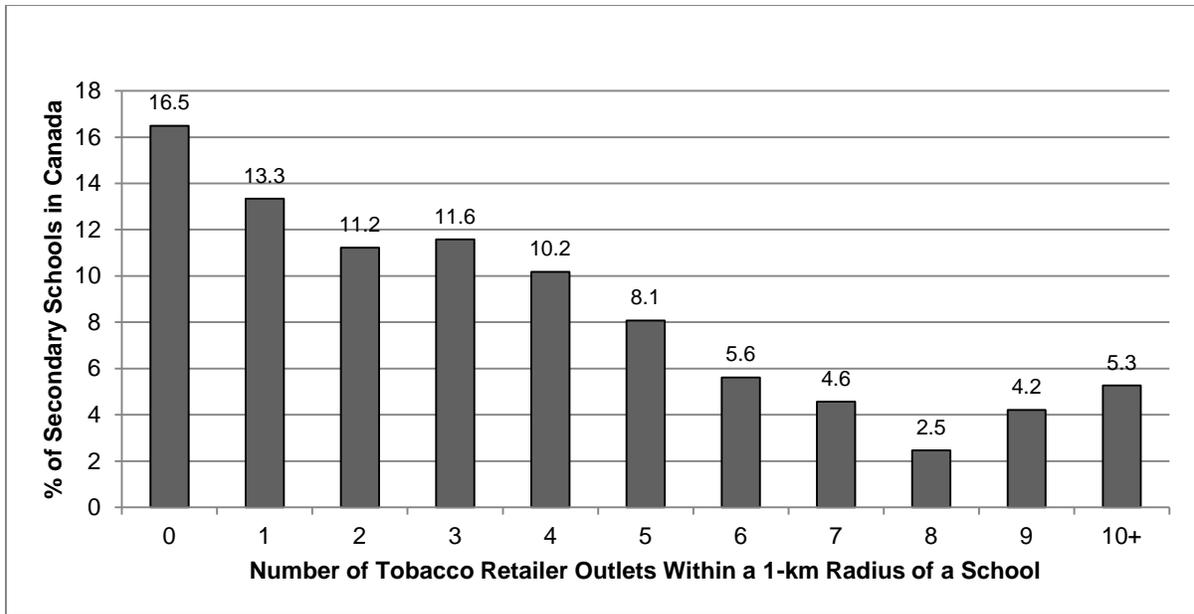


Figure 6. Percentage of secondary schools in Canada by the number of tobacco retailer outlets within a 1-km radius of a school.

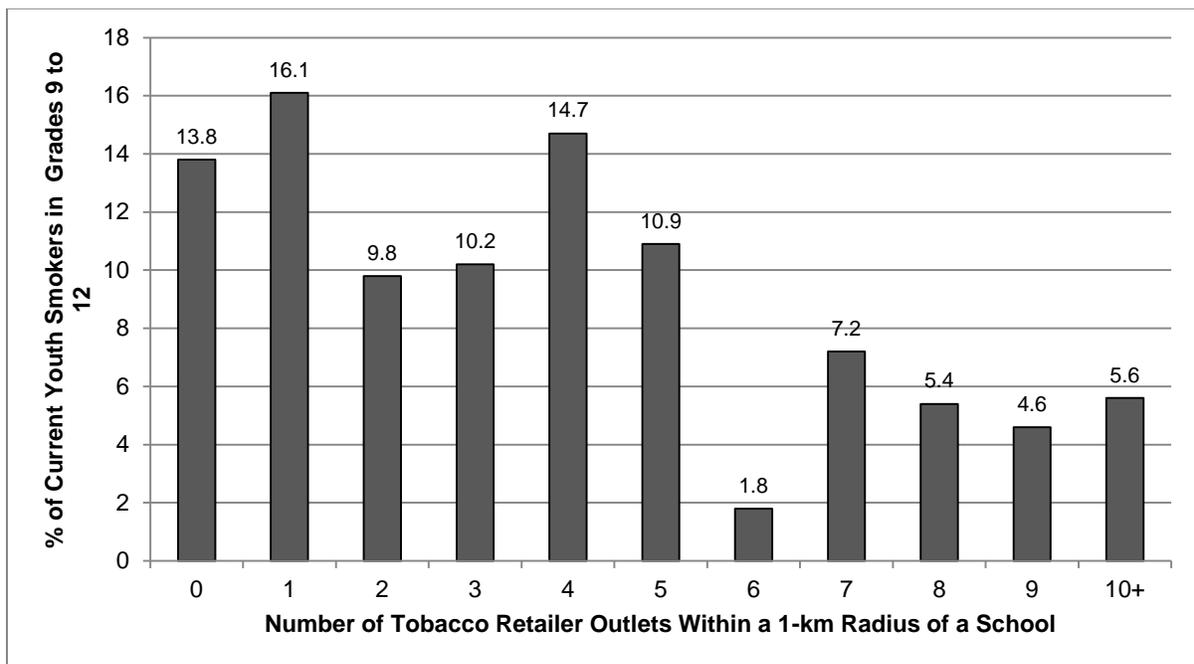


Figure 7. Percentage of current youth smokers in Grades 9 to 12 by the number of tobacco retailers within a 1-km of a school a smoking student attends.

5.1.2.1 Results of sensitivity analysis for missing and invalid response data

Sociodemographic and behavioural characteristics comparing students who provided data for the response variable, that is, “Where do you usually get your cigarettes?” to those who did not are presented in Table 17. Overall, 10.5% ($n = 18,154$) of responses were missing. Responses were more likely to be missing among youth in Grades 10 and 11 compared with youth in Grade 9 and 12 ($\chi^2 = 10.1$, $df = 3$, $p = .018$). Youth who reported that they usually or always share a cigarette with others were more likely to have missing response data compared to youth who share never ($\chi^2 = 15.7$, $df = 3$, $p < .0001$). Youth who encountered a store clerk that suggested a particular brand of cigarettes were less likely to missing response data compared to those who did not ($\chi^2 = 18.4$, $df = 2$, $p < .0001$). Responses were also more likely to be missing among youth who reported ever trying marijuana ($\chi^2 = 6.2$, $df = 1$, $p = .013$). Youth who were binge smokers were less likely to be missing responses compared to their counterparts ($\chi^2 = 15.2$, $df = 1$, $p < .0001$). As shown in Table 18, only youth who ever tried marijuana were more likely to be missing data compared to youth who did not (OR 1.91, 95% CI 1.13-3.22).

5.1.2.2 Between-school differences in cigarette access

Significant between school-random variation in cigarette access was identified for cigarette access from a retailer source [$\sigma^2_{\mu_0} = 0.7896(0.1760)$, $p < .0001$], and from a friend or stranger [$\sigma^2_{\mu_0} = 0.4839(0.1379)$, $p < .0001$]. As estimated by the ICC (see calculations in Appendix F), school-level differences accounted for 19.4% of the variability in the odds of a youth smoker reporting that they usually access cigarettes from a retailer source, and 10.5% of the variability in the odds of a youth smoker reporting that they usually access cigarettes from a friend or stranger. Significant between-school differences were not found for youth smokers who reported accessing cigarettes from a family member.

5.2 Research Questions 2 and 3

5.2.1 From a retailer source

As shown in Table 5, males were more likely to report usually accessing cigarettes from a retailer compared to females (OR 2.08, 95% CI 1.74- 2.48). Relative to Grade 9 students, youth in Grade 12 were more likely to report that they usually access their cigarettes from a retailer (OR 6.27, 95% CI 4.67-8.52). Youth with \$100 or more spending money per week were more likely to purchase cigarettes from a retailer compared to youth with no spending money (OR 1.69, 95% CI 1.32-2.16). Daily smokers were more likely to report that they usually accessed cigarettes from a retailer compared to an occasional smoker (OR 1.38, 95% CI 1.16-1.63). Similarly, youth who encountered a store clerk that suggested a particular brand of cigarettes were more likely to report usually buying their own cigarettes from a retailer (OR 1.42, 95% CI 1.10-1.82). Among occasional smokers, youth who binge smoke were less likely to report accessing cigarettes from a retailer source compared to youth who did not binge smoke (OR 0.65, 95% CI 0.48-0.86).

Each additional tobacco retailer outlet within a 1-km radius surrounding a school that a smoking student attends was associated with an increased likelihood of a youth smoker reporting that they purchased their own cigarettes from a retailer (OR 1.04, 95% CI 1.01-1.07) (Figure 8). Aboriginal status, having a smoking parent or guardian, having a smoking sibling, the number of close smoking friends, average number of cigarettes per day, perceived accessibility to cigarettes, frequency of sharing cigarettes with others, ever binge drink, and ever tried marijuana were not significantly related to the odds of a youth smoker accessing cigarettes from a retailer source.

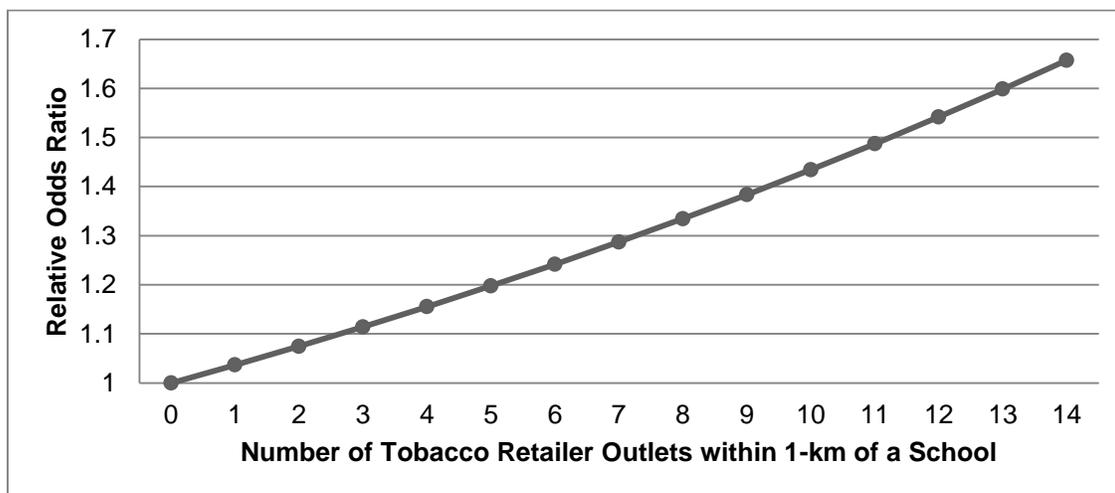


Figure 8. Relative odds of a youth smoker in Grades 6 to 12 accessing cigarettes from a retailer, by number of tobacco retailers within 1-km of a school

5.2.2 From a family member

Females are more likely to report usually accessing cigarettes from a family member compared to males (OR 0.68, 95% CI 0.53-0.88). Youth in Grade 11 or Grade 12 were less likely to access cigarettes from a family member compared to youth smokers in Grade 9 (OR 0.58, 95% CI 0.41-0.83 and OR 0.38, 95% CI 0.25-0.58, respectively). Youth with a smoking parent or guardian were more likely to access cigarettes from a family member compared to youth with no smoking parent or guardian (OR 2.95, 95% CI 2.02-4.31), as were youth with a smoking sibling compared to youth with no smoking siblings (OR 1.51, 95% CI 1.16-1.96). Conversely, youth with 3 or more close smoking friends had a decreased likelihood of reporting that they accessed cigarettes from a family member compared to youth with no close smoking friends (OR 0.30, 95% CI 0.18-0.50). Daily smokers were more likely to get cigarettes from a family member compared to occasional youth smokers (95% CI 1.72-2.34), as were youth who smoked 11 or more cigarettes per day (OR 1.64, 95% CI 1.22-2.20). Aboriginal status, spending money per week, perceived ease of access to cigarettes, frequency of sharing cigarettes with others, ever binge drink, ever marijuana use, binge

smoking, and tobacco retailer outlet density were not significantly related to the odds of a youth smoker reporting that they accessed cigarettes from a family member.

5.2.3 From a friend or someone else

Females were more likely to report usually accessing cigarettes from a friend or someone else compared to males (OR 0.52, 95% CI 0.44-0.61). Youth in Grade 11 or Grade 12 were less likely to access cigarettes from a friend or someone else compared to youth in Grade 9 (OR 0.74, 95% CI 0.58-0.94 and OR 0.37, 95% CI 0.28-0.48, respectively). Aboriginal youth were also less likely to access cigarettes from a friend or stranger compared to non-Aboriginal (OR 0.59, 95% CI 0.47, 0.74). An inverse relationship between amount of spending money per week and accessing cigarettes from a friend or someone else was identified. Relative to youth with no spending money per week, youth who had \$100 or more spending money per week were less likely to purchase cigarettes from a friend or someone else (OR 0.71, 95% CI 0.56-0.90), whereas youth with \$1 or \$20 spending money per week were more likely to access cigarettes from a friend or someone else (OR 1.37, 95% CI 1.07-1.76). Having a smoking parent or guardian was associated with a decreased likelihood of a youth smoker getting their cigarettes from a friend or someone else (OR 0.78, 95% CI 0.66-0.93), as were youth who were daily smokers (OR 0.47, 95% CI 0.40-0.55). Youth who reported that they sometimes or usually or always share a cigarette with others were more likely to access cigarettes from a friend or someone else (OR 2.80, 95% CI 1.94, 4.04 and OR 3.15, 95% CI 2.17-4.58, respectively), than those who never share a cigarette. Having a smoking sibling, number of close friends who smoke, the average number of cigarettes smoked per day, perceived accessibility to cigarettes, ever binge drink, ever used marijuana, binge smoking, and tobacco retailer outlet density were not significantly associated with the odds of a youth smoker accessing cigarettes from a friend or someone else.

5.2.3.1 Proportional change in variance

Using the between-school random variance estimate and the variance of the new model with individual student variables, 54% of school-level variance in cigarette access from a retailer was attributable to student characteristics, of those that made the final model, while 25.8% of the school-level variance in cigarette access from a friend or someone else was attributable to student characteristics, of those which that made the final model. Calculations are provided in Appendix G.

Table 5. Multilevel logistic regression analyses examining characteristics associated with cigarette access behaviour (grades 9 to 12), 2008-2009, Canada.

	Adjusted Odds Ratio (95% CI)		
	Usually buys their own cigarettes from a retailer	Usually gets cigarettes from a family member	Usually gets cigarettes from a friend or someone else
<i>Sociodemographic characteristics</i>			
Sex			
Female	1.00	1.00	1.00
Male	2.08 (1.74, 2.48)***	0.68 (0.53, 0.88)**	0.52 (0.44, 0.61)***
Grade			
9	1.00	1.00	1.00
10	1.62 (1.23, 2.14)***	0.75 (0.53, 1.06)	0.88 (0.69, 1.12)
11	2.35 (1.78, 3.10)**	0.58 (0.41, 0.83)**	0.74 (0.58, 0.94)*
12	6.27 (4.64, 8.47)***	0.38 (0.25, 0.58)***	0.37 (0.28, 0.48)***
Aboriginal status			
Non-aboriginal			1.00
Aboriginal	–	–	0.59 (0.47, 0.74)***
Spending money per week			
\$0	1.00		1.00
\$1 to \$20	0.76 (0.57, 1.01)		1.37 (1.07, 1.76)*
\$21 to \$100	1.21 (0.95, 1.55)		0.96 (0.77, 1.20)
More than \$100	1.69 (1.32, 2.17)***	–	0.71 (0.56, 0.90)**
Parent(s) smokes			
No		1.00	1.00
Yes	–	2.95 (2.02, 4.31)***	0.78 (0.66, 0.93)**
Sibling(s) smokes			
No or I have no brothers or sisters		1.00	
Yes	–	1.51 (1.16, 1.96)**	–
Number of close smoking friends			
None		1.00	
1 to 2		0.63 (0.36, 1.10)	
3 or more	–	0.30 (0.18, 0.50)***	–
<i>Behavioural characteristics</i>			
Current smoking status			
Occasional	1.00	1.00	1.00
Daily	1.38 (1.16, 1.63)***	1.72 (1.27, 2.34)***	0.47 (0.40, 0.55)***
Average number of cigarettes per day			
0 to 10 cigarettes		1.00	
11 or more cigarettes	–	1.64 (1.22, 2.20)**	–
Do you think it would be difficult or easy for you to get cigarettes if you wanted to?			
	–	–	–

Difficult			
Easy			
When you smoke, how often do you share a cigarette with others?			
Never			1.00
Sometimes			2.80 (1.94, 4.04)***
Usually or Always	–	–	3.15 (2.17, 4.58)***
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?			
No	1.00		
Yes	1.42 (1.11, 1.82)**	–	–
Ever binge drink			
No			
Yes	–	–	–
Ever used marijuana			
No			
Yes	–	–	–
Ever binge smoked [§]			
No	1.00		
Yes	0.65 (0.48, 0.86)***	–	–
<i>School-level characteristic</i>			
Number of tobacco retailers (each retailer vs. none)			
Confirmed tobacco retailers [¥]	1.04 (1.01, 1.07)*		
Unconfirmed tobacco retailers [¥]	1.04 (1.01, 1.07)*		
Confirmed and unconfirmed tobacco retailers [¥]	1.02 (1.01, 1.04)*	–	–

Controlling for random variation across schools and region, and all other characteristics in the Table.

Model 1: 1 = Usually buys their own cigarettes from a store ($n = 72,632$), 0 = Usually gets their cigarettes from other sources ($n = 82,647$)

Model 2: 1 = Usually buys their own cigarettes from a family member ($n = 12,999$), 0 = Usually gets their cigarettes from other sources ($n = 162,303$)

Model 3: 1 = Usually buys their own cigarettes from a friend or someone else ($n = 69,658$), 0 = Usually gets their cigarettes from other sources ($n = 105,654$)

– estimate not reportable from the NLMIXED procedure in SAS 9.2; variable exceeded the $p < 0.5$ level for model inclusion.

