

The student and school neighbourhood characteristics  
associated with smoking susceptibility, experimental and  
established smoking among secondary school students  
(grades 9 to 12) in Canada

by

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

Waterloo, Ontario, Canada, 2013

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## **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

**Background:** Lifetime smoking often commences as naïve experimentation during adolescence which frequently develops into a strong addictive habit that is difficult to break. Despite the evidence and acknowledgement of the harmful outcomes of smoking, youth smoking rates remain high in North America.

**Objective:** The purpose of this dissertation was to examine which student- and school-level factors differentiated (1) susceptible never smokers from non-susceptible never smokers, (2) experimental smokers from never smokers, and (3) current smokers from experimental smokers among a nationally representative sample of Canadian students in grade 9-12.

**Methods:** Student-level data from Canada's nationally representative 2008-2009 Youth Smoking Survey (2008 YSS) were linked with school-level data from the 2006 Census, and one built environment characteristic, and examined using multi-level logistic regression analyses. The 2008 YSS was administered to 51,922 students from grades 6 to 12 in 10 provinces in Canada. The present study used only a subset from the students who were in grades 9 to 12 ( $n=29,296$ ) from 133 secondary schools. The first study compared susceptible never smokers with non-susceptible never smokers and used a sub-sample of 15,982 never smokers. The second study that compared experimental smokers with never smokers used a sub-sample of 16,044 never smokers and 2,028 experimental smokers. The third study compared 3,412 current smokers with 2,028 experimental smokers.

**Results:** Sixty-nine out of 133 secondary schools were located in urban areas. The mean number of tobacco retailers within a 1-km radius of each secondary school was 5.8 (range, 0-49). The mean household income was \$56 424 (range, \$30 784-\$97 706). Within schools, the average prevalence rate for susceptible never smokers was 27.1% (range, 0%-58.3%), for experimental smokers was 6.2% (range, 0%-17.4%), and for current smokers was 11.6% (range, 0%-39.1%). Overall as hypothesized in these three studies, student-level and school-level characteristics were associated with smoking susceptibility among never smokers, experimental smoking and current smoking. The likelihood of susceptibility among never smokers ( $\sigma^2 u_0 = 0.05$  [0.01],  $P=0.0002$ ), experimental smoking ( $\sigma^2 u_0 = 0.23$  [0.05],  $P<0.0001$ ) and current smoking ( $\sigma^2 u_0 = 0.13$  [0.04],  $P<0.001$ ) significantly varied across schools. Among the three school neighbourhood characteristics examined, two were significantly associated with smoking behaviour. This study identified that attending a

school in an urban (AOR=0.62; 95% CI 0.46-0.82) setting or in a high socioeconomic status (SES) neighbourhood (AOR=0.88; 95% CI 0.79-0.98) was inversely associated with odds of a student being an experimental smoker versus a never smoker when adjusting for student-level characteristics. The number of tobacco retailers that were located within 1-km radius of each school was associated with the odds of a student being a current smoker (versus an experimental smoker) (AOR 1.03; 95% CI 1.01-1.05) and also associated with a student being a susceptible never smoker (versus a non-susceptible never smoker) (AOR 1.01; 95% CI 1.00-1.02). In sum, all the school neighbourhood factors examined exhibited moderate associations with the dependent variables.

Several student-level intrapersonal (gender, grade, amount of pocket money, alcohol and marijuana use, attitudes and tobacco-related knowledge, self-esteem, perception of school rules, and perceived school connectedness) and social context (family members and friends who smoke, and smoking rules at home) characteristics were associated with smoking susceptibility, experimental smoking and current smoking. Students were more likely to be susceptible never smokers (vs. non-susceptible) if they were: in lower grades, reported low self-esteem, used alcohol or marijuana, had close friends who smoked, came from homes without a total ban on smoking, and held positive attitudes towards smoking. Students were more likely to be experimental smokers (vs. never smokers) if they were: in grades 10 or 11, reported low school connectedness, used alcohol or marijuana, believed that smoking can help people relax, received pocket money each week, and had a family member or close friend who smoked. Students were more likely to be current smokers (vs. experimental smokers) if they were: male, in higher grades, believed that smoking can help when they are bored, reported low school connectedness, used marijuana, had a sibling or close friend who smoked, and had no smoking bans at home.

**Conclusions:** This study showed that the characteristics of the school a student attends may increase their likelihood of a student being in any of the smoking stages that were examined. The location of a school that is, being in an urban or a high SES neighbourhood was inversely associated with experimental smoking when adjusting for student characteristics. The number of tobacco retailers located within 1-km radius of each school was associated with the odds of a student being a current smoker and also associated with a never smoker being susceptible to smoking. Several student-level factors were associated with the three smoking stages. Understanding these factors will provide more insight to guide stakeholders interested in developing anti-tobacco strategies that are responsive to the risk and protective factors of adolescents in different smoking stages.

## Acknowledgements

First, I really want to thank my first supervisor Dr. Sandra Bullock who opened the door for me to do my PhD studies at the University of Waterloo. Secondly, I am very grateful for my current supervisors Drs. Steve Manske and Scott Leatherdale for accepting to be my supervisors in the third year of my PhD studies in spite the fact that each of them already had students they were supervising. I am also indebted to their consistent support and patience throughout my studies. I am really thankful for the great support I received from Dr. Steve Brown. Special thanks to Drs. Mary Thompson, Steve Brown and Donna Murnaghan for accepting to be in my committee.

I used secondary data from Canada's 2008-2009 Youth Smoking Survey (YSS). The YSS is a product of the pan-Canadian capacity building project funded through a contribution agreement and contract between Health Canada and the Propel Centre for Population Health Impact from 2004 to 2011. The YSS consortium includes Canadian tobacco control researchers from all provinces and provided training opportunities for university students (like myself ) at all levels. I would like to acknowledge the Youth Smoking Survey (YSS) team for their great contribution without which my research would not be possible, specifically the schools, school boards, teachers, students, and researchers from Propel Centre for Population Health Impact. Special thanks to Robin Burkhalter, Drs. Tara Elton-Marshall and Rashid Ahmed.

I would also like to acknowledge the financial support that I received for my PhD studies namely the University of Waterloo Graduate Entrance Scholarship, Senate Graduate Scholarship in Health Studies, University of Waterloo Graduate Scholarship, Presidential Graduate Scholarships, and the Ontario Graduate Scholarships.

My PhD studies could not have been complete without the contribution of the faculty members from the School of Public Health and Health Systems and also the support of several wonderful people like Erin Hobin, Nour Schoueri, Mary Vu, Natasha Lane and Dana Zummach. I am glad that our paths crossed.

I do not have words to express how grateful I am for the unrelenting support that I received from my husband, Sospeter and our children, Kimathi and Mutugi who labored alongside me during my doctoral studies.

## **Dedication**

This thesis is dedicated to my husband, Sospeter who challenged me to do a PhD. He consistently supported me throughout my studies including caring for our two boys in spite of doing his doctoral studies at the same time. I cannot forget my lovely children Kimathi and Mutugi who patiently put up with my absence when I had to burn the midnight candle and reassured me that all would be well. I also dedicate this thesis to my mother Pauline Jepketer and departed father Samuel Kiptanui who valued education and gave up a lot to educate me. And more importantly, I dedicate this thesis to the Almighty God who is my daily inspiration and hope.

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# Chapter 1

## INTRODUCTION

### 1.1 Introduction

Globally, about 5 million people die each year from tobacco-related deaths (World Health Organization, 2011). Tobacco remains a leading cause of preventable morbidity and death in North America (American Lung Association, 2011; Health Canada, 2011). It is estimated that more than 37,000 people in Canada and 443,000 people in the United States of America (U.S.) die annually from tobacco-caused diseases such as lung cancer, coronary heart disease, and chronic obstructive pulmonary disease (American Lung Association, 2011). This translates to more than 16% and 20% of all deaths in Canada (Health Canada, 2011) and the U.S. (Centers for Disease Control and Prevention, 2010a) respectively. Tobacco use has also been found to be associated with alcohol use (Baumeister & Tossman, 2005), and precedes and increases the risk of illicit drug use (U.S. Department of Health and Human Services, 2012). Since nearly all (88%) first use of cigarettes occurs by 18 years of age, and the vast majority of these adolescents become addicted to nicotine by young adulthood (Centers for Disease Control and Prevention, 2010b; Mowery, Brick, & Farrelly, 2000; U.S. Department of Health and Human Services, 2012), an important public health priority is preventing adolescents from initiating tobacco use or progressing beyond initial use. Adolescents who began smoking before age 16 had twice the odds of not quitting compared to those who initiated at a later age (Khuder, Dayal, & Mutgi, 1999). Thus, early initiators are at an increased risk of tobacco-related diseases (Chen, 2003). Despite these dangers, young people continue to initiate smoking for a variety of reasons.