§ among current occasional youth smokers in Grades 9 to 12 only

¥ estimates found separately for (1) confirmed, (2) unconfirmed, (3) confirmed and unconfirmed tobacco retailers

* $p < .05$ ** $p < .01$ *** $p < .001$

5.3 Research Question 4

Approximately 20.2% ($n = 15,095$) of current youth smokers in Grades 9 to 12 in Ontario, Quebec, and the Atlantic regions accessed contraband cigarettes and 79.8% ($n = 59,495$) accessed non-contraband cigarettes. The majority of youth smokers reported accessing contraband cigarettes from a friend or someone else ($n = 4,548$), while among those who accessed non-contraband cigarettes, most youth smokers accessed their cigarettes from a retailer ($n = 35,669$).

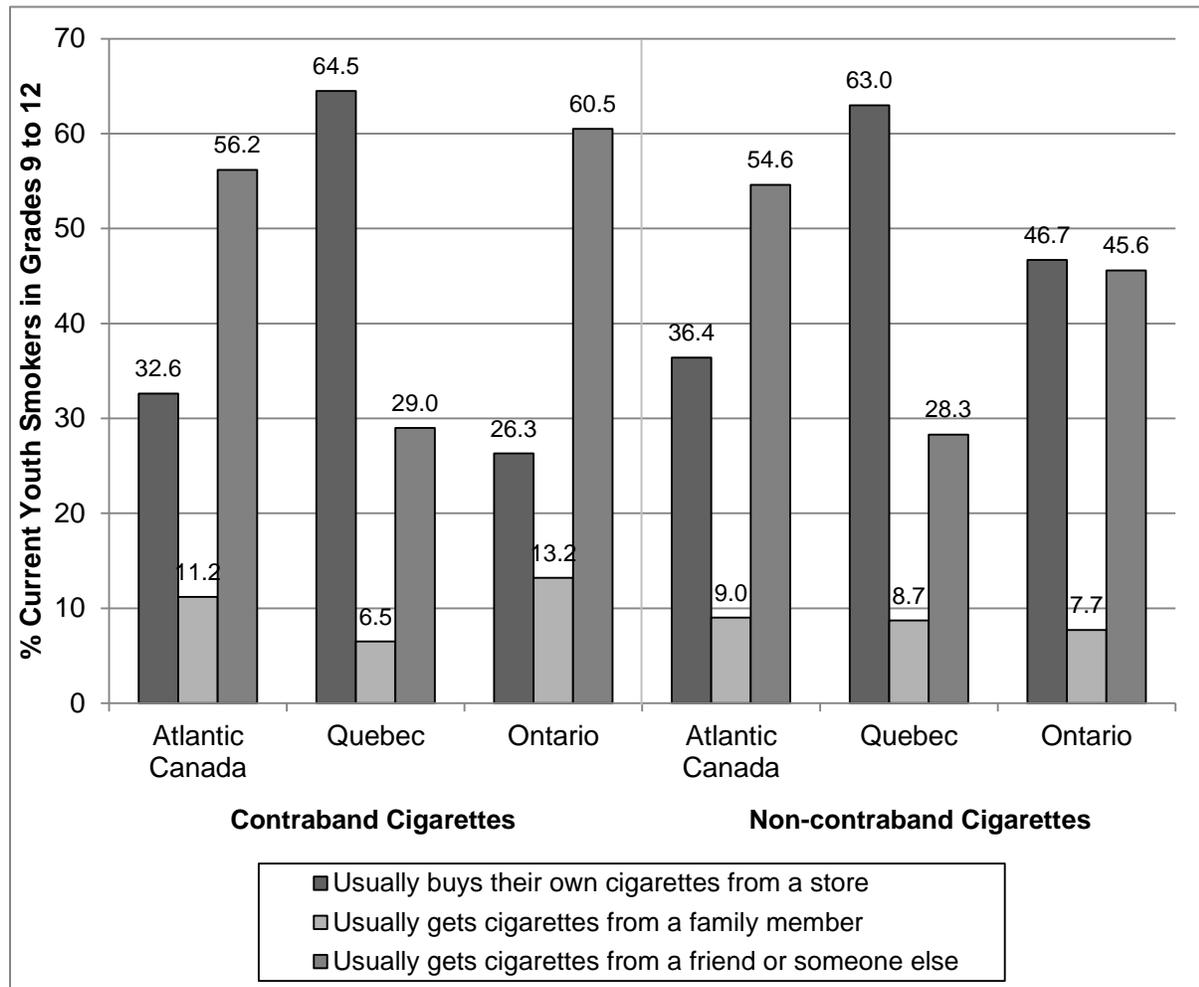


Figure 9. Percentage of current youth smokers in Grades 9 to 12 in Ontario, Quebec, and Atlantic regions and source of supply, by type of cigarettes.

Table 6. Descriptive statistics for the sample of youth who purchase contraband by cigarette access (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.

Parameter	Usually buys their own cigarettes from a retailer % ^a , (n = 6,465)	Usually gets cigarettes from a family member % ^a , (n = 1,817)	Usually gets cigarettes from a friend or someone else % ^a , (n = 6,814)	Chi-square	p-value
<i>Sociodemographic characteristics</i>					
Sex					
Male	70.5	42.8	54.5	$\chi^2(2) = 23.69$	<.0001
Female	29.5	53.2	45.5		
Grade					
9 or 10	51.0	52.0	57.3	$\chi^2(2) = 2.55$	0.28
11 or 12	49.0	48.0	42.7		
Aboriginal status					
Non-aboriginal	88.4	86.3	90.1	$\chi^2(2) = 1.1$	0.577
Aboriginal	11.6	#	9.9		
Spending money per week					
\$0 to \$20	33.2	50.0	42.2	$\chi^2(2) = 8.25$	0.0162
\$20 or more	66.8	50.0	57.8		
Parent(s) smokes					
No	31.4	#	29.3	$\chi^2(2) = 6.08$	0.0478
Yes	68.6	60.9	70.7		
Sibling(s) smokes					
No or I have no brothers or sisters	57.8	#	55.3	$\chi^2(2) = 6.48$	0.0392
Yes	42.2	59.0	44.7		
Number of close smoking friends					
Fewer than 5	34.6	60.1	40.5	$\chi^2(2) = 17.6$	0.0002
5 or more	65.4	39.9	59.5		
<i>Behavioural characteristics</i>					
Current smoking status					
Occasional	43.0	#	51.9	$\chi^2(2) = 30.64$	<.0001
Daily	57.0	81.8	48.1		
Average number of cigarettes per day					
0 to 10 cigarettes	55.8	28.9	57.9	$\chi^2(2) = 18.45$	<.0001
11 or more cigarettes	44.2	71.1	42.1		

Do you think it would be difficult or easy for you to get cigarettes if you wanted to?						
Difficult	#	#	#	$\chi^2(2) = 18.93$	0.282	
Easy	98.1	87.5	96.2			
When you smoke, how often do you share a cigarette with others?						
Never	13.1	#	0.0	$\chi^2(4) = 66.83$	<.0001	
Sometimes	52.4	57.4	48.1			
Usually or Always	34.5	23.8	51.9			
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?						
No	78.0	‡	‡	‡	‡	
Yes	22.0					
Ever binge drink						
No	#	#	#	$\chi^2(2) = 4.56$	0.103	
Yes	92.9	85.0	93.1			
Ever tried marijuana						
No	#	#	#	$\chi^2(2) = 3.3$	0.193	
Yes	95.1	96.5	97.8			
Binge smoked [§]						
No	79.6	#	76.3	$\chi^2(2) = 12.21$	0.0002	
Yes	#	#	23.7			

^a weighted population estimate, # estimate not reportable due to small cell size ($n < 30$)

† New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland & Labrador

‡ Alberta, Saskatchewan, Manitoba

§ among current occasional youth smokers in Grades 9 to 12 only

‡ variable applicable for cigarette access from a retailer only; see section 4.6.2.2

5.3.1 Access to contraband cigarettes

Descriptive statistics for youth smokers accessing contraband cigarettes are shown in Table 6. Males were more likely to report accessing contraband cigarettes from a retailer and from a friend or someone else compared to females, while females were more likely to access contraband from a family member than males ($\chi^2 = 23.69$, $df = 2$, $p < .0001$). Youth with \$20 or more spending money per week were more likely to access contraband cigarettes from a retailer and from a friend or someone else ($\chi^2 = 8.25$, $df = 2$, $p = 0.0162$). Youth with a smoking parent or guardian were less likely to purchase contraband cigarettes from a retailer and from a friend or someone else; however, youth were more likely to access contraband cigarettes from a family member if they had a smoking parent or guardian ($\chi^2 = 6.08$, $df = 2$, $p = 0.0478$). Youth with a smoking sibling were more likely to report accessing contraband cigarettes from a family member compared to youth with no smoking sibling ($\chi^2 = 6.48$, $df = 2$, $p = .0392$). Youth with more than five close friends who smoke were more likely to access contraband cigarettes from a retailer or a friend or someone else, whereas youth with fewer close smoking friends were more likely to get contraband cigarettes from a family member ($\chi^2 = 17.6$, $df = 2$, $p = .0002$).

Daily smokers were likely to report accessing contraband cigarettes from a retailer or a family member, but not from a friend or someone else, compared to occasional smokers ($\chi^2 = 30.64$, $df = 2$, $p < .0001$). Youth who smoked 11 or more cigarettes per day were less likely to access contraband cigarettes from a retailer or from a friend or someone else compared to youth who smoked fewer cigarettes per day, whereas youth who smoked 11 or more cigarettes per day were more likely to access cigarettes from a family member ($\chi^2 = 18.45$, $df = 2$, $p = < .0001$). Youth who reported that they usually or always share a cigarette with others were less likely to access contraband cigarettes from a retailer or from a family member compared to youth who sometimes share, whereas youth who usually or always share a cigarette with others were more likely to access contraband cigarettes

from a friend or someone else ($\chi^2 = 67.66$, $df = 4$, $p = <.0001$). Youth who binge smoked were less likely to access cigarettes from a friend or someone else compared to youth who do not ($\chi^2 = 12.21$, $df = 2$, $p = 0.0002$).

5.3.2 Access to non-contraband cigarettes

Descriptive statistics for youth smokers accessing non-contraband cigarettes are presented in Table 13. Among youth who access non-contraband cigarettes, males were more likely to report getting cigarettes from a retailer compared to females, whereas females were more likely to access cigarettes from a family member, a friend or someone else ($\chi^2 = 84.31$, $df = 2$, $p = <.0001$). Youth in Grades 11 or 12 were more likely to report getting cigarettes from all sources of supply compared to youth in Grades 9 or 10 ($\chi^2 = 34.12$, $df = 2$, $p = <.0001$). Similarly, youth with more than \$20 spending money per week were more likely to access cigarettes from all sources compared to youth with less spending money ($\chi^2 = 53.11$, $df = 2$, $p = <.0001$). The majority (96.2%) of youth with a smoking parent or guardian were more likely to access cigarettes from a family member compared to youth with no smoking parent or guardian ($\chi^2 = 56.1$, $df = 2$, $p = <.0001$). Youth with five or more close smoking friends were more likely to access cigarettes from a store or from a friend or someone else compared to youth with fewer close smoking friends ($\chi^2 = 37.14$, $df = 2$, $p = <.0001$).

Daily smokers were more likely to report accessing cigarettes from a retailer or from a family member compared to occasional smokers, whereas occasional smokers were more likely to report getting cigarettes from a friend or someone else ($\chi^2 = 89.51$, $df = 2$, $p = <.0001$). Youth who smoke 11 or more cigarettes per day were less likely to access cigarettes from a retailer or from a friend or someone else compared to youth who smoke fewer cigarettes per day, whereas youth were more likely to report getting cigarettes from a family member if they smoked 11 or more cigarettes per day ($\chi^2 = 20.23$, $df = 2$, $p = <.0001$). Youth who ever tried marijuana were also more likely to report accessing cigarettes from all sources of supply ($\chi^2 = 11.45$, $df = 2$, $p = .0003$). Among youth

who binge smoke, 12.6% of youth smokers reported buying their own cigarettes from a store and about 30% reported accessing cigarettes from a friend or someone else ($\chi^2 = 36.82$ $df = 2$, $p = <.0001$).

5.4 Research Question 5

5.4.1 Access to contraband cigarettes

As shown in Table 7, males were more likely to access contraband cigarettes from a retailer compared to females (OR 2.55, 95% CI 1.49-4.38), whereas females were more likely to access these from a family member (OR 0.42, 95% CI 0.22-0.82). Gender was not associated with contraband access from a friend or someone else. Youth in Grades 11 or 12 were more likely to access contraband cigarettes from a retailer compared to youth in Grades 9 or 10 (OR 3.66, 95% CI 1.58-8.51). Conversely, youth in Grade 11 or 12 were less likely to access contraband cigarettes from a friend or someone else (OR 0.55, 95% CI 0.34-0.89) compared to youth in Grade 9 or 10. Aboriginal youth were more likely to get contraband cigarettes from a retailer compared to non-Aboriginal youth (OR 3.66, 95% CI 1.58-8.51). Youth with \$20 or more spending money per week were more likely to access cigarettes from a retailer compared to youth with less money (OR 1.89, 95% CI 1.11-3.22). Youth who reported that they sometimes (OR 0.21, 95% CI 0.07-0.63) or usually or always (OR 0.25, 95% CI 0.08-0.74) share a cigarette with others were less likely to access contraband from a retailer. Conversely, the odds of a youth smoker accessing cigarettes from a friend or someone else increased if they reported that they sometimes share (OR 10.60, 95% CI 2.46-53.47), or usually or always share cigarettes (OR 8.47, 95% CI 1.78-40.00). No significant associations were found for youth accessing cigarettes from a family member.

5.4.1.1 Results of sensitivity analysis for youth access to contraband access

Differences in student characteristics that made the final model in the sensitivity analyses compared to those discussed in section 5.4.1 were apparent. Important factors associated with youth buying contraband cigarettes from a store, such as weekly spending money, perceived ease of access to cigarettes, and the frequency of sharing cigarettes with others, described in the previous section were not significant in the sensitivity analyses. The number of close smoking friends, however, was associated with an increased likelihood for youth to buy their own contraband cigarettes from a store (OR 2.50, 95% CI 1.13-5.54). The frequency of sharing cigarettes with others and smoking status were not associated with youth accessing contraband cigarettes from a friend or someone else in contrast to findings discussed in the previous section. No student characteristics were related to contraband cigarette access from a family member. With respect to the magnitude of the associations and width of confidence intervals, these were comparatively larger in the sensitivity analyses than point estimates derived from using less discriminating response categories to ascertain contraband cigarette access.

Table 7. Multiple logistic regression analyses examining characteristics associated with cigarette access behaviour among youth who purchase contraband cigarettes (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada

	Adjusted Odds Ratio (95% CI)		
	Usually buys their own cigarettes from a retailer	Usually gets cigarettes from a family member	Usually gets cigarettes from a friend or someone else
Sociodemographic characteristics			
Sex			
Female	1.00	1.00	1.00
Male	2.55 (1.49, 4.38)**	0.42 (0.22, 0.82)*	0.73 (0.46, 1.17)
Grade			
9 or 10	1.00		1.00
11 or 12	2.19 (1.27, 3.77)**	0.78 (0.40, 1.54)	0.55 (0.34, 0.89)*
Aboriginal status			
Non-aboriginal	1.00		
Aboriginal	3.66 (1.58, 8.51)**	–	–
Spending money per week			
\$0 to \$20			
\$20 or more	1.89 (1.11, 3.22)*	–	–
Parent(s) smokes			
No			
Yes	–	–	–
Sibling(s) smokes			
No or I have no brothers or sisters			
Yes	–	–	–
Number of close smoking friends			
Fewer than 5			
5 or more	–	–	–
Behavioural characteristics			
Current smoking status			
Occasional			1.00
Daily	–	–	0.57 (0.36, 0.91)*
Average number of cigarettes per day			
0 to 10 cigarettes			
11 or more cigarettes	–	–	–

Do you think it would be difficult or easy for you to get cigarettes if you wanted to?			
Difficult	1.00		
Easy	4.96 (1.17, 21.08)*	–	–
Share cigarettes			
Never	1.00		1.00
Sometimes	0.21 (0.07, 0.63)*		16.63 (3.44, 77.84)***
Usually or Always	0.25 (0.08, 0.74)*	–	12.96 (2.75, 61.11)**
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?			
No			
Yes	–	–	–
Ever binge drink			
No			
Yes	–	–	–
Ever used marijuana			
No			
Yes	–	–	–

Controlling for random variation across schools, gender, grade, and region, and all other characteristics in the Table.

Model 1: 1 = Usually buys their own cigarettes from a store ($n = 6,465$), 0 = Usually gets their cigarettes from other sources ($n = 8,630$)

Model 2: 1 = Usually buys their own cigarettes from a family member ($n = 1,817$), 0 = Usually gets their cigarettes from other sources ($n = 13,278$)

Model 3: 1 = Usually buys their own cigarettes from a friend or someone else ($n = 6,814$), 0 = Usually gets their cigarettes from other sources ($n = 8,281$)

– estimate not reportable from the NLMIXED procedure in SAS 9.2; variable exceeded the $p < 0.5$ level for model inclusion.