Researchers have used several theories including the Theory of Triadic Influence (TTI) (Flay & Petraitis, 1994; Flay, Petraitis, & Hu, 1999) and the Ecological theory (Bronfenbrenner, 1979) to try and understand the complex factors and environment in which adolescents initiate and maintain smoking. The TTI posits that youth smoking behaviours are a result of a combination and interaction of not only individual or intrapersonal factors but also of broader societal influences namely, friends and family members (social context), and school environment factors (socio-cultural e.g., school-based policies and/or programs) including neighbourhood characteristics that are beyond the school environment (e.g., neighbourhood socioeconomic status [SES], rural or urban location, and the number of tobacco retailers surrounding a school) (Flay et al., 1999).

Few youth smoking studies investigate the simultaneous role and interaction of individual factors with the broader societal factors. The present study addressed two gaps in extant literature. It examined how school neighbourhood factors are associated with adolescent smoking behaviour simultaneously with the

student intrapersonal and social context factors. Second, these factors were examined among adolescents in different smoking stages (i.e., smoking susceptibility among never smokers, experimental smoking and current smoking). This is important because researchers are increasingly adopting the perspective that determinants of smoking and thus interventions may change according to where the adolescent is in the smoking continuum (Karp, O'Loughlin, Hanley, Tyndale, & Paradis, 2006). In this study, a neighbourhood was operationally defined as the catchment area surrounding the school (Lee & Cubbin, 2002; Matheson et al., 2011).

Data from three sources were linked to allow for simultaneous examination of student and school environment (which incorporated the neighbourhood surrounding a school) characteristics that may be associated with adolescents' smoking susceptibility among never smokers, experimental smoking and current/established smoking behaviour. Understanding these factors will provide much needed information for policy makers to use in improving or developing new tobacco control strategies that target youth in different stages of smoking in the future.