§ among current occasional youth smokers in Grades 9 to 12 only

* $p < .05$ ** $p < .01$ *** $p < .001$

5.4.2 Access to non-contraband cigarettes

As presented in Table 14, males were more likely to access cigarettes from a retailer compared to females (OR 2.43, 95% CI 1.89-3.25). Youth in Grade 11 or 12 were more likely to report accessing cigarettes from a retailer compared to youth in Grade 9 or 10 (OR 2.24, 95% CI 1.67-3.01), as were youth with more than \$20 spending money per week (OR 1.50, 95% CI 1.13-2.00). Daily smokers were more likely to buy their own cigarettes from a retailer compared to occasional smokers (OR 1.49, 95% CI 1.14-1.94). Similarly, youth were more likely to buy their own cigarettes from a retailer if they encountered a store clerk who suggested a particular brand of cigarettes (OR 1.90, 95% 1.23-2.93).

Youth with a smoking parent or guardian were more likely to access cigarettes from a family member (OR 6.64, 95% CI 2.86-15.45), as were youth with a smoking sibling (OR 1.75, 95% CI 1.13-2.70). Daily smokers were more likely to access cigarettes from a family member compared to occasional smokers (OR 2.62, 95% CI 1.64-4.20). Similarly, youth who smoked 11 or more cigarettes per day had a greater likelihood of accessing cigarettes from a family member than youth who smoked fewer cigarettes per day (OR 1.93, 95% CI 1.21-3.10). Neither gender nor grade was associated with youth getting cigarettes from a family member.

Males were less likely to access cigarettes from a friend or someone else compared to females (OR 0.42, 95% CI 0.32-0.55). Similarly, youth in Grade 11 or 12 were also less likely to get cigarettes from a friend or someone else compared to youth in Grade 9 or 12 (OR 0.50, 95% CI 0.50-0.66). Youth were more likely to access cigarettes from a friend or someone else if they had a smoking parent (OR 0.74, 95% 0.55-0.96). Daily smokers were less likely to get cigarettes from a friend or someone else compared to occasional smokers (OR 0.47, 95% CI 0.36-0.61).

Chapter 6 Discussion

6.1 Summary and interpretation of the main findings

The primary objective of this study was to examine the student-level characteristics associated with underage youth smokers accessing cigarettes from: (a) a retailer source; (b) a family member, (c) a friend or someone else. It also investigated whether tobacco retailer outlet density had a direct effect on cigarette access after controlling for individual characteristics, using a novel approach of linking built environment data to the student-level data of all provinces. Overall, a substantial number of underage youth smokers reported usually buying their own cigarettes from a store, and getting cigarettes from social sources. A considerable amount of variation across schools in terms of cigarette access was also identified, as well as numerous student characteristics associated with how youth smokers usually access their cigarettes.

6.1.1 Youth access to sources of cigarettes

Results from the present study indicate that a substantial proportion of Canadian youth in Grades 9 to 12 were able to undermine current tobacco access laws. Moreover, the majority of Canadian youth smokers also reported accessing cigarettes from a friend or stranger. Although Health Canada reported in 2009 that 84.3% of Canadian tobacco retailers were compliant with the law (CRG, 2009), this study's weighted estimates suggest that numerous underage youth smokers reported usually buying their cigarettes from a store. Therefore, it is unlikely that the few retailers who consistently follow tobacco compliance protocols can adequately curb youth cigarette access through commercial sources. Furthermore, the ability for many youth to procure cigarettes from social sources highlights the need to implement interventions beyond addressing retailer behaviour alone.

The high proportion of youth using retailer and social sources for cigarettes is consistent with the study hypotheses and with multiple studies that also used cross-sectional assessments to examine

cigarette access behaviours among Canadian youth (Leatherdale & Strath, 2005; Leatherdale, 2007), American youth (Forster et al., 2003; Kaestle, 2008; Porkony et al., 2005), and youth residing in the U.K. (Croghan et al., 2003; Hughes et al., 2010; Jones et al., 2002). Under the support of the Theory of Triadic Influence (TTI) (Flay, 1999), these findings also demonstrate that behavioural characteristics of the context of peer relationships are associated with cigarette access from social sources, and may help support the exchange of cigarettes within the social networks of youth smokers.

The prevalence of youth smokers accessing social sources of cigarettes found in this study was greater than the estimate by CTUMS data (Health Canada, 2010). This discrepancy may be attributable to differences in the specification of social sources in the surveys. Both the CTUMS and YSS included a friend, family, or someone else who provided free cigarettes as possible responses in the survey; however, the YSS incorporated additional measures that asked for youth to report if they purchased cigarettes from a friend or someone else, and if they stole cigarettes from a friend or someone else (Health Canada, 2010). Consequently, a higher proportion of youth who usually access cigarettes from a social source may have been ascertained in the YSS compared to the number who responded to the corresponding question in the CTUMS. Since economic transactions for cigarettes may occur between friends or strangers and since youth may steal cigarettes (Croghan et al., 2003; Dent & Biglan, 2004; DiFranza & Coleman, 2001; Katzman et al., 2007; Jansen et al., 2011), the YSS results appear to represent the multiple avenues youth use for cigarette acquisition from social sources, thus improving its generalizability to the target population of underage youth smokers.

6.1.2 Tobacco retailer density and cigarette access

As hypothesized, the current study identified significant differences in how youth smokers access cigarettes across schools. These differences suggest that the characteristics of the school are associated with students' risk for accessing cigarettes. The finding that students attending a school

surrounded by more tobacco retailers had an increased likelihood of buying their own cigarettes from a store, after controlling for individual characteristics, is consistent in both direction and magnitude with previous research (Leatherdale and Strath, 2007; McCarthy et al., 2009). Contrary to the study hypothesis, no between-school random variation was found for cigarette access from a family member, a finding that seems plausible since the transactions of cigarettes between family members and youth are more likely to occur at home than at school.

In addition to coinciding with previous research, the association between increased tobacco retailer density and increased youth access to commercial sources is supported by theory. TTI (Flay, 1999) suggests that characteristics in the school environment such as high tobacco retailer density surrounding schools may affect proximal influences that, in turn, potentially increase the risk of youth purchasing their own cigarettes from a store. For instance, the current study found that youth were more likely to buy their own cigarettes if they encountered a store clerk who suggested a particular brand of cigarettes. The approval of youth cigarette sales by store clerks may influence youths' social normative beliefs, which coincides well with TTI as a proximal influence (Flay, 1999). High tobacco retailer density may ultimately increase this store clerk behaviour and subsequent behaviour of youth access to commercial sources since the ubiquitous physical availability of tobacco may make smoking appear socially acceptable, as suggested by research on the perception of alcohol and outlet density (Abbey, Scott, & Smith, 1993; Kuntsche & Kuendig, 2005).

It is important to note that the odds ratio for the finding that a student attending a school surrounded by more tobacco retailers was more likely to buy their own cigarettes from a store is likely a conservative estimate. The DMTI dataset used in this study provided the number of tobacco retailer outlets within a 1-km radius of schools. This dataset was comprised of types of retailers known to sell cigarettes (labelled "Tobacco"), including gas stations and convenience stores, as well as types of retailers that could possibly sell cigarettes but were unconfirmed to do so due to

limitations in data collection (labelled “Maybe tobacco”) such as bowling alleys. While the odds ratios for unconfirmed counts and a combination of confirmed and unconfirmed counts were found to be significant in additional analyses, this study used only confirmed counts of tobacco retailer outlets for statistical interpretations, thus avoiding potentially adding random variation. Therefore, the actual number of tobacco retailer outlets was understated in this study. The magnitude of this point estimate may be greater with a verification of unconfirmed tobacco retailer outlets.

6.1.3 Importance of student characteristics

Several sociodemographic characteristics associated with cigarette access found in the current study are in line with the study hypotheses. Similar to the published literature (Castrucci et al., 2002; Forster et al., 2003; Harrison et al., 2000; Jones et al., 2002; Kaestle, 2009; Leatherdale, 2005; Leatherdale & Strath, 2007), male youth in this study were more likely to report buying their own cigarettes, while female youth were more likely to report getting their cigarettes from a social source. Also consistent with research (Castrucci et al., 2002; Forster et al., 2003; Harrison et al., 2000; Hughes et al., 2010; Jones et al., 2002; Leatherdale, 2005; Leatherdale & Strath, 2007), older youth were more likely to report buying cigarettes from a store compared to younger youth, as were youth with more spending money (DiFranza et al., 2009; Katzman et al., 2007). Having a smoking parent, guardian, or sibling was associated with a greater likelihood of youth smokers accessing cigarettes from a family member. These findings corroborate with the existing literature (Hughes et al., 2010; Milton et al., 2008; Rainio & Rimpelä, 2009) and lend further support for family members as an important route for cigarette access.

Contrary to expectations and inconsistent with research (Hughes et al., 2010), the number of close smoking friends was not associated with youth smokers getting cigarettes from a friend or someone else. Although exploratory analyses with explanatory variables did not reveal detect collinearity effects, one possible explanation for this null finding may be due to the manner in which

categories were grouped. The six original response categories of the variable, that is, the number of close friends who smoke, were collapsed into three. This modification may have reduced the sensitivity of this measure and subsequently the statistical power to detect significant associations (Weiner et al., 2003). Given the additional finding that youth with three or more close friends who smoke had a lower likelihood of getting cigarettes from family members, perhaps youth with more smoking friends often seek their peers to obtain cigarettes rather than parents (Forster et al., 2003). On the other hand, Leatherdale and Strath (2007) suggest that the number of close friends may not be as important for cigarette access as it is for smoking behaviour, and that the social context in which the social exchange of cigarettes occurs may be more informative to investigate. Exploratory analysis revealed that occasional youth smokers who binge smoke (i.e., smoked 11 or more cigarettes on the occasions they smoked) were less likely to buy their own cigarettes from a retailer, after adjusting for all other variables in the model. This finding illuminates the greater role that smoking peers may have in the social exchange of cigarettes among occasional smokers. Perhaps occasional smokers primarily acquire cigarettes from others in order to consume a high quantity on a smoking occasion depending on the social situation. However, since no association between binge smoking and cigarette access from friends and strangers was found here, additional research specifically investigating the context of tobacco access among binge smokers and peer relations is required clarify this association.

Numerous behavioural characteristics related to cigarette access identified in the current study also coincided with the study hypotheses. Consistent with previous research (Castrucci et al., 2002; Croghan et al., 2003; Leatherdale, 2005; Leatherdale & Strath, 2007; Widome et al., 2007), smoking status was an important factor related to access: daily smokers were more likely to buy from a retailer, whereas occasional smokers were more likely to access cigarettes from a friend or stranger. Inconsistent with the hypotheses, daily and heavy smoking, that is, smoking more than 11 cigarettes per day were associated with an increased likelihood of getting cigarettes from a family member.

With the association between having a smoking parent or sibling and increased access to cigarettes from family members, taken together these findings indicate that the apparent ease with which youth obtain cigarettes from family members may increase their risk to become heavier smokers. This interpretation is supported by earlier studies on smoking parents and youth cigarette access among heavy smokers (DiFranza & Coleman, 2001; Hughes et al., 2010), and is also theoretically founded on TTI where parental tobacco use may influence youths' social normative beliefs about smoking (Flay, 1999) by providing an environment that facilitates their access (Forster et al., 2003).

Contrary to expectations, no significant associations were found between cigarette access behaviours and perceived accessibility, binge drinking, and marijuana use despite significant differences. While the statistical significance of chi-square values may be a reflection of the large sample size, prior research investigating the influence of risk behaviours on cigarette access (Hughes et al., 2010) warrants further exploration of binge drinking and marijuana use, other illicit substances that youth access despite legislations. In particular, additional analyses revealed that missing data was especially problematic for ever use of marijuana in the sample, and this non-response may have underestimated its association with cigarette access. Section 6.3 addresses this issue of missing data in greater detail. Univariate logistic regression also showed that perceived ease of access to cigarettes was significantly associated with cigarette access behaviours; however, these relationships may have been explained away by other explanatory variables related to cigarette access in the final models.

6.2 Summary and interpretation of the exploratory findings

To build on previous research by Leatherdale et al. (2011), the current study also performed an exploratory analysis examining the student-level sociodemographic and behavioural characteristics associated with youth access to contraband cigarettes. The sample of current youth smokers in Grades 9 to 12 residing in Ontario, Quebec, and the Atlantic provinces was selected to best represent the

majority of youth accessing these illegal cigarettes that primarily originate from First Nations territories of the Akwesasne and St. Regis along the Canadian and American borders, Kahnawake in Quebec, and Six Nations and Tyendinaga in Ontario (RCMP, 2008). Results from the present study suggest that many current youth smokers are able to access contraband cigarettes from friends and strangers, family members, and retailers.

6.2.1 Access to contraband cigarettes

This study found that a substantial proportion of Canadian youth smokers accessed contraband cigarettes, with the majority accessing these from a friend or someone else. This finding is consistent with previous research (Leatherdale et al., 2011). In contrast to the study hypotheses, the proportions of contraband sources of cigarettes differed from prevalence estimates reported by Leatherdale et al. (2011), for two reasons. First, the studies differed in the manner in which the proportion of youth smokers accessing contraband cigarette were classified. Leatherdale et al. (2011) measured this as the proportion of youth smokers who reported accessing cigarettes from a First Nations reserve, whereas the current study created a composite measure using YSS responses to price and volume of cigarettes to estimate this proportion. The current project could not use the same contraband access measure as Leatherdale et al. (2011) due to small sample size. Another possible explanation for the discrepancy between the reported proportions is that youth smokers can purchase cigarettes for less because of reasons other than the fact that cigarettes are contraband. For example, they may pay differentially for non-contraband cigarettes based on their relationships with peers (DiFranza & Coleman, 2001; Jansen et al., 2011). Overall, the proportion of youth estimated to have accessed contraband cigarettes here may be over-reported in this study, contaminated by the inclusion of those accessing non-contraband cigarettes, and thus the data need to be interpreted with caution.

A sensitivity analysis was conducted to examine a sample of youth accessing contraband cigarettes operationally defined with fewer price categories compared to the sample analyzed here.

For instance, in the sensitivity analysis, youth smokers were thought to have accessed contraband if they paid less than \$4.50 for a package of 20 or 25 cigarettes, whereas for the reported results in the main study, \$6.00 was set as the maximum cost paid for contraband cigarettes. Results from the sensitivity analysis were different from the findings reported here. For example, the number of close smoking friends was associated with contraband cigarette access from a retailer in the sensitivity analysis; however, this association was not found based on the current sample. Differences in these findings suggest that depending on which response categories of price are selected to represent youth access to contraband cigarettes, the samples of youth smokers may be diverse on background characteristics. Put another way, the study may be investigating a different population that led to a variation in findings, which should be considered when generalizing these results to the broader population of youth smokers.

6.2.2 Characteristics associated with access to contraband cigarettes

Consistent with both the study hypotheses and previous research (Leatherdale et al., 2011), males were more likely to access contraband cigarettes from a retailer than were females, whereas females were more likely to access these from a family member; however, gender was not associated with access to contraband cigarettes from a friend or someone else. Also similar with previous research (Leatherdale et al., 2011), youth in Grades 11 or 12 were more likely to access contraband cigarettes from a retailer compared to youth in Grade 9 or 10, whereas youth in Grade 9 or 10 were more likely to access cigarettes from a friend or someone else. In contrast to Leatherdale et al. (2011), money was an important factor for youth accessing cigarettes from a retailer, likely because there was a greater proportion of youth smokers accessing contraband from retailers under the current study's definitions (42.8% vs. 18.8%) that may have been accessing non-contraband cigarettes. Finally, youth who were occasional smokers and had more friends were more likely to access cigarettes from a friend or someone else, a finding aligning with other studies (Forster et al., 2003; Forster et al., 2003;

Katzman et al., 2007). Occasional smokers smoking fewer cigarettes on an occasion may rely on their friends to acquire these, rather purchasing a large quantity of cigarettes from a retailer.

The study also identified that Aboriginal youth were more likely to get contraband cigarettes from a retailer. Youth purchasing tobacco off-reserve are subject to paying tobacco taxes (Ross & Chaloupka, 2003), and given that the YSS does not survey youth living on-reserve, the Aboriginal youth in this study were thus considered to have accessed contraband tobacco. Given the high prevalence of current smoking among Aboriginal youth (Elton-Marshall, Leatherdale, & Burkhalter, 2011), it is conceivable that Aboriginal youth must purchase contraband cigarettes in greater quantities from retailers to maintain their smoking, rather than borrowing fewer cigarettes from friends and strangers.

The finding that youths' perceived ease of accessibility to cigarettes was associated with an increased likelihood for youth to access these from a retailer conflicts with the premise of access policies designed to make cigarette acquisition difficult (Davis, 1991), and perhaps the ubiquity of the contraband cigarette supply makes it increasingly easier for youth to obtain these products. Previous research suggests that perceived accessibility may increase the risk for youth to smoke (Doubeni, Li, Fouayzi, & DiFranza, 2008), and highlights the need to implement different access interventions to decrease youths' ease of access to contraband. The general finding that many youth smokers were able to access contraband cigarettes from a retailer coincides with preliminary evidence examining the prevalence of legitimate independent convenience stores willing to sell contraband cigarettes to potential consumers (Callaghan, Victor, Tavares, & Taylor, 2008). While the Canadian Convenience Stores Association (CCSA) has shown great concern over the growing contraband tobacco market impeding their businesses (CCSA, 2011), the data presented here suggests that some retailers may also participate in the distribution of contraband cigarettes to youth smokers, possibly as a means to recover income losses from the reduced demand for legal cigarettes.

This study did not identify any statistically significant associations with youth getting contraband cigarettes from family members other than gender, possibly due to issues in the classification of respondents and small sample size. However, given strength of the previous findings of youth cigarette access from family members by Leatherdale et al. (2011), future work should consider creating sensitive survey measures that more accurately estimate the population of youth smokers obtaining contraband.

6.3 Study limitations and strengths

The study has several limitations that need to be considered when interpreting the findings. First, students were asked to report their *usual* source of cigarettes. These data cannot establish whether the student uses that source exclusively or uses multiple sources of cigarettes. Youth can obtain cigarettes from internet sources with relative ease (Ribsl, Williams, & Kim, 2003), and may distribute them to others; however, Thus, the actual prevalence of youth smokers accessing cigarettes from a retailer or a social source may be potentially higher than estimates presented in the results.

A second limitation concerns classroom-based surveys that may be subject to certain biases since students absent during data collection may have different sociodemographic and behavioural characteristics from those who were present (Guttmacher et al., 2002; Weitzman et al., 2003). For instance, the finding that youth who ever tried marijuana were more likely to have missing response data compared to youth who have not, and with previous research on the association on ever use of marijuana and increased absenteeism (Pathammavong et al., 2011), suggest that estimates of risk behaviour in the current study may be underestimated, even after weighting the data (Guttmacher et al., 2002; Weitzman et al., 2003). Perhaps using qualitative methods, while more resource-intensive, can develop a better understanding of youth involvement in risk behaviours than through classroom-based surveys alone.

A fourth limitation is that the current study fitted three binary models and thus could not make precise comparisons between the types of cigarette access behaviours. Polytomous regression modelling may be more informative for understanding such associations. For instance, by creating one response variable with three categories, direct comparisons of cigarette access can be examined between retailers vs. family members, retailers vs. friends or strangers, and family members vs. friends or strangers (Pampel, 2000). Logistic regression models were also run without weights due to limitations in the NLMIXED procedure; however, the odds ratios appeared to be consistent with previous research examining cigarette access (Leatherdale, 2005; Leatherdale & Strath, 2007).

A fifth limitation is that the postal code geocoding method used to link tobacco retailer outlets in the EPOI-DMTI dataset to student-level data are subject to misclassification errors that may have limited this study's ability to detect associations (DeLuca & Kanaroglou, 2008). Attempts to confirm retailers that sold cigarettes by calling each one proved to be unfeasible. However, as discussed in section 6.1.2, sensitivity tests using data of confirmed tobacco retailers, unconfirmed tobacco retailers, and a combination of both yielded similar results in magnitude and direction, and was not a cause for concern.

As previously discussed in section 6.2.1, sampling bias may have occurred in the contraband cigarette analysis due to the categories of price for cigarettes set by the YSS. In addition, the large width of the confidence intervals was indicative of insufficient sample size for the analyses especially when examining behavioural characteristics.

Finally, the cross-sectional design of the study limits causal inferences to be drawn from the observed associations. Longitudinal studies may contribute in understanding potential temporal relationships.

On the other hand, several study strengths are worth noting. The YSS data in this study are from a nationally representative sample of current youth smokers in Canada, providing valuable insight for stakeholders and researchers interested in developing or implementing programs and policies to reduce youth access to cigarettes. The current study sample builds on the paucity of research on cigarette access in the context of schools, incorporating 287 schools in the analysis, thereby allowing for more sensitive school-level comparisons than was possible with the 29 schools by Leatherdale and Strath (2007). To the best of the researchers' knowledge, this was one of few studies to integrate an ecological measure using the 2008-09 DMTI-EPOI dataset for examining youth access to cigarettes. Instead of examining social sources together, the separation of this group into family members, and friends and strangers enhances current knowledge about how youth may access cigarettes differentially, depending on their social relationships. The exploratory study on contraband extended on the preliminary evidence of youth smokers accessing these specifically from a retailer, a family member, and from a friend or someone else, providing insight into interventions on the complex issue of contraband cigarette access.

6.4 Implications for policy and programs

The results of the study highlight several emerging concerns that may have implications for policies and programs. First, it appears that current tobacco legislations are inadequate at preventing youth from acquiring cigarettes. The substantial population of youth smokers accessing cigarettes from stores may provide insight for the federal government to enhance their current strategies targeting tobacco retailer behaviour. The proportion of Canadian youth smokers usually buying their own cigarettes presented in the current study is similar to those reported in previous research (Leatherdale & Strath, 2007) and in health surveys (Health Canada, 2010), findings suggesting that compliance rates may be an inaccurate indicator of how youth acquire cigarettes. Since youth can also undermine current retailer restrictions through social sources of tobacco, the consideration of current

tobacco compliance testing protocols is required. Improving such protocols may reduce youth access to tobacco through retailers and may subsequently lead to reduced cigarette access through social sources.

Another cause for concern is the finding that the school characteristics a smoking student attends is associated with how youth access their cigarettes; specifically, a youth smoker attending a school surrounded by more tobacco retailer outlets was associated with a greater risk of purchasing cigarettes from a retailer compared to a similar student attending a school surrounded by fewer tobacco retailers. This unique finding will be especially valuable for researchers and stakeholders who are interested in developing or implementing school-level tobacco control programs and policies to reduce youth access to cigarettes, in addition to tobacco access policies addressing retailer behaviour. School-based tobacco possession bans, for example, may be selectively enforced at schools surrounded by many tobacco retailers and may thereby help strengthen the school policies associated with reduced youth smoking (Jason, Pokorny, & Schoeny, 2003). Another possible consideration from this school-level finding may be the enforcement of stronger sanctions for non-compliant retailers within the school community. In general, a first offence for noncompliance results in a warning, and subsequent offences result in a ticket or a charge is laid, with some provinces issuing sales suspensions or revocations of tobacco licenses for repeat offences (Health Canada, 2011; Tilson, 2011). However, more severe strategies beyond warnings do not often occur (Tilson, 2002). Thus, even when 84.3% of retailers are compliant with the law, current measures may need to be strengthened in order to have a sufficient deterrent effect among non-compliant retailers, with a potential avenue for the improvement of monitoring and enforcement strategies targeting retailers in close proximity to schools.

This school-level result and the finding that tobacco retailers may also promote youth access to contraband cigarettes may be relevant for interventions designed to reduce the physical availability

of tobacco, such as tobacco retail licensing, zoning and density regulations, and selling tobacco in designated sales outlets only, perhaps by targeting schools at greatest risk of students buying their own cigarettes from stores. Furthermore, based on alcohol research (Popova, Giesbrecht, Bekmuradov, & Patra, 2009), the study findings also provide insight into new initiatives designed to limit youth access to cigarettes from retailers, such as by restricting tobacco selling times around high-risk schools during school lunch breaks, an opportune time for youth to purchase cigarettes (DiFranza & Coleman, 2001).

Gender differences in cigarette acquisition strategies whereby males were more likely to access cigarettes from retailers while females were more likely to get cigarettes, including contraband cigarettes, from social sources suggest that effective tobacco policies may require gender-specific implementation. To overcome the issue of social sources of cigarettes, future research should investigate what influences adults to supply youth with cigarettes.

The finding that smoking parents are strongly related to youth accessing cigarettes from a family member may also suggest interventions directed at parents. Since parents with lax rules about smoking may promote the social exchange of cigarettes (Forster et al., 2003), a public education campaign targeting smoking parents may help them better understand the associated harms and consequences of facilitating cigarette access. For instance, previous research suggests that parents with a history of smoking in high school were more likely to be influenced by a mass media campaign banning youth access to tobacco compared to parents who had not smoked in high school (Carver, Reinert, Range, & Campbell, 2003). Additional research is required to determine whether changes in parental attitudes about cigarette access translate to sustained behavioural changes.

6.5 Implications for future research

Students were asked to report their usual source of cigarettes, and in doing so, the study was unable to determine the student's periodic sources of cigarettes. An additional YSS measure could also allow a student participant to make multiple selections to determine whether s/he uses multiple sources of cigarettes, or uses one source exclusively. Detailed information regarding the type of retailer source of cigarettes (e.g., gas station, convenience store, etc.), whether youth purchase cigarettes from the same retailer, and how long they have been buying their own cigarettes may be especially useful for researchers and policymakers.

Since the tobacco retailer outlet density finding here are marginally related to cigarette access and given the high proportion of unexplained school-level variance for cigarette access from retailers, friends, and strangers, substantially more research is required to better understand the factors within the school environment that impact how underage youth access cigarettes. Information regarding the proximity of a tobacco retailer to a school, type of retailer, and a walkability index measuring the ease with which an individual can walk to reach a destination would be useful for the identification of high-risk schools than using a 1-km distance measure alone. Additional ecological measures may be worthwhile to examine. For instance, although this study used weekly spending money as a proxy for socioeconomic status, previous research has identified the association between neighbourhood-level socioeconomic status and tobacco retailer density (Chuang, Cubbin, Ahn, & Winkleby, 2005; Novak et al., 2006), which may help to increase the explained between-school variance. Pearce, Hiscock, Moon, and Barnett (2008) investigated whether different neighbourhood measures of geographical access to tobacco retailer outlets influenced individual smoking behaviour by incorporating rurality and deprivation measures. Further insight in school-level characteristics would be valuable for informing the development of new school tobacco control interventions aimed at preventing youth from acquiring cigarettes.

Since the YSS does not collect data on youth tobacco purchase attempts before youth encounter a noncompliant retailer, additional measures on store clerk behaviour incorporated into the YSS would be insightful for an improved understanding of how retailer compliance laws impact youth cigarette access. Although the 2010-11 YSS has incorporated a survey measure assessing whether a youth smoker was asked for age or identification when they purchased cigarettes, another measure to consider adding could be the number of times a youth smoker attempted to purchase cigarettes until they encountered a noncompliant retailer. Previous research has shown that youth presenting photo identification were more likely to report accessing cigarettes from a retailer (Klonoff et al., 2001; Leatherdale & Strath, 2007); a spurious association arising from the fact that youth who persistently attempt to buy their own cigarettes would be asked for age or identification as a function of the frequency of their purchase attempts. Overall, there is a need to enhance current monitoring and surveillance measures to capture more accurate estimates of retailer compliance rates for evaluating the effectiveness of current point-of-sale restrictions.

Based on sensitivity analyses as discussed in section 6.2.1, the current YSS measures of volume of cigarettes purchased and price paid for cigarettes may also need to be revised to better quantify the number of youth accessing contraband cigarettes. A possible survey question could segregate the package sizes of cigarettes into separate questions and then ask youth to mark the amount paid to purchase the corresponding package of cigarettes as a continuous measure. For instance, a survey question could ask, “If you purchased a package of 20 or 25 cigarettes, how much did you pay?” and the respondent would write the amount paid. Such a measure could prevent issues with linking survey questions and avoid constraints of set response categories of price.

Chapter 7 Conclusions

Overall, the current findings demonstrate that current tobacco access restrictions are inadequate as youth can procure cigarettes from both retailers and social sources. Current retailer compliance testing protocols do not accurately capture the substantial population of youth smokers undermining these restrictions. These monitoring and surveillance measures must be enhanced for researchers and policymakers to better evaluate the effectiveness and progress of current point-of-sale restrictions.

Youths' social sources for cigarettes must be targeted by interventions aside from addressing retailer behaviour. By linking existing data systems and using multilevel approaches to explore how aspects of the built environment impact youth cigarette access, this project illuminates how retailer outlet density influences tobacco uptake in nearby schools. Such insight may help inform policies on tobacco availability such as licensing and zoning and density regulations, as well as new school-level tobacco access policies and programs.

The widespread availability of contraband tobacco facilitates the ease at which youth can access cigarettes, while simultaneously undermining taxation policies. Findings from the current study build on previous research identifying more potential points of intervention to better prevent contraband cigarette access among youth. Further work needs to be done to solidify the relationship between youth access to contraband cigarettes from family members.

Appendix A

Summary of studies examining sociodemographic characteristics

Table 8. Summary of literature examining sociodemographic characteristics associated with cigarette access

Author(s)	Country	Type of Study	Sample	Characteristics Examined	Results (Type of Access) & Limitations
				1) Grade 2) Sex 3) Spending money 4) Smoking parent 5) Smoking older sibling 6) No. smoking friends 7) Smoking strangers	
Castrucci, Gerlach, Kaufman, & Olreans (2002)	US	7.1.1 Cross-sectional survey Note: three-stage clustered design using a nationally representative sample	17,287 secondary school students (ages 13-19)	1) Age 2) Sex 6) No. smoking friends	1) An inverse relationship between age and the likelihood of acquiring cigarettes through alternative means. Compared with 13- and 14-year olds, 16-year olds were 42% less likely and 17-year olds 59% less likely to acquire cigarettes by non-commercial means; OR 0.87 (95% CI 0.60-1.27); OR 0.58 (95% CI 0.40-0.86); OR 0.41 (0.28-0.61) as age in years increases 2) Females were 58% more likely to acquire cigarettes through non-commercial sources than were males; OR 1.58 (95% CI 1.24-1.98) 6) Not significant; having one or more best friends who smoked was not associated with acquisition of cigarettes through non-commercial sources; OR 1.39 (95% CI 0.87, 2.21) → "Of your four best (gender) friends, how many smoke cigarettes?" Those with =>1 friends coded as having a peer-smoking influence <i>Limitations:</i> Respondents asked for <i>usual</i> source of cigarettes (it does not mean they use that source exhaustively); self-reported data
Croghan, Aveyard, Griffin, & Cheng (2003)	UK	Cross-sectional survey, one-to-one interviews, and focus groups (exploratory)	662 students in years 9 and 10 (ages 13-15)	1) Age 2) Sex 6) No. smoking friends	1) Not significant; odds for obtaining cigarettes usually by social source vs. retail source: OR 0.88 (95% CI 0.56-1.39) w/ age in years 2) Not significant; odds for obtaining cigarettes usually by social source vs. retail source: OR 0.86 (95% CI 0.46-1.62) w/ female reference group 6) Those who smoked only alone were much more likely to use a social source than those who smoked also with or only with friends: OR 0.16 (95% CI 0.04-0.60) <i>Limitations:</i> Some youth did not reveal information, biasing views of peer market within the school; data obtained are from students clustered within schools,

					violating assumption of independence between students not met - statistically significant findings may not be truly significant; small frequencies indicate point estimates of percentages may not reflect the true population percentage
DiFranza & Coleman (2001)	US	Paper surveys and focus group discussions	68 adolescent smokers (ages 12-19)	4) Smoking parent 6) No. smoking friends 7) Smoking strangers	4) Parents were overwhelmingly the primary source of tobacco for youths at the onset of smoking; it appears that many youths become addicted with cigarettes stolen from parents (42% of $n = 68$) 6) All of the high school aged subjects had friends who worked in stores or gas stations and had no difficulty buying tobacco (99% of $n = 68$) 7) Asking strangers to buy tobacco appears almost universal at the junior high school level (<i>Gave someone over 18 money to buy them</i> ; 94% of $n = 68$) <i>Limitations:</i> Unrepresentative sample of youth from their communities, only represent youth circumventing point-of-sale interventions; bias since subjects were identifiable by school personnel to be smokers, which suggests that they may have been less concerned about getting caught than other youths; small sample size
DiFranza, Savageau, & Fletcher (2009)	US	Cross-sectional survey	16,244 students (ages 15-17)	3) Spending money	3) Daily smoking decreased for each dollar increase in price of cigarettes; OR 0.49 (95% CI 0.29-0.83) <i>Limitations:</i> Self-reported data; did not control for local policies or programs
Forster, Chen, Blaine, Perry, & Toomey (2003)	US	Cross-sectional survey	4,124 students in grades 8, 9, and 10 (ages 13-16)	1) Grade 2) Sex 5) Smoking older sibling 6) Best friend smokes	Ninth graders, those who have a sibling who smokes, those whose best friend smokes, those who bought their own cigarettes were more likely to participate in social exchange (that is, acquiring cigarettes from and providing cigarettes to members of the social networks of teenagers who smoke) <i>Limitations:</i> Select sample of Minnesota communities limits generalizability (not representative of all states); sample limited to grades 8, 9, & 10 only
Harrison, Fulkerson, & Park (2000)	US	Cross-sectional survey	133,794 students in grades 6, 9, and 12 (ages 11 to 18)	1) Age 2) Sex	1) Age is negatively correlated with exclusively social access, that is, as age increases, users are more likely to buy; $r = -0.41$, $p < 0.001$ 2) Consistently higher rate of males than females in

the use of commercial sources to obtain cigarettes (OR 2.13, b=0.76, SE=0.03) w/ female referent group for social access only

Limitations: Definition of commercial sources included shoplifting; survey was limited to one Midwestern state, limiting generalizability of commercial sources since youth access to tobacco varies by state and local community depending on the laws there

Hughes, Hughes, Atkinson, Bellis, & Smallthwaite (2010)	UK	Cross-sectional survey	9,833 students (ages 15-16)	1) Age 4) Smoking parent	1) Fewer 15-year olds than 16-year olds accessed cigarettes themselves from shops and more accessed them from siblings and friends 4) 31% of the heaviest smokers reported accessing through parents, compared with just 4% of those who smoke only when drinking alcohol <i>Limitations:</i> Used self-reported data that might underestimate cigarette consumption when categorizing smoking behaviour; unknown refusal rate for participation
Jones, Sharp, Husten, & Crossett (2002)	US	Cross-sectional survey; 1995, 1997, and 1999 national Youth Risk Behaviour Surveys	10,904, 16,262, & 15,349 secondary school students, respectively (ages 14-18)	1) Grade 2) Sex	1) 12 th grade students were significantly more likely than 9 th , 10 th , and 11 th grade students to buy their cigarettes in a store; Grade 9: 12.1% (±4.8); Grade 10: 21.9% (±7.5); Grade 11: 28.5 (±6.4); Grade 12: 38.7 (±7.0) 2) Males (29.8%, ±4.7) were significantly more likely than females (17.6%, ±5.6) to buy their cigarettes in a store; usually bought in a store & (±95%) <i>Limitations:</i> Measured "usual" source of cigarettes, so the data could not identify to what extent students used multiple sources to obtain cigarettes
Kaestle (2009)	US	Cross-sectional survey	426 middle and high school students	2) Sex	2) Girls are significantly more likely to receive cigarettes for free, particularly from adults <i>Limitations:</i> Used self-reported data, prone to recall bias
Katzman, Markowitz, & McGeary (2007)	US	Cross-sectional survey; 1995, 1997, 1999, 2001 Youth Risk Behavior Surveys)	49,169 secondary school students	3) Spending money	1) Higher prices and taxes induce a shift away from being a buyer (i.e. buying from a store, vending machine, someone else buys for me), and increase the probability of not smoking