## **1.2 Study rationale and objective**

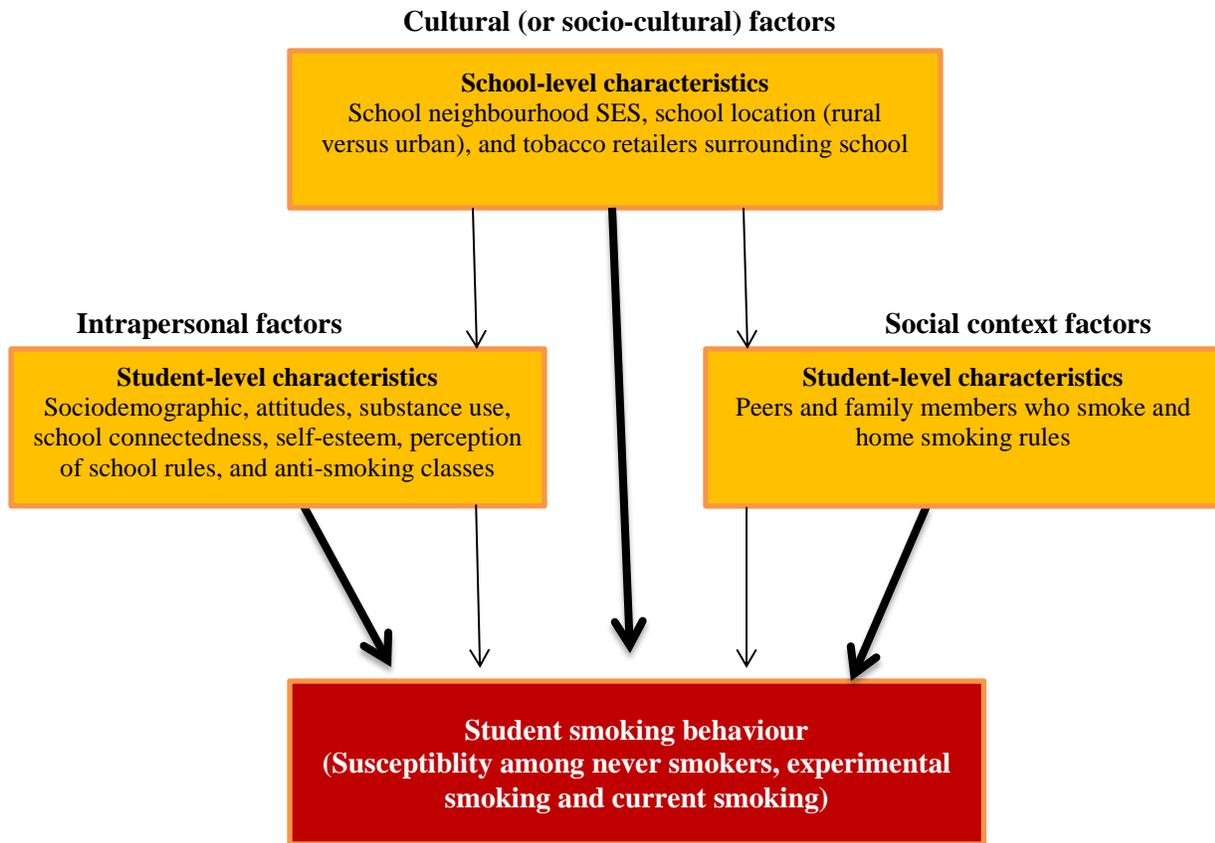
### **1.2.1 Study rationale**

First, evidence from the literature review identified two important research gaps (section 2.6.4) that served as the basis for the three study questions. These study questions were limited by the variables that were available in the three linked data sets, for example school-based programs and/or policies, smoking in movies, stress, and depression data were not available in linked dataset (Table B3 [refer to last column] in Appendix B). Second, investigating the role of the school neighbourhood characteristics (i.e., SES, location [rural versus urban], and the number of tobacco retailers surrounding the school), and students' smoking behaviour, specifically, susceptibility among never smokers, experimental smoking and current smoking (Figure 1) is crucial in developing and improving youth tobacco control strategies in the future. Third, the availability of data which addressed these levels of influences that were consistent with the literature review (refer to Table B3 in Appendix B), ecological theory (section 2.2.1) and the TTI (section 2.2.2) constructs offered a great opportunity to contribute to science.

### **1.2.2 Study objective**

To assess how school neighbourhood SES, location (rural vs. urban), and the number of tobacco retailers surrounding the school, along with students-level characteristics are associated with smoking susceptibility

among never smokers, experimental smoking and current smoking among a nationally representative sample of Canadian students in grades 9 to 12.



→ Direct effect

→ Contextual interactions

Figure 1: Schema of the student- and school-level factors that are associated with student smoking

## **1.3 Study 1: Smoking susceptibility among never smokers**

### **1.3.1 Research Question 1**

Which school-level characteristics (SES, location, and the number of tobacco retailers surrounding the school) and student-level intrapersonal (socio demographics, attitudes, substance use, school connectedness, self-esteem, perception of school rules, and anti-smoking classes), and social context (peers and family who smoke and home smoking rules) characteristics are associated with the likelihood of student being a susceptible never smoker compared to a non-susceptible never smoker?

#### **1.3.1.1 Research Question 1 Hypothesis**

Null hypothesis ( $H_0$ ): Student- and school-level characteristics will not be associated with the likelihood of a never smoker being susceptible to smoking.

Alternative hypothesis ( $H_a$ ): Student- and school-level characteristics will be associated with the likelihood of a never smoker being susceptible to smoking.

## **1.4 Study 2: Experimental smokers versus never smokers**

### **1.4.1 Research Question 2**

Which school-level characteristics (SES, location, and the number of tobacco retailers surrounding the school) and student-level intrapersonal (socio demographics, attitudes, substance use, school connectedness, self-esteem, perception of school rules, and anti-smoking classes), and social context (peers and family who smoke and home smoking rules) characteristics are associated with the likelihood of a student being an experimental smoker compared to a never smoker?