Leatherdale & Strath (2007)	Ontario, CAN	Cross-sectional survey	19,464 secondary school students (ages <18)	<ul style="list-style-type: none"> 1) Age 2) Sex 4) Smoking parent 5) Smoking older sibling 6) No. smoking friends 	<p>1) Older underage smokers were also more likely to usually buy their own cigarettes (OR = 1.84, p < .001) and less likely to access cigarettes through friends (OR = 0.91, p < .05) or someone else (OR = 0.61, p < .001) than younger underage smokers</p> <p>2) Male smokers were more likely to usually buy their own cigarettes (odds ratio [OR] = 1.93, p < .001) and less likely to usually get someone else to buy their cigarettes (OR = 0.55, p < .001) than female smokers</p> <p>4) A smoker with a parent who smokes was less likely to usually buy their own cigarettes (OR = 0.81, p < .05) than a smoker without a smoking parent</p> <p>5) A smoker who smokes with his or her family was less likely to usually buy their cigarettes from friends (OR = 0.61, p < .001) than a smoker who does not smoke with his or her family</p> <p>6) Not significant</p> <p><i>Limitations:</i> Students reported usual source of cigarettes</p>
Leatherdale (2005)	Ontario, CAN	Cross-sectional survey	737 occasional smokers & 2,050 regular smokers	<ul style="list-style-type: none"> 1) Age 2) Sex 4) Smoking parent 5) Smoking older sibling 6) No. smoking friends 	<p>1) The odds of an occasional smoker buying his/her own cigarettes increased with age (OR 1.48, 1.31-1.67)</p> <p>2) Males were more likely than females to buy their own cigarettes (OR 1.50, 1.10-2.06)</p> <p>4) The odds of a regular smoker buying his/her cigarettes from a friend decreased if s/he had a mother who smoked (OR 0.58, 0.38-0.90)</p> <p>5) Not significant</p> <p>6) Not significant</p> <p><i>Limitations:</i> Cross-sectional study, so causal relationships cannot be inferred; secondary data analysis limited data for all measures that would have been examined in the ideal study, e.g., disposable income or SES; usual sources of cigarettes; self-reported data</p>
Robinson & Amos (2010)	UK	Focus group topic groups	14 focus groups	7) Smoking strangers	7) 'Proxy sales' in which young people approach strangers outside retailers and ask them to purchase cigarettes on their behalf are important

Appendix B
Summary of studies examining behavioural characteristics

Table 9. Summary of literature investigating behavioural characteristics associated with cigarette access

Author(s)	Country	Type of Study	Sample	Characteristics Examined 1) <i>Smoking status</i> 2) <i>Average number of cigarettes/day</i> 3) <i>Ever used marijuana</i> 4) <i>Ever binge drink</i>	Results <i>(Social Sources or Retailer Source)</i>
Castrucci, Gerlach, Kaufman, & Orleans (2002)	US	Cross-sectional survey -Three-stage clustered design using a nationally representative sample -Schools randomly selected	17,287 secondary school students (ages 13-19)	1) Smoking status 2) Average number of cigarettes per day	1) & 2) Those who acquired cigarettes by non-commercial means smoked fewer cigarettes per day and on fewer days per month than those who purchased their own cigarettes (%±s.e. presented in Table 2) [Note: Smoker = smoking 1 or more cigarettes in the past 30 days]
Croghan, Aveyard, Griffin, & Cheng (2003)	UK	Cross-sectional survey, one-to-one interviews, and focus groups	662 students in years 9 and 10 (ages 13-15 years)	1) Smoking status	1) Most (71.0%) occasional smokers obtained cigarettes from social sources while most (67.7%) regular smokers obtained cigarettes commercially (proportions only) [Note: Regular smokers = at least one cigarette/week; occasional smokers = all others]
Harrison, Fulkerson, & Park (2000)	US	Cross-sectional survey	133,794 students in grades 6, 9, and 12 (ages 11-18)	2) Average number of cigarettes per day	2) The odds of exclusively social access decrease as cigarette daily use quantity increases, e.g., frequency of use (compared with 20+ times): for 10-19 times, OR 1.88 (b=0.63; SE=0.11), while 1-2 times, OR 12.01 (b=2.48; SE=0.08)
7.2 Hughes, Hughes, Atkinson, Bellis, & Smallthwaite (2010)	UK	Cross-sectional survey	9,833 students (ages 15-16)	4) Ever binge drank	4) Schoolchildren that binged on alcohol more than once a week were more likely to smoke than those that never binged; OR 9.6 (95% CI 6.6-13.8) [Note: binge drinking definition = drinking >5 drinks per occasion]
Leatherdale (2005)	Ontario, CAN	Cross-sectional survey	737 occasional smokers & 2,050	1) Smoking status	1) The majority of occasional smokers reported usually buying their cigarettes from

regular smokers in secondary school (age13-18)

a friend (59.5%), whereas the majority of regular smokers reported usually buying their own cigarettes (59.8%)

[Note: Regular smoker = students who smoked everyday or almost everyday in the past 30 days; occasional smoker = smoked more than once in the past 30 days]

Leatherdale & Strath (2007)	Ontario, CAN	Cross-sectional survey	19,464 secondary school students (ages <18)	1) Smoking status 2) Average number of cigarettes per day	1) Regular smokers were more likely to usually buy their own cigarettes (OR = 2.81, p < .05) or get someone else to buy their cigarettes (OR = 4.90, p < .01) than occasional smokers 2) Smokers who have six or more cigarettes a day were also more likely to usually buy their own cigarettes (OR = 1.44, p < .01) or get someone else to buy their cigarettes (OR = 2.03, p < .001) than smokers who have less than six cigarettes a day
Leatherdale, Hammond, & Ahmed (2007) Note: not in terms of access	CAN	Cross-sectional survey	Grades 5–9 inclusive, in both 2002 (n = 19,018) and 2004– 2005 (n = 29,243); current data includes youth in grades 7–9 who responded to the substance use section of the 2002 (n = 11,757) and 2004 (n = 16,705) surveys	3) Ever used marijuana 4) Ever binge drank	3) & 4) Previous research has investigated the co-morbid use of alcohol, marijuana, and tobacco among youth: few youth reported only having ever smoked a whole cigarette without also having tried alcohol or marijuana (0.9% in 2002, 0.4% in 2004) or having ever smoked a whole cigarette and ever tried marijuana without also having tried alcohol (0.3% in 2002, 0.2% in 2004) <i>Limitations:</i> The measure of binge drinking may be over-reported since it is not clear if youth interpret five drinks as five “standard” drinks or five sips or five swigs of a single drink given the way the current measure is worded. It should also be noted that the cross-sectional nature of the design does not allow for causal inferences regarding the association between alcohol, marijuana, and tobacco use
NSW Government Cancer Institute (2009)	New Zealand		Ages 18-24	4) Ever binge drank	4) Six in ten smokers admitted to “binge” smoking <i>Limitations:</i> Different population

Appendix C

Study hypotheses for Research Questions 2 and 5

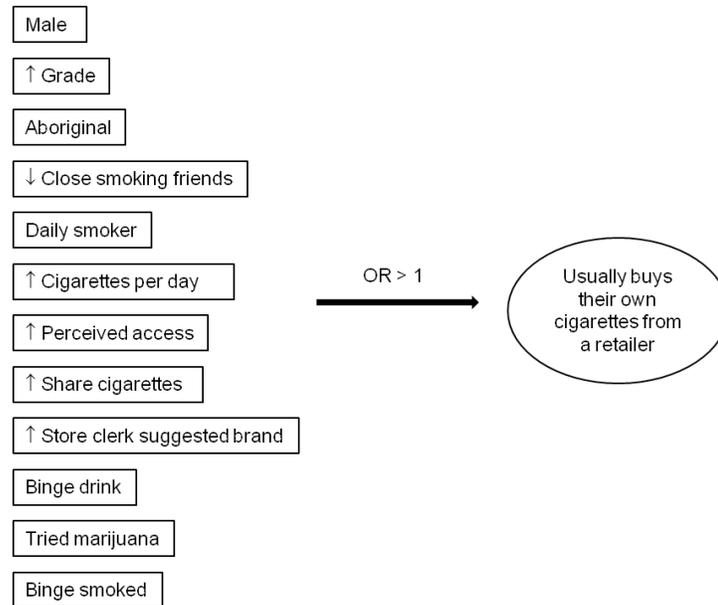


Figure 10. Hypotheses for cigarette access from a retailer

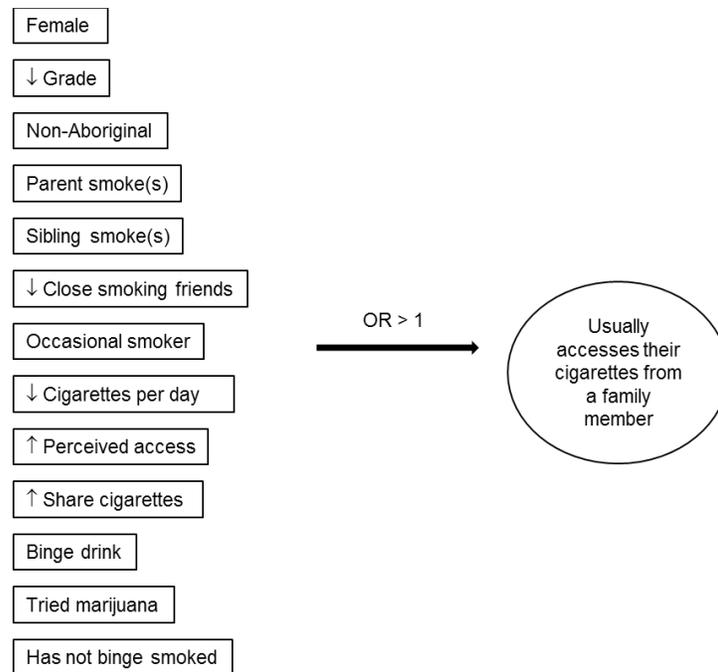


Figure 11. Hypotheses for cigarette access from a family member

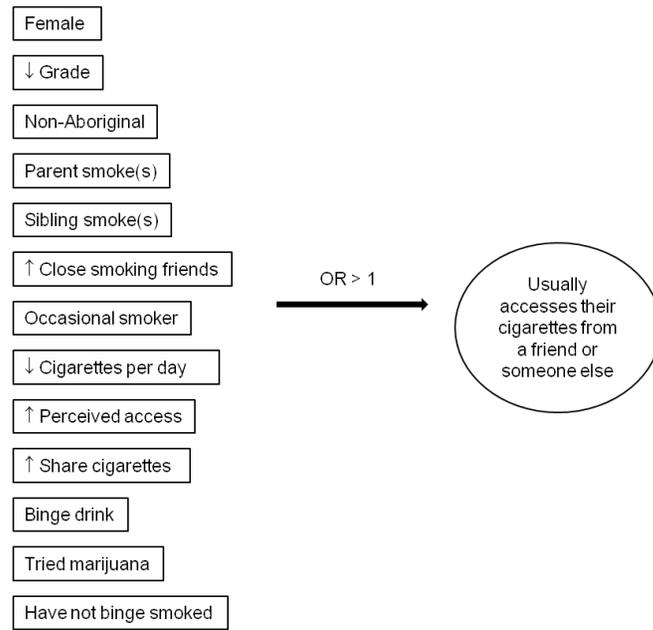


Figure 12. Hypotheses for cigarette access from a friend or someone else

Appendix D
2008-09 Youth Smoking Survey Questionnaire (Module B)

27. What brand of cigarettes do you usually smoke? (Check only one)
- I do not smoke
 - I do not have a regular brand
 - Accord
 - Accord Select
 - Avanti Elite
 - Avanti Slim
 - Belmont Filter
 - Belmont Silver
 - Belvedere
 - Benson & Hedges Deluxe
 - Benson & Hedges Sterling
 - Benson & Hedges Sapphire
 - Benson & Hedges Black
 - Benson & Hedges Gold
 - Benson & Hedges Silver
 - Canadian Classics White
 - Canadian Classics Silver
 - Craven "A"
 - Craven Menthol
 - Du Maurier
 - Du Maurier Distinct
 - Du Maurier Premiere
 - Du Maurier Prestige
 - Du Maurier Special
 - Export "A" Full Flavour Green
 - Export "A" Medium
 - Export "A" Smooth
 - John Player's Special
 - Legend Full Flavour
 - Legend Smooth
 - MacDonald Ultra Smooth
 - MacDonald Special Extra Smooth
 - MacDonald Special Smooth
 - Mark Ten Original
 - Mark Ten Blue
 - Matinee Slims
 - Number 7
 - Number 7 Blue
 - Number 7 Silver
 - Number 7 Red
 - Peter Jackson Mellow Flavour
 - Peter Jackson Select Flavour
 - Player's Rich Flavour
 - Player's
 - Player's Smooth Flavour
 - Rothmans
 - Rothmans Special
 - Viceroy Blue
 - Viceroy Red
 - Viscount
 - Viscount Menthol
 - American brands (e.g. Camel, Marlboro)
 - Cigarettes from First Nations/Native brands
 - Other

28. For the cigarette brand that you indicated, what size cigarette do you usually smoke? (Check only one)
- I do not smoke
 - I do not have a regular size
 - King Size
 - Regular Size
 - Superslim
 - 100s
 - Other
29. Why do you smoke the brand of cigarettes that you do? (Mark all that apply)
- I do not smoke
 - I do not have a usual brand
 - My friends smoke the same brand
 - My parents smoke the same brand
 - I like the packaging
 - This brand costs less than other brands
 - I like the image of this brand
 - I like the taste
 - They are the only ones that I can get
 - They have less tar
 - For the nicotine buzz
 - Other
30. Where do you usually get your cigarettes?
- I do not smoke
 - I buy them myself at a store
 - I buy them from a friend or someone else
 - I ask someone to buy them for me
 - My brother or sister gives them to me
 - My mother or father gives them to me
 - A friend or someone else gives them to me
 - I take them from my mother, father, or siblings
 - I buy them from a First Nations Reserve
 - Other

31. Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?
- I did not buy cigarettes from a store in the last 6 months
 - Yes, a store clerk suggested a brand
 - No, a store clerk did not suggest a brand
32. Thinking about the last time you bought cigarettes in the last 12 months, what did you buy?
- I did not buy cigarettes in the last 12 months
 - A pack of 20 cigarettes
 - A pack of 25 cigarettes
 - A bag of 200 cigarettes
 - A single cigarette
 - A can or pouch of tobacco (loose tobacco)
 - A carton (200 cigarettes)
 - Another amount
33. Thinking about the last time you bought cigarettes in the last 12 months, about how much did you pay for each single cigarette, pack, bag, or carton?
- I did not buy cigarettes in the last 12 months
 - I do not remember the price
 - Less than 10 cents
 - 10 cents to 50 cents
 - 51 cents to \$4.50
 - \$4.51 to \$6.00
 - \$6.01 to \$20.00
 - \$20.01 to \$45.00
 - \$45.01 to \$60.00
 - \$60.01 or more

Do Not Forget This Column

34. Have you ever tried to quit smoking cigarettes?
- I have never smoked
 - I have only smoked a few times
 - I have never tried to quit
 - I have tried to quit once
 - I have tried to quit 2 or 3 times
 - I have tried to quit 4 or 5 times
 - I have tried to quit 6 or more times
35. Have you ever tried any of the following? (Mark all that apply)
- Smoking pipe tobacco
 - Smoking cigarillos or little cigars (plain or flavoured)
 - Smoking cigars (not including cigarillos or little cigars, plain or flavoured)
 - Smoking roll-your-own cigarettes (tobacco only)
 - Using smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
 - Using nicotine patches, nicotine gum, or nicotine lozenges
 - I have not tried any of these things
36. In the last 30 days, did you use any of the following? (Mark all that apply)
- Pipe tobacco
 - Cigarillos or little cigars (plain or flavoured)
 - Cigars (not including cigarillos or little cigars, plain or flavoured)
 - Roll-your-own cigarettes (tobacco only)
 - Smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
 - Nicotine patches, nicotine gum, or nicotine lozenges
 - I have not used any of these things in the last 30 days

37. In the last 30 days, where did you buy cigarillos or little cigars (plain or flavoured)? (Mark all that apply)

- I did not buy cigarillos or little cigars
- I bought cigarillos or little cigars at a store
- I bought them from my brother or sister
- I bought them from a friend / someone else
- I asked someone else to buy them for me

38. In the last 30 days, how often did you smoke cigarillos or little cigars (plain or flavoured)?

- I have never done this
- I did not smoke any cigarillos or little cigars in the last 30 days
- Once in the last 30 days
- Less than once a week
- Once a week
- 2 to 6 times a week
- Once a day
- More than once a day

Do Not Forget This Column

39. The last time you bought/got cigarillos or little cigars (plain or flavoured), how many did you buy/get?

- I have never bought/got cigarillos or little cigars
- A single cigarillo or little cigar
- A pack of 5
- A pack of 10
- A pack of 20
- Another amount

40. Have you ever used flavoured tobacco products (menthol, cherry, strawberry, vanilla, etc.)?

- Yes
- No

41. Please answer the following questions based on your opinion.

	Yes	No	I do not know
a. Do people have to smoke for many years before it will hurt their health?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Is there any danger to your health from an occasional cigarette?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Can smoking help people when they are bored?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. Does smoking help people relax?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. Does quitting smoking reduce health damage even after many years of smoking?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
f. Does smoking help people stay slim?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
g. Can people become addicted to tobacco?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
h. Can tobacco smoke be harmful to the health of non-smokers?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
i. Do people who smoke become more popular?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
j. Can smokers quit anytime they want?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
k. Do you think smoking is cool?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
l. Should smoking be allowed around kids at home?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
m. Should smoking be allowed around kids in cars?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
n. Is it nicer to date people who do not smoke?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

You, Your Family, and Your Friends

42. Do any of your parents, step-parents, or guardians smoke cigarettes?

- Yes
- No
- I do not know

43. Do any of your brothers or sisters smoke cigarettes?

- Yes
- No
- I do not know
- I have no brothers or sisters

44. What are the rules about smoking in your home?

- No one is allowed to smoke in my home
- Only special guests are allowed to smoke in my home
- People are allowed to smoke only in certain areas in my home
- People are allowed to smoke anywhere in my home

45. Excluding yourself, how many people smoke inside your home every day or almost every day? Do not count those who smoke outside.

- None
- 1 person
- 2 people
- 3 people
- 4 people
- 5 or more people

Do Not Forget This Column

46. Do you ever smoke inside your home?

- Yes
- No
- I do not smoke

47. During the last 7 days, on how many days did you ride in a car with someone who was smoking cigarettes?

- 0 days
- 1 or 2 days
- 3 or 4 days
- 5 or 6 days
- All 7 days
- I did not ride in a car in the last 7 days
- I do not know

48. Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?

- None
- 1 friend
- 2 friends
- 3 friends
- 4 friends
- 5 or more friends

49. In your family, you are... (Check only one)

- The only daughter
- The oldest daughter
- A middle daughter
- The youngest daughter
- The only son
- The oldest son
- A middle son
- The youngest son

Appendix E

YSS variables and coding definitions

Table 10. Study variables, their corresponding survey questions, and coding definitions for main analysis

Variable Name	Survey Question #	Coding
<i>Outcome variables</i>		
Cigarette access from a retailer source	30. Where do you usually access your cigarettes?	1=I buy them myself at a store 0=All others (except do not smoke)
Cigarette access from a family member	30. Where do you usually access your cigarettes?	1=My brother or sister gives them to me, My mother or father gives them to me, I take them from my mother, father, or siblings 0=All others (except do not smoke)
Cigarette access from a friend or stranger	30. Where do you usually access your cigarettes?	1=I buy them from a friend or someone else, I ask someone to buy them for me, A friend or someone else gives them to me 0=All others (except do not smoke)
Cigarette access from a First Nations reserve	30. Where do you usually get your cigarettes?	1=I buy them from a First Nations Reserve 0=All others (except do not smoke)
<i>Student characteristics: Sociodemographic</i>		
Grade	1. What grade are you in?	3=Grade 12 2=Grade 11 1=Grade 10 0=Grade 9
Sex	3. Are you male or female?	1=Male 0=Female
Aboriginal status	4. Are you an aboriginal person?	1=Aboriginal 0=Non-aboriginal
Weekly spending money	8. About how much money do you usually get each week to spend on yourself or to save?	3=More than \$100 2=\$21 to \$40, \$41 to \$100 1=\$1 to \$5, \$6 to \$10, \$11 to \$20 0=Zero
Smoking parent/guardian	42. Do any of your parents, step-parents, or guardians smoke cigarettes?	1=Yes 0=All other
Smoking older sibling	43. Do any of your brothers or sisters smoke cigarettes?	1=Yes 0=All other
Number of close friends who smoke	48. Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?	2= 3 or more 1=1 to 2 0=None
<i>Student characteristics :Behavioural</i>		
Smoking status	See YSS Microdata User Guide (Health Canada, 2010)	1=Daily 0=Occasional
Average number of cigarettes per day	24. Thinking back over the last 30 days, on the days that you smoked, how many cigarettes did you usually smoke each day?	1=11 or more cigarettes 0=0 to 10 cigarettes
Perceived ease of access	18. Do you think it would be easy or difficult to get cigarettes if you wanted to smoke?	1=Yes 0=No
Share	26. When you smoke, how often do you share a cigarette with others?	2=Usually or Always 1=Sometimes 0=Never
Clerk	31. Within the last 6 months, has a store clerk suggested a particular brand?	1=Yes 0=No
Ever binge drink	60. In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?	1=Yes 0=No

Ever used marijuana	62. In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...)	1=I have used marijuana but not in the last 12 months 0=I have never used marijuana
Binge smoker	Occasional smoker and 25. Average number of whole cigarettes smoked on the days that the respondent smoked	1=Binge smoker (11 or more cigarettes) 0=Not a binge smoker (10 or fewer cigarettes)
<i>School-level characteristic</i>		
Number of tobacco retailers surrounding a school	EPOI-DMTI data	Continuous

Table 11. Study variables, their corresponding survey questions, and coding definitions for exploratory contraband analysis

Variable Name	Survey Question #	Coding
<i>Outcome variables</i>		
Cigarette access from a retailer source	30. Where do you usually access your cigarettes?	1=I buy them myself at a store 0=All others (except do not smoke)
Cigarette access from a family member	30. Where do you usually access your cigarettes?	1=My brother or sister gives them to me, My mother or father gives them to me, I take them from my mother, father, or siblings 0=All others (except do not smoke)
Cigarette access from a friend or stranger	30. Where do you usually access your cigarettes?	1=I buy them from a friend or someone else, I ask someone to buy them for me, A friend or someone else gives them to me 0=All others (except do not smoke)
<i>Stratification variable</i>		
Contraband cigarette access	32. Thinking about the last time you bought cigarettes in the last 12 months, what did you buy? and 33. Thinking about the last time you bought cigarettes in the last 12 months, about how much did you pay for each single cigarette, pack, bag, or carton?	See Table 1.
<i>Student characteristics: Sociodemographic</i>		
Sex	3. Are you male or female?	1=Male 0=Female
Grade	1. What grade are you in?	1=Grade 11 or 12 0=Grade 9 or 10
Aboriginal status	4. Are you an aboriginal person?	1=Aboriginal 0=Non-aboriginal
Weekly spending money	8. About how much money do you usually get each week to spend on yourself or to save?	1=\$20 or more 0=Less than \$20
Smoking parent/guardian	42. Do any of your parents, step-parents, or guardians smoke cigarettes?	1=Yes 0=All other
Smoking older sibling	43. Do any of your brothers or sisters smoke cigarettes?	1=Yes 0=All other
Number of close friends who smoke	48. Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?	1=5 or more 0=Less than 5
<i>Student characteristics: Behavioural</i>		
Smoking status	See YSS Microdata User Guide (Health Canada, 2010)	1=Daily 0=Occasional
Average number of cigarettes per day	24. Thinking back over the last 30 days, on the days that you smoked, how many cigarettes did you usually smoke each day?	1=11 or more cigarettes 0=0 to 10 cigarettes

Perceived ease of access	18. Do you think it would be easy or difficult to get cigarettes if you wanted to smoke?	1=Yes 0=No
Share	26. When you smoke, how often do you share a cigarette with others?	2=Usually or Always 1=Sometimes 0=Never
Clerk	31. Within the last 6 months, has a store clerk suggested a particular brand?	1=Yes 0=No
Ever binge drink	60. In the last 12 months, how often did you have 5 drinks of alcohol or more on one occasion?	1=Yes 0=No
Ever used marijuana	62. In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...)	1=I have used marijuana but not in the last 12 months 0=I have never used marijuana
Binge smoker	Occasional smoker and 25. Average number of whole cigarettes smoked on the days that the respondent smoked	1=Binge smoker (11 or more cigarettes) 0=Not a binge smoker (10 or fewer cigarettes)

Appendix F

Calculation of Intraclass Correlation Coefficient

The school-level variance term ($\sigma_{\mu 0}^2$) was used to calculate the intraclass correlation (ICC) for binary outcomes (Snijders & Bosker, 1999): $ICC = \frac{\sigma_{\mu 0}^2}{\sigma_{\mu 0}^2 + \frac{\pi^2}{3}}$.

The school-level variance for cigarette access from a retailer was $\sigma_{\mu 0}^2 = 0.7896$, based on an empty model without explanatory variables. As seen in the calculation below, school-level differences accounted for 19.4% of the variability in the odds of a youth smoker reporting that they usually access cigarettes from a retailer source.

$$\begin{aligned}
 ICC_{From\ a\ retailer} &= \frac{\sigma_{\mu 0}^2}{\sigma_{\mu 0}^2 + \frac{\pi^2}{3}} \\
 &= \frac{0.7896}{0.7896 + \frac{\pi^2}{3}} \\
 &= 0.194\ or\ 19.4\%
 \end{aligned}$$

The school-level variance for cigarette access from a friend or someone else was $\sigma_{\mu 0}^2 = 0.3843$ based on an empty model without explanatory variables. As seen in the calculation below, school-level differences accounted for 10.5% of the variability in the odds of a youth smoker reporting that they usually access cigarettes from a friend or stranger.

$$\begin{aligned}
 ICC_{From\ a\ friend\ or\ someone\ else} &= \frac{\sigma_{\mu 0}^2}{\sigma_{\mu 0}^2 + \frac{\pi^2}{3}} \\
 &= \frac{0.3843}{0.3843 + \frac{\pi^2}{3}} \\
 &= 0.105\ or\ 10.5\%
 \end{aligned}$$

Appendix G

Calculation of Proportional Change in Variance

Table 12. Proportional change in variance by the new model including student characteristics

Outcome variable	Empty model with no variables	Model with student and school variables	Explained variance
Usually accessing cigarettes from a retailer	0.7896	0.3634	54.0%
Usually accessing cigarettes from a friend or someone else	0.3843	0.2849	25.8%

According to Merlo et al. (2004), the proportional change in variance quantifies the proportion of school-level variance in cigarette access that is attributable to significant student characteristics, using the formula: $PVC = \frac{(V_{N-1} - V_{N-2})}{V_{N-1}}$

Based on this formula, 54% of between-school random variation in cigarette access from a retailer was attributable to significant student characteristics, of those that made the final model.

$$\begin{aligned}
 PVC_{\text{From a retailer}} &= \frac{(V_{N-1} - V_{N-2})}{V_{N-1}} \\
 &= \frac{0.7896 - 0.3634}{0.7896} \\
 &= 0.54 \text{ or } 54\%
 \end{aligned}$$

Based on this formula, 25.8% of between-school random variation in cigarette access from a friend or someone else was attributable to significant student characteristics, of those that made the final model.

$$\begin{aligned}
 PVC_{\text{From a friend or someone else}} &= \frac{(V_{N-1} - V_{N-2})}{V_{N-1}} \\
 &= \frac{0.3843 - 0.2849}{0.3843} \\
 &= 0.258 \text{ or } 25.8\%
 \end{aligned}$$

Appendix H
Results of youth access to non-contraband cigarettes

Table 13. Descriptive statistics for the sample of youth who purchase non-contraband by cigarette access (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada

Parameter	Usually buys their own cigarettes from a retailer % ^a , (n = 35,075)	Usually gets cigarettes from a family member % ^a , (n=3,910)	Usually gets cigarettes from a friend or someone else % ^a , (n = 20,510)	Chi-square	p-value
<i>Sociodemographic characteristics</i>					
Sex					
Male	61.3	37.6	40.2	$\chi^2(2) = 84.31$	<.0001
Female	38.7	62.4	59.8		
Grade					
9 or 10	26.1	35.3	39.0	$\chi^2(2) = 34.12$	<.0001
11 or 12	73.9	61.7	61.1		
Region					
Atlantic Canada [†]	7.5	14.5	17.5	$\chi^2(4) = 54.29$	<.0001
Quebec	32.4	35.2	22.4		
Ontario	60.1	50.3	60.1		
Aboriginal status					
Non-aboriginal	93.8	95.7	92.2	$\chi^2(2) = 2.77$	0.25
Aboriginal	6.2	#	7.8		
Spending money per week					
\$0 to \$20	17.0	#	32.6	$\chi^2(2) = 53.11$	<.0001
\$20 or more	83.0	82.2	67.4		
Parent(s) smokes					
No	36.7	#	38.1	$\chi^2(2) = 56.10$	<.0001
Yes	63.3	96.2	67.9		
Sibling(s) smokes					
No or I have no brothers or sisters	60.0	43.7	63.7	$\chi^2(2) = 17.06$	0.0002
Yes	40.0	56.3	36.3		
Number of close smoking friends					
Less than 5	30.9	57.7	42.0	$\chi^2(2) = 37.14$	0.0002
5 or more	69.1	47.3	58.0		
<i>Behavioural characteristics</i>					
Current smoking status					
Occasional	41.8	23.6	61.0	$\chi^2(2) = 89.51$	<.0001
Daily	58.2	76.4	39.0		

Average number of cigarettes per day						
0 to 10 cigarettes	57.4	28.9	55.8	$\chi^2(2) = 34.40$	<.0001	
11 or more cigarettes	42.6	71.1	44.2			
Do you think it would be difficult or easy for you to get cigarettes if you wanted to?						
Difficult	#	#	#	$\chi^2(2) = 1.64$	0.441	
Easy	98.0	96.3	97.9			
When you smoke, how often do you share a cigarette with others?						
Never	#	#	#	$\chi^2(4) = 23.78$	<.0001	
Sometimes	66.8	44.8	65.1			
Usually or Always	30.7	50.3	32.0			
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?						
No	88.8	‡	‡	‡	‡	
Yes	11.2					
Ever binge drink						
No	4.4	#	#	$\chi^2(2) = 0.4$	0.819	
Yes	95.6	96.8	95.5			
Ever tried marijuana						
No	12.5	#	8.8	$\chi^2(2) = 11.45$	0.003	
Yes	87.5	95.9	91.2			
Binge smoked [§]						
No	87.4	#	70.5	$\chi^2(2) = 36.82$	<.0001	
Yes	12.6	#	29.5			

^a weighted population estimate, # estimate not reportable due to small cell size ($n < 30$)

† New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland & Labrador

‡ Alberta, Saskatchewan, Manitoba

§ among current occasional youth smokers in Grades 9 to 12 only

‡ variable applicable for cigarette access from a retailer only; see section 4.6.2.2

Table 14. Multiple logistic regression analyses examining characteristics associated with cigarette access behaviour among youth who purchase non-contraband cigarettes (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada

	Adjusted Odds Ratio (95% CI)		
	Usually buys their own cigarettes from a store	Usually gets cigarettes from a family member	Usually gets cigarettes from a friend or someone else
<i>Sociodemographic characteristics</i>			
Sex			
Female	1.00	1.00	1.00
Male	2.43 (1.89, 3.25)***	0.87 (0.56, 1.35)	0.42 (0.32, 0.55)***
Grade			
9 or 10	1.00	1.00	1.00
11 or 12	2.24 (1.67, 3.01)***	0.65 (0.42, 1.01)	0.50 (0.50, 0.66)***
Aboriginal status			
Non-aboriginal	–	–	–
Aboriginal	–	–	–
Spending money per week			
\$0 to \$20	–	–	–
\$20 or more	1.50 (1.13, 2.00)**	–	–
Parent(s) smokes			
No	–	1.00	1.00
Yes	–	6.64 (2.86, 15.45)***	0.74 (0.55, 0.96)***
Sibling(s) smokes			
No or I have no brothers or sisters	–	1.00	–
Yes	–	1.75 (1.13, 2.70)*	–
Number of close smoking friends			
None	–	–	–
1 to 2	–	–	–
3 or more	–	–	–
<i>Behavioural characteristics</i>			
Current smoking status			
Occasional	1.00	–	1.00
Daily	1.49 (1.14, 1.94)**	–	0.47 (0.36, 0.61)***
Average number of cigarettes per day			
0 to 10 cigarettes	–	1.00	–
11 or more cigarettes	–	2.62 (1.64, 4.20)***	–

Do you think it would be difficult or easy for you to get cigarettes if you wanted to?			
Difficult			
Easy	–	–	–
Share cigarettes			
Never			
Sometimes			
Usually or Always	–	–	–
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?			
No	1.00		
Yes	1.90 (1.23, 2.93)**	–	–
Ever binge drink			
No			
Yes	–	–	–
Ever used marijuana			
No			
Yes	–	–	–
Ever binge smoked [§]			
No			
Yes	–	–	–

Controlling for random variation across schools, gender, grade and region, and all other characteristics in the Table.

Model 1: 1 = Usually buys their own cigarettes from a store ($n = 35,075$), 0 = Usually gets their cigarettes from other sources ($n = 24,420$)

Model 2: 1 = Usually buys their own cigarettes from a family member ($n = 3,910$), 0 = Usually gets their cigarettes from other sources ($n = 55,585$)

Model 3: 1 = Usually buys their own cigarettes from a friend or someone else ($n = 20,510$), 0 = Usually gets their cigarettes from other sources ($n = 38,985$)

– estimate not reportable from the NL MIXED procedure in SAS 9.2; variable exceeded the $p < 0.5$ level for model inclusion.

§ among current occasional youth smokers in Grades 9 to 12 only

* $p < .05$ ** $p < .01$ *** $p < .001$

Appendix I
Results of youth access to contraband cigarettes – Sensitivity analysis

Table 15. Descriptive statistics for the sample of youth who purchase contraband by cigarette access (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada.