#### **1.4.1.1 Research Question 2 Hypothesis**

Null hypothesis ( $H_0$ ): Student- and school-level characteristics will not be associated with the likelihood of a student being an experimental smoker.

Alternative hypothesis ( $H_a$ ): Student- and school-level characteristics will be associated with the likelihood of a student being an experimental smoker.

## **1.5 Study 3: Current smokers versus experimental smokers**

### **1.5.1 Research Question 3**

Which school-level characteristics (SES, location, and the number of tobacco retailers surrounding the school) and student-level intrapersonal (socio demographics, attitudes, substance use, school connectedness, self-esteem, perception of school rules, and anti-smoking classes), and social context (peers and family who smoke and home smoking rules) characteristics are associated with the likelihood of a student being a current smoker compared to an experimental smoker?

#### **1.5.1.1 Research Question 3 Hypothesis**

Null hypothesis (H<sub>0</sub>): Student- and school-level characteristics will not be associated with the likelihood of a student being a current smoker.

Alternative hypothesis (H<sub>a</sub>): Student- and school-level characteristics will be associated with the likelihood of a student being a current smoker.

Results from these investigations will contribute to the growing knowledge on youth tobacco use and inform decision- and policy-makers on how to improve existing tobacco prevention programs and/or policies among adolescents in Canada.

## Chapter 2

### LITERATURE REVIEW

#### 2.1 Overview

This section begins with a summary of two tobacco-related theoretical frameworks (section 2.2.1 and 2.2.2) that guided this present study, then addresses the prevalence of tobacco use among Canadian adolescents (section 2.3), the rationale for targeting tobacco use among adolescents (section 2.4), and smoking stages (section 2.5). This is followed by a literature review section (2.6) and ends with a summary of the literature review (section 2.6.3) including the identified research gaps (section 2.6.4).

#### 2.2 Theoretical framework

Researchers have used several theories or models to try and understand the complex factors of human behaviour. This study was guided by the ecological systems theory (Bronfenbrenner, 1979) and the theory of triadic influence (TTI) (Flay & Petraitis, 1994; Flay et al., 1999) because both have been used in literature to comprehensively examine the individual characteristics and the broader environments in which adolescents initiate and maintain smoking. The next section is an overview of these two theories.

##### 2.2.1 Ecological Systems Theory

The ecological theory by Bronfenbrenner (1979) claims that behaviour is influenced by five types of environmental systems that influence and interact with each other. Four reflect different levels of proximity to the individual: microsystem, mesosystem, exosystem, and macrosystem (Figure 2). The fifth system is the chronosystem which takes into account the dimension of time in relation to a child's development. The microsystem is the immediate setting of the adolescents. It mainly comprises of the biology of the individual and the key social agents of the adolescent, such as family members and school. The mesosystem provides the connection between the microsystem and other layers (e.g. the connection between the family and school or church). The exosystem consists of the larger system with which adolescents have an indirect relationship, for example, mass media and the school system. The macrosystem is the outermost layer that goes beyond the school system and is made up of the cultural values, customs, SES, physical environment and policies that affect all the other layers (Bronfenbrenner, 1979).