Parameter	Usually buys their own cigarettes from a retailer % ^a , (n = 2,976)	Usually gets cigarettes from a family member % ^a , (n = 1,481)	Usually gets cigarettes from a friend or someone else % ^a , (n = 4,548)	Chi-square	p-value
<i>Sociodemographic characteristics</i>					
Sex					
Male	68.3	54.5	56.6	$\chi^2(2) = 6.65$	0.036
Female	31.7	45.5	43.4		
Grade					
9 or 10	48.9	53.6	56.8	$\chi^2(2) = 2.24$	0.2949
11 or 12	51.1	46.4	43.2		
Region					
Atlantic Canada [†]	#	#	20.1	$\chi^2(4) = 24.34$	<.0001
Quebec	48.2	#	28.7		
Ontario	37.3	63.4	51.2		
Aboriginal status					
Non-aboriginal	82.0	86.1	88.3	$\chi^2(2) = 3.09$	0.2136
Aboriginal	#	#	#		
Spending money per week					
\$0 to \$20	44.7	52.4	49.8	$\chi^2(2) = 1.384$	0.5006
\$20 or more	55.3	47.6	50.2		
Parent(s) smokes					
No	29.3	#	29.8	$\chi^2(2) = 2.06$	0.3569
Yes	70.7	79.0	70.2		
Sibling(s) smokes					
No or I have no brothers or sisters	67.3	#	51.5	$\chi^2(2) = 14.59$	0.0007
Yes	32.7	57.3	48.5		
Number of close smoking friends					
Fewer than 5	32.8	58.4	44.9	$\chi^2(2) = 14.46$	0.0007
5 or more	67.2	41.6	55.1		
<i>Behavioural characteristics</i>					
Current smoking status					
Occasional	38.4	#	49.9	$\chi^2(2) = 30.43$	<.0001
Daily	61.6	85.4	50.1		

Average number of cigarettes per day					
0 to 10 cigarettes	48.5	#	56.6	$\chi^2(2) = 25.67$	<.0001
11 or more cigarettes	51.5	81.8	43.4		
Do you think it would be difficult or easy for you to get cigarettes if you wanted to?					
Difficult	#	#	#	$\chi^2(2) = 2.53$	0.282
Easy	96.4	92.6	96.6		
When you smoke, how often do you share a cigarette with others?					
Never	#	#	#	$\chi^2(4) = 67.66$	<.0001
Sometimes	47.6	55.2	43.5		
Usually or Always	39.4	#	56.5		
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?					
No	71.2	†	‡	‡	‡
Yes	28.9				
Ever binge drink					
No	#	#	#	$\chi^2(2) = 4.99$	0.0825
Yes	92.0	84.3	94.1		
Ever tried marijuana					
No	#	#	#	$\chi^2(2) = 3.57$	0.168
Yes	93.6	96.2	97.4		
Binge smoked [§]					
No	67.8	#	77.9	$\chi^2(2) = 4.19$	0.123
Yes	#	#	#		

^a weighted population estimate, # estimate not reportable due to small cell size ($n < 30$)

† New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland & Labrador

‡ Alberta, Saskatchewan, Manitoba

§ among current occasional youth smokers in Grades 9 to 12 only

‡ variable applicable for cigarette access from a retailer only; see section 4.6.2.2

Table 16. Multiple logistic regression analyses examining characteristics associated with cigarette access behaviour among youth who purchase contraband cigarettes (grades 9 to 12 in Ontario, Quebec, and Atlantic regions), 2008-2009, Canada

	Adjusted Odds Ratio (95% CI)		
	Usually buys their own cigarettes from a retailer	Usually gets cigarettes from a family member	Usually gets cigarettes from a friend or someone else
Sociodemographic characteristics			
Sex			
Female	1.00		1.00
Male	2.70 (1.23, 5.96)*	–	0.85 (0.44, 1.64)
Grade			
9 or 10	1.00		1.00
11 or 12	4.07 (1.79, 9.26)**	–	0.35 (0.17, 0.72)*
Aboriginal status			
Non-aboriginal	1.00		1.00
Aboriginal	13.43 (3.85, 46.90)***	–	0.25 (0.09, 0.69)*
Spending money per week			
\$0 to \$20			
\$20 or more	–	–	–
Parent(s) smokes			
No			
Yes	–	–	–
Sibling(s) smokes			
No or I have no brothers or sisters			
Yes	–	–	–
Number of close smoking friends			
Fewer than 5	1.00		
5 or more	2.50 (1.13, 5.54)*	–	–
Behavioural characteristics			
Current smoking status			
Occasional			
Daily	–	–	–
Average number of cigarettes per day			
0 to 10 cigarettes			
11 or more cigarettes	–	–	–

Do you think it would be difficult or easy for you to get cigarettes if you wanted to?			
Difficult			
Easy	–	–	–
Share cigarettes			
Never			1.00
Sometimes			11.47 (2.46, 53.47)**
Usually or Always	–	–	8.47 (1.79, 40.00)**
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?			
No			
Yes	–	–	–
Ever binge drink			
No			
Yes	–	–	–
Ever used marijuana			
No			
Yes	–	–	–

Controlling for random variation across schools, gender, grade, and region, and all other characteristics in the Table.

Model 1: 1 = Usually buys their own cigarettes from a store ($n = 2,976$), 0 = Usually gets their cigarettes from other sources ($n = 5,966$)

Model 2: 1 = Usually buys their own cigarettes from a family member ($n = 1,418$), 0 = Usually gets their cigarettes from other sources ($n = 4,524$)

Model 3: 1 = Usually buys their own cigarettes from a friend or someone else ($n = 4,548$), 0 = Usually gets their cigarettes from other sources ($n = 4,394$)

– estimate not reportable from the NLMIXED procedure in SAS 9.2; variable exceeded the $p < 0.5$ level for model inclusion.

§ among current occasional youth smokers in Grades 9 to 12 only

* $p < .05$ ** $p < .01$ *** $p < .001$

Appendix J
Results of missing response data – Sensitivity analysis

Table 17. Descriptive statistics for the sample of youth by missing responses (grades 9 to 12), 2008-2009, Canada

Parameter	Non-missing respondents % ^a , (n = 155,279)	Missing respondents % ^a , (n = 18,154)	Chi-square	p-value
<i>Sociodemographic characteristics</i>				
Sex				
Female	44.9	45.3	$\chi^2(1) = 0.02$	0.880
Male	55.1	54.7		
Grade				
9	18.5	23.1	$\chi^2(3) = 10.07$	0.0179
10	28.0	26.8		
11	28.9	31.4		
12	24.6	18.7		
Region				
Atlantic Canada [†]	43.3	45.4	$\chi^2(4) = 4.34$	0.357
Quebec	23.0	24.3		
Ontario	11.2	11.7		
Prairies [†]	17.5	13.4		
British Columbia	5.0	5.4		
Aboriginal status				
Non-aboriginal	83.8	81.0	$\chi^2(1) = 2.0$	0.157
Aboriginal	16.2	19.0		
Spending money per week				
\$0	7.3	8.0	$\chi^2(3) = 0.3$	0.961
\$1 to \$20	23.7	23.0		
\$21 to \$100	38.5	38.2		
More than \$100	30.6	30.8		
Parent(s) smokes				
No	29.8	27.5	$\chi^2(1) = 0.871$	0.351
Yes	70.2	72.5		
Sibling(s) smokes				
No or I have no brothers or sisters	51.3	49.6	$\chi^2(1) = 0.367$	0.545
Yes	48.7	50.4		
Number of close smoking friends				
None	3.7	5.5	$\chi^2(2) = 4.12$	0.125
1 to 2	14.8	12.8		
3 or more	81.5	81.7		

<i>Behavioural characteristics</i>				
Smoking status				
Occasional	49.4	45.7	$\chi^2(1) = 1.92$	0.166
Daily	50.6	54.3		
Average number of cigarettes per day				
0 to 10 cigarettes	56.0	54.4	$\chi^2(1) = 0.338$	0.561
11 or more cigarettes	44.0	45.6		
Do you think it would be difficult or easy for you to get cigarettes if you wanted to?				
Difficult	2.7	#	$\chi^2(1) = 0.474$	0.491
Easy	97.3	96.7		
When you smoke, how often do you share a cigarette with others?				
Never	4.9	8.4	$\chi^2(2) = 15.73$	<0.001
Sometimes	54.6	45.3		
Usually or Always	40.5	46.3		
Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?				
No	85.9	76.3	$\chi^2(1) = 18.41$	<0.001
Yes	14.1	23.7		
Ever binge drink				
No	5.6	#	$\chi^2(1) = 1.41$	0.235
Yes	94.4	92.8		
Ever tried marijuana				
No	8.1	4.4	$\chi^2(1) = 6.23$	0.0125
Yes	91.9	95.6		
Binge smoked ^b				
No	72.9	59.1	$\chi^2(1) = 15.2$	<0.001
Yes	27.1	40.9		

^a weighted population estimate, # estimate not reportable due to small cell size ($n < 30$)

† New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland & Labrador

‡ Alberta, Saskatchewan, Manitoba

§ among current occasional youth smokers in Grades 9 to 12 only

Table 18. Univariate logistic regression analyses examining characteristics associated with providing a missing response (grades 9 to 12), 2008-2009, Canada

	Adjusted Odds Ratio (95% CI)
	Missing (vs. Not Missing)
Grade	
9	1.00
10	0.18 (0.14, 0.23)**
11	0.77 (0.57, 1.04)
12	0.89 (0.66, 1.19)
When you smoke, how often do you share a cigarette with others?	
Never	1.00
Sometimes	0.49 (0.32, 0.74)***
Usually or Always	0.67 (0.44, 1.01)
Ever tried marijuana	
No	1.00
Yes	1.91 (1.13, 3.22)*

* $p < .05$ ** $p < .01$ *** $p < .001$

References

- Abbey, A., Scott, R.O., & Smith, M.J. (1993). Physical, subjective, and social availability: Their relationship to alcohol consumption in rural and urban areas. *Addiction*, 88, 489-99.
- Ashe, M., Jernigan, D., Kline, R., & Galaz, R. (2003). Land use planning and the control of alcohol, tobacco, firearms, and fast food restaurants. *American Journal of Public Health*, 93(9), 1404-8.
- Azagba, S. & Sharaf, M. (2011). Cigarette taxes and smoking participation: evidence from recent tax increases in Canada. *International Journal of Environmental Research and Public Health*, 8(5), 1583-1600.
- Auditor General of Ontario. (2008). *2008 Annual Report*. Retrieved on October 21, 2010 from: <http://www.auditor.on.ca:81/isysquery/irl7190/1/doc>
- Bandura, A. (1986). *A Social Foundations of Thought and Action: A Society Cognitive Theory*. Englewood Cliffs, NJ: Prentice Hall.
- Breslau, N., Fenn, N., & Peterson, E.L. (1993). Early smoking initiation and nicotine dependence in a cohort of young adults. *Drug and Alcohol Dependence*, 33(2), 129-37.
- Breslau, N. & Peterson, E.L. (1996). Smoking cessation in young adults: age of initiation of cigarette smoking and other suspected influences. *American Journal of Public Health*, 86(2), 214-20.
- Baumol, W. J., & Blinder, A. S. (2008). *Macroeconomics: Principles & Policy, 11th edition*. Mason, OH: South-Western Cengage Learning.
- Bronfenbrenner, U. (1979). *The Ecology of Human Development*. Cambridge, MA: Harvard University Press.
- Callaghan, R.C., Veldhuizen, S., Leatherdale, S., Murnaghan, D., & Manske, S. (2009). Use of contraband cigarettes among adolescent daily smokers in Canada. *Canadian Medical Association Journal*, 181(6-7), 384-6.
- Canadian Cancer Society. (2008). *Overview of summary of municipal tobacco retail license fees in Canada*. Toronto, ON: Canadian Cancer Society.
- Canadian Convenience Stores Association. (2010). *Call for youth tobacco possession ban*. Retrieved on February 26, 2010 from: http://www.conveniencestores.ca/index.php?option=com_content&task=view&id=253&Itemid=1

- Canadian Convenience Stores Association. (2010). *Contraband Tobacco*. Retrieved on July 7, 2011 from:
http://www.conveniencestores.ca/index.php?option=com_content&view=article&id=314:contraband-tobacco&catid=46:contraband-tobacco&Itemid=100064
- Canadian Legal Information Institute. (2004). *Prevention of Youth Tobacco Use Act*. Retrieved on February 25, 2010 from: <http://www.canlii.org/en/ab/laws/stat/rsa-2000-c-p-22/latest/rsa-2000-c-p-22.html>
- Carver, V., Reinert, B., Range, L.M., & Campbell, C. (2003). Media campaign influences parents' opinions about their children and tobacco. *Journal of Public Health Management and Practice*, 9(1), 72-8.
- Castrucci, B. C., Gerlach, K. K., Kaufman, N. J., & Orleans, C. T. (2002). Adolescents' acquisition of cigarettes through noncommercial sources. *The Journal of Adolescent Health*, 31(4), 322-6.
- Coalition for a Smoke-Free Nova Scotia. (2011). *Pricing and taxation*. Retrieved on July 7, 2011 on <http://www.smokefreens.ca/nova-scotia-tobacco-control/pricing-and-taxation/>
- Centers for Disease Control and Prevention. (1989). *Reducing the consequences of smoking: 25 years of progress—A report of the surgeon general*. Rockville, MD: US Department of Health and Human Services, Public Health Service.
- Centers for Disease Control and Prevention. (2010). *Youth Risk Behaviour Surveillance – United States, 2009*. Retrieved on November 5, 2010 from: <http://www.cdc.gov/mmwr/pdf/ss/ss5905.pdf>
- Callaghan, R.C., Victor, J.C., Tavares, J., & Taylor, L. (2008). Letter to Vander Berken, T., Janssens, J., Verpoest, K., Balcaen, A., & Vander Laenen, F. *Tobacco Control*.
- Chapman, S., & Freeman, B. (2009). Regulating the tobacco retailer environment: beyond reducing sales to minors. *Tobacco Control*, 18, 496-501.
- Chen, M.J., Gruenewald, P.J., & Remer, L.G. (2009). Does alcohol outlet density affect youth access to alcohol? *Journal of Adolescent Health*, 44, 582-9.
- Chuang, Y., Cubbin, C., Ahn, D., & Winkleby, M. A. (2005). Effects of neighbourhood socioeconomic status and convenience store concentration on individual level smoking. *Journal of Epidemiology and Community Health*, 59(7), 568-73.
- Cohen, J.E. & Anglin, L. Outlet density: a new frontier for tobacco control. *Addiction*, 104(1), 2-3.

- Corporate Research Group. (2009). *Evaluation of retailers' behaviour towards certain youth access-to-tobacco restrictions*. Ottawa, ON: Health Canada.
- Croghan, E., Aveyard, P., Griffin, C., & Cheng, K. K. (2003). The importance of social sources of cigarettes to school students. *Tobacco Control, 12*(1), 67-73.
- Davis, R.M. Reducing youth access to tobacco. *The Journal of the American Medical Association, 266*, 3186-88.
- DeLuca, P.F. & Kanaroglou, P.S. (2008). Effects of alternative point pattern geocoding procedures on first and second order statistical measures. *Spatial Science, 53*(1), 131-41.
- Department of Justice. (2010). *Tobacco Act*. Retrieved on February 20, 2010 from: <http://laws.justice.gc.ca/en/T-11.5/>
- DiFranza, J. (2000). Youth access: The baby and the bath water. *Tobacco Control, 9*(2), 120-1.
- DiFranza, J., Celebucki, C. C., & Seo, H. G. (1998). A model for the efficient and effective enforcement of tobacco sales laws. *American Journal of Public Health, 88*(7), 1100-1.
- DiFranza, J., & Coleman, M. (2001). Sources of tobacco for youths in communities with strong enforcement of youth access laws. *Tobacco Control, 10*(4), 323-8.
- DiFranza, J. R., Savageau, J. A., & Fletcher, K. E. (2009). Enforcement of underage sales laws as a predictor of daily smoking among adolescents: A national study. *BMC Public Health, 9*, 107.
- Doubeni, C.A., Li, W., Fouayzi, H., & DiFranza, J.R. (2008). Perceived accessibility as a predictor of youth smoking. *Annals of Family Medicine, 6*(4), 323-30.
- Ellickson, P.L., Tucker, J.S., & Klein, D.J. (2001). High-risk behaviours associated with early smoking: results from a 5-year follow-up. *Journal of Adolescent Health, 28*(6), 465-73.
- Elton-Marshall, T., Leatherdale, S.T., & Burkhalter, R. (2011). Tobacco, alcohol and illicit drug use among Aboriginal youth living off-reserve: Results from the Youth Smoking Survey. *Canadian Medical Association Journal*. doi: I:10.1503/cmaj.10191
- Ferrence, R. (2001). Diffusion theory and drug use. *Addiction, 96*(1), 165-73.
- Flay, B. R. (1999). Understanding environmental, situational, and intrapersonal risk and protective factors for youth tobacco use: the Theory of Triadic Influence. *Nicotine & Tobacco Research, 1S*, S111-14.

- Flom, P., McMahon, J. M., & Pouget, E. R. (2006). *Using PROC NLMIXED and PROC GLIMMIX to analyze dyadic data with binary outcomes*. Cary, NC: SAS, Inc.
- Friend, K., Carmona, M., Wilbur, P., & Levy, D. (2001). Youths' social sources of cigarettes: the limits of youth-access policies. *Contemporary Drug Problems*, 28, 507-26.
- Friis, R.H & Sellers, T.A. (2004). *Epidemiology for Public Health Practice*. Mississauga, ON: Jones and Bartlett Publishers Canada.
- Forster, J., Chen, V., Blaine, T., Perry, C., & Toomey, T. (2003). Social exchange of cigarettes by youth. *Tobacco Control*, 12(2), 148-54.
- Gartner, C. & McNeill, A. (2009). Options for global tobacco control beyond the Framework Convention in Tobacco Control. *Addiction*, 105(1), 1-3.
- Glanz, K., Rimer, B. K., & Viswanath, K. (2008). *Health Behavior and Health Education: Theory, Research, and Practice, 4th edition*. San Francisco, CA: Jossey Bass.
- Gruber, J., Sen, A., & Stabile, M. (2003). Estimating price elasticities when there is smuggling: the sensitivity of smoking to price in Canada. *Journal of Health Economics*, 22, 821-42.
- Gutmacher, S., Weitzman, B.C., Kapadia, F., & Weingber, S.L. (2002). Classroom-based surveys of adolescent risk-taking behaviours: reducing the bias of absenteeism. *American Journal of Public Health*, 92(2), 235-7.
- Harrison, P. A., Fulkerson, J. A., & Park, E. (2000). The relative importance of social versus commercial sources in youth access to tobacco, alcohol, and other drugs. *Preventive Medicine*, 31(1), 39-48.
- Health Canada. (2009). *Federal Tobacco Control Strategy*. Retrieved November 10, 2010 from: <http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php>
- Health Canada. (2008). *Summary of results of the 2006-07 Youth Smoking Survey*. Retrieved October 20, 2010 from: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2006-2007/result-eng.php
- Health Canada. (2010). *Canadian Tobacco Use Monitoring Survey (CTUMS), 2009*. Retrieved October 20, 2010, from: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_ctums-esutc_2009/ann_summary-sommaire-eng.php

- Health Canada. (2010). *Summary of results of the 2008-09 Youth Smoking Survey*. Retrieved October 20, 2010, from: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2008-2009/result-eng.php
- Health Canada. (2011). *Youth access to tobacco – retailer behaviour*. Retrieved July 27, 2011, from: <http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/res/news-nouvelles/retailer-detailant-eng.php>
- Henderson, M., Ecob, R., Wight, D., & Abraham, C. (2008). What explains between-school differences in rates of smoking? *BMC Public Health*, 8, 218.
- Henriksen, L., Feighery, E. C., Schleicher, N. C., Cowling, D. W., Kline, R. S., & Fortmann, S. P. (2008). Is adolescent smoking related to the density and proximity of tobacco outlets and retail cigarette advertising near schools? *Preventive Medicine*, 47(2), 210-4.
- Hosmer, D. W., & Lemeshow, S. (2000). *Applied Logistic Regression, 2nd edition*. Hoboken, NJ: John Wiley & Sons, Inc.
- Hughes, S. K., Hughes, K., Atkinson, A. M., Bellis, M. A., & Smallthwaite, L. (2010). Smoking behaviours, access to cigarettes and relationships with alcohol in 15- and 16-year-old schoolchildren. *The European Journal of Public Health*.
- Hyland, A., Bauer, J. E., Li, Q., Abrams, S. M., Higbee, C., Peppone, L., et al. (2005). Higher cigarette prices influence cigarette purchase patterns. *Tobacco Control*, 14(2), 86-92.
- Imperial Tobacco Canada. (2007). Social Report 2006-2007 Imperial Tobacco Canada: Let's talk. Retrieved February 20, 2011, from: <http://www.imperialtobaccocanada>
- Imperial Tobacco Canada. (2011). Impact of illegal tobacco. Retrieved February 20, 2011, from: http://www.imperialtobaccocanada.com/groupca/sites/IMP_7VSH6J.nsf/vwPagesWebLive/DO7VXRLJ?opendocument&SKN=1
- Institute of Medicine. (2007). *Ending the tobacco epidemic: A blueprint for the nation*. Washington, DC: The National Academics Home.
- Jansen, P., Toomey, T.L., Nelson, T.F., Fabian, L.E.A., Lenk, K.M., & Forster, J.L. (2011). Sources of cigarettes among adolescent smokers: free or purchased? *American Journal of Health Education*, 42(3), 154-60.

- Jason, L.A., Pokorny, S.B., Adams, M.L., Topliff, A., Harris, C.C., & Hunt, Y. (2009). Effects of youth tobacco access and possession policy interventions on heavy adolescent smokers. *International Journal of Environmental Research and Public Health*, 6, 1-9.
- Jones, S. E., Sharp, D. J., Husten, C. G., & Crossett, L. S. (2002). Cigarette acquisition and proof of age among US high school students who smoke. *Tobacco Control*, 11(1), 20-5.
- Katzman, B., Markowitz, S., & McGeary, K. A. (2007). An empirical investigation of the social market for cigarettes. *Health Economics*, 16(10), 1025-39.
- Khuder, S.A., Dayal, H.H., & Mutgi, A.B. (1999). Age at smoking onset and its effect on smoking cessation. *Addictive Behaviors*, 24(5), 673-77.
- Klonoff, E. A., & Landrine, H. (2004). Predicting youth access to tobacco: The role of youth versus store-clerk behavior and issues of ecological validity. *Health Psychology*, 23(5), 517-24.
- Klonoff, E. A., Landrine, H., Lang, D., Alcaraz, R., & Figueroa-Moseley, C. (2001). Adults buy cigarettes for underaged youths. *American Journal of Public Health*, 91(7), 1138-9.
- Kuntsche, E.N. & Huendig, H. (2005). Do school surroundings matter? Alcohol outlet density, perception of adolescent drinking in public, and adolescent alcohol use. *Addictive Behaviors*, 30, 151-58.
- Leatherdale, S. (2005). Predictors of different cigarette access behaviours among occasional and regular smoking youth. *Canadian Journal of Public Health*, 96(5), 348-52.
- Leatherdale, S., Ahmed, R., & Vu, M. (in press). Factors associated with different cigarette access behaviours among underage smoking youth who usually smoke contraband (native) cigarettes. *Canadian Journal of Public Health*.
- Leatherdale, S. T., Ahmed, R., Barisic, A., Murnaghan, D., & Manske, S. (2009). Cigarette brand preference as a function of price among smoking youths in Canada: Are they smoking premium, discount or native brands? *Tobacco Control*, 18(6), 466-73.
- Leatherdale, S. T., Hammond, D., & Ahmed, R. (2008). Alcohol, marijuana, and tobacco use patterns among youth in Canada. *Cancer Causes & Control*, 19(4), 361-9.
- Leatherdale, S. T., & Manske, S. (2005). The relationship between student smoking in the school environment and smoking onset in elementary schools. *Cancer Epidemiology, Biomarkers, & Prevention*, 14(7), 1762-5.

- Leatherdale, S., McDonald, P. W., Cameron, R., & Brown, K. S. (2005). A multilevel analysis examining the relationship between social influences for smoking and smoking onset. *American Journal of Health Behavior, 29*(6), 520-30.
- Leatherdale, S. T., & Strath, J. M. (2007). Tobacco retailer density surrounding schools and cigarette access behaviors among underage smoking students. *Annals of Behavioral Medicine, 33*(1), 105-111.
- Liang, L., & Chaloupka, F. J. (2002). Differential effects of cigarette price on youth smoking intensity. *Nicotine & Tobacco Research, 4*, 109-14.
- Lovato, C.Y., Zeisser, C., Campbell, S., Watts, A.W., Halpin, P., Thompson, M.,... Brown, K.S. (2010). Adolescent smoking: effect of school and community characteristics. *American Journal of Preventive Medicine, 39*(6), 507-14.
- Makomaski Illing, E.M. & Kaiserman, M.J. (1998). Mortality attributable to tobacco use in Canada and its regions, 1998. *Canadian Journal of Public Health, 95*(1), 38-44.
- Mastrianna, F. V. (2010). *Basic Economics*. Mason, OH: South-Western Cengage Learning.
- McCarthy, W.J., Mistry, R., Lu, Y., Patel, M., Zheng, H., & Dietsch, B. (2009). Density of tobacco retailers near schools: effects of tobacco use among students. *American Journal of Public Health, 99*(11), 2006-13.
- Meier K.J. & Licari, M.J. (1997). The effect of cigarette taxes on cigarette consumption, 1955 through 1994. *American Journal of Public Health, 87*(7), 1126-30.
- Milton, B., Woods, S.E., Dugdill, L., Porcellato, L., & Springett, R. J. (2008). Starting young? children's experiences of trying smoking during pre-adolescence. *Health Education Research, 23*(2), 298-309.
- Ministry of Health Promotion. (2010). *Creating a Smoke-Free Ontario*. Retrieved on February 19, 2010 from: http://www.mhp.gov.on.ca/english/health/smoke_free/accomplishments.asp
- Ministry of Revenue. (2011). *Illegal tobacco*. Retrieved March 30, 2011 from http://www.rev.gov.on.ca/en/tax/tt/faq_illegal.html
- Non-Smokers' Rights Association. (2011). Cigarette prices in Canada. Retrieved on March 26, 2011 from http://www.nsra-adnf.ca/cms/file/pdf/cigarette_prices_Canada_26_March_2009.pdf

- Novak, S. P., Reardon, S. F., Raudenbush, S. W., & Buka, S. L. (2006). Retail tobacco outlet density and youth cigarette smoking: A propensity-modeling approach. *American Journal of Public Health, 96*(4), 670-6.
- Nova Scotia House of Assembly. (2009). *Smoke-Free Places Act*. Retrieved on February 25, 2010 from: <http://www.gov.ns.ca/legislature/legc/statutes/smokfree.htm>
- Smoke-Free Ontario Scientific Advisory Committee. (2010). Evidence to Guide Action: Comprehensive Tobacco Control in Ontario. Toronto, ON: Ontario Agency for Health Protection and Promotion.
- Ontario Tobacco Research Unit. (2010, April). Prohibition of tobacco sales in specific places: Monitoring Update. Toronto, ON: Ontario Tobacco Research Unit.
- Ontario Tobacco Research Unit. (2009, April). An update on cigarettes purchased on First Nations reserves. Toronto, ON: Ontario Tobacco Research Unit.
- Paglia-Boak, A., Mann, R.E., Adlaf, E.M., & Rehm, J. (2009). *Drug use among Ontario students 1977-2009: Detailed OSDUHS findings*. Toronto, ON: Centre for Addiction and Mental Health.
- Pampel, F.C. (2000). *Logistic regression: a primer*. London, U.K.: Sage Publications, Inc.
- Pathammavong R, Leatherdale S, Ahmed R, Griffith J, Nowatzki J, & Manske S. (2011). Examining the link between education related outcomes and student health risk behaviours among Canadian youth: data from the 2006 National Youth Smoking Survey. *Canadian Journal of Education/Revue canadienne de l'éducation, 34*, 215-47.
- Pearce, J., Hiscock, R. Moon, G., & Barnett, R. The neighbourhood effects of geographical access to tobacco retailers on individual smoking behaviour.
- Physicians for a Smoke-Free Canada. (2010). *Tobacco-free pharmacies*. Retrieved on January 15, 2011 from http://www.smoke-free.ca/pdf_1/pharmacy-backgroundunder.pdf
- Popova, S., Giesbrescht, N., Bekmuradov, D., & Patra, J. (2009). Hours and days of sale and density of alcohol outlets: Impacts on alcohol consumption and damage: A systematic review. *Alcohol & Alcoholism, 44*(5), 500-16.
- Pouliou, T., & Elliot, S. J. (2010). Individual and socio-environmental determinants of overweight and obesity in urban Canada. *Health and Place, 16*(2), 362-7.

- Public Health Law & Policy. (2010). *Land use for tobacco retailers*. Retrieved on February 23, 2010 from: www.phlpnet.org/.../Land%20Use%20Ordinance-%20CHECKLIST_12_07.pdf
- Rainio, S.U. & Rimpelä, A.H. (2009). Home-based sourcing of tobacco among adolescents. *Preventive Medicine, 48*, 378-82.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical Linear Models: Applications and Data Analysis*. Thousand Oaks, CA: Sage Publications, Inc.
- Rehm, J., Gnam, W., Popova, S., Baliunas, D., Brochu, S., Fischer, B., et al. (2007). The costs of alcohol, illegal drugs, and tobacco in Canada, 2002. *Journal of Studies on Alcohol and Drugs, 68*(6), 886-95.
- Revenu Québec. (2010). *New tobacco tax measures*. Retrieved on July 7, 2011 from http://www.revenuquebec.ca/en/a-propos/evasion_fiscale/tabac/t_nouvelles_mesures.aspx
- Ribisl, K.M. (2011). Research gaps related to tobacco product marketing and sales in the Family Smoking Prevention and Tobacco Control Act. *Nicotine & Tobacco Research*. doi: 10.1093/ntr/ntr098
- Ribisl, K. M., Williams, R. S., & Kim, A. E. (2003). Internet sales of cigarettes to minors. *Journal of the American Medical Association, 290*(10), 1356-9.
- Robinson, J., & Amos, A. A qualitative study of young people's sources of cigarettes and attempts to circumvent underage sales laws. *Addiction, 105*(10), 1835-43.
- Rogers, E. M. (2003). *Diffusion of Innovations, 5th edition*. New York, NY: Free Press.
- Ross, H., & Chaloupka, F. J. (2003). The effect of cigarette prices on youth smoking. *Health Economics, 12*(3), 217-30.
- Rossi, P. H., Wright, J. D., & Anderson, A. B. (1983). *Handbook of Survey Research*. San Diego, CA: Academic Press, Inc.
- Royal Canadian Mounted Police. (2008). *2008 Contraband Tobacco Enforcement Strategy*. Retrieved on October 25, 2010 from: <http://www.rcmp-grc.gc.ca/pubs/tobac-tabac/tobacco-tabac-strat-2008-eng.htm>
- SAS Institute (2001). *The SAS System for Windows*. Cary, NC: SAS Institute, Inc.

- Sabiston, C., Lovato, C., Ahmed, R., Pullman, A., Hadd, V., Campbell, H. S., et al. (2009). School smoking policy characteristics and individual perceptions of the school tobacco context: Are they linked to students' smoking status? *Journal of Youth and Adolescence*, 38(10), 1374-87.
- Snijders, T., & Bosker, R. (1999). *Multilevel Analysis*. Thousand Oaks, CA: Sage Publications, Inc.
- Statistics Canada. (2010). *DLI – Youth Smoking Survey*. Retrieved on November 10, 2010 from: <http://www.statcan.gc.ca/dli-ild/data-donnees/ftp/yss-etj-eng.htm>
- Stead, L. F., & Lancaster, T. (2005). Interventions for preventing tobacco sales to minors. *Cochrane Database of Systematic Reviews (Online)*, CD001497.
- Tauras, J. A., Chaloupka, F. J., Farrelly, M. C., Giovino, G. A., Wakefield, M., Johnston, L. D., et al. (2005). State tobacco control spending and youth smoking. *American Journal of Public Health*, 95(2), 338-44.
- Thomas R., & Perera, R. (2006). School-based programmes for preventing smoking. *Cochrane Database of Systematic Reviews*, 3, CD001293.
- Tilson, M. (2002). A critical analysis of youth access laws. Retrieved on July 27, 2011 from: http://www.cancer.ca/~media/CCS/Canada%20wide/Files%20List/English%20files%20heading/pdf%20not%20in%20publications%20section/A%20critical%20analysis%20of%20youth%20tobacco%20access%20laws%20-%20English_69664397.ashx
- Tilson, M. (2011). *Reducing the availability of tobacco products at retail: Policy analysis*. Retrieved on July 27, 2011 from: http://www.nsra-adnf.ca/cms/file/Reducing_Retail_Availabilty_policy_analysis_final_2011.pdf
- United States Department of Health and Human Services. (1994). *Preventing tobacco use among young people: A report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office of Smoking and Health; 1994.
- United States Department of Health and Human Services. (2000). *Reducing tobacco use*. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office of Smoking and Health.

- Wakefield, M., & Giovino, G. (2003). Teen penalties for tobacco possession, use, and purchase: Evidence and issues. *Tobacco Control, 12 Suppl 1*, i6-13.
- Waller, B.J, Cohen, J.E., Ferrence, R., Bull, S., & Adlaf, E.M. (2003). The early 1990s cigarette price decrease and trends in youth smoking in Ontario. *Canadian Journal of Public Health, 94*(1), 31-5.
- Weiner, I.B., Freedheim, D.K., Schinka, J.A., & Velicer, W.F. (2003). *Handbook of Psychology: Research methods in Psychology*. Hoboken, NJ: John Wiley & Sons, Inc.
- Weitzman, B.C., Guttmacher, S., Weinberg, S., & Kapadia, F. (2003). Low response rate schools in surveys of adolescent risk taking behaviour: possible biases, possible solutions. *Journal of Epidemiology and Community Health, 57*, 63-7.
- White, H.R., Padina, R.J., & Chen, P.H. (2002). Developmental trajectories of cigarette use from early adolescence into young adulthood. *Drug and Alcohol Dependence, 65*(2), 167-78.
- Widome, R., Forster, J. L., Hannan, P. J., & Perry, C. L. (2007). Longitudinal patterns of youth access to cigarettes and smoking progression: Minnesota adolescent community cohort (MACC) study (2000-2003). *Preventive Medicine, 45*(6), 442-6.
- World Health Organization. (2009). *Preventing violence by reducing the availability and harmful use of alcohol*. Retrieved on February 26, 2010 from:
http://whqlibdoc.who.int/publications/2009/9789241598408_eng.pdf
- University of Waterloo. (2009). *Youth Smoking Survey (YSS): 2008-09 YSS Microdata User Guide*. Waterloo: Propel Centre for Population Health Impact, 1-53.