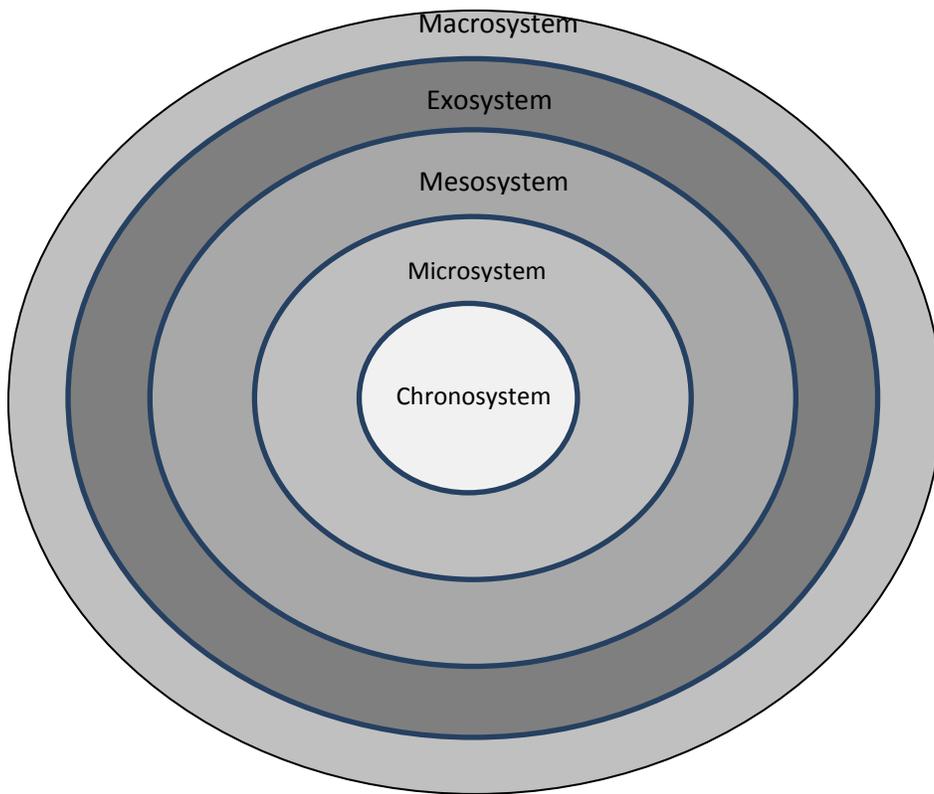


Figure 2: Ecological Systems Theory (Adapted from Google images)

The Ecological theory, especially the microsystem (e.g., individual, family and school factors) and mesosystem (connections between factors in the microsystem) has been used to understand adolescent tobacco use (Leatherdale et al., 2005a; Leatherdale et al., 2005b; Leatherdale et al., 2005c; Sabiston et al., 2009; Turner, Mermelstein, & Flay, 2004; Wium & Wold, 2009). Few youth smoking studies investigate the role of the broader macrosystem (e.g., number of tobacco retailers near schools) (Henriksen et al., 2008; Leatherdale & Strath, 2007; Lee & Cubbin, 2002; Lovato, Sabiston, Hadd, Nykiforuk, & Campbell, 2007) that is a highly relevant territory for youth who spend a good portion of their after-school time in their neighbourhood (Wen et al., 2009). One main limitation with the Ecological theory is that it is general and lacks clarity in how various variables in the different layers affect each other (Glanz, Rimer, & Lewis, 2002). Moreover, it is a global theory of behaviour and is not specific to smoking. Fortunately, this limitation is one of the key strengths of the Theory of Triadic Influence.

### 2.2.2 Theory of Triadic Influence

The Theory of Triadic Influence (TTI) (Flay & Petraitis, 1994) was a recommendation from the review by Petraitis et al. (1995). The purpose of this review was to organize and integrate existing 14 multivariate

prominent theories (refer to Table F12 in Appendix F) of experimental substance use (ESU) (e.g., tobacco, alcohol and marijuana use) in an attempt to offer a new comprehensive framework that would be used to address ESU. The review showed that most of these theories were never planned to be comprehensive models that explained all the constructs of ESU. Instead, most theories focused on certain constructs that partly explained the etiology of ESU (Petraitis et al., 1995). For example, the cognitive-affective theories (e.g., the theory of reasoned action (Ajzen & Fishbein, 1980) or theory of planned behaviour (Ajzen, 1985) focused on decision-making processes that contribute to ESU (refer to Table F12 in Appendix F). On the other hand, the social learning theories (e.g., social learning theory (Akers, 1977) and social cognitive theory (Hawkins & Weis, 1985) examined the effects of substance use using social models. This led Petraitis et al. (1995) to recommend a new integrated theory named TTI.

The TTI postulates that youth smoking behaviour is influenced by a complex system of factors that are categorized into three “streams” of influence (Flay & Petraitis, 1994; Flay et al., 1999). The first stream represents the broad socio-cultural environment that contributes to or end at adolescents’ personal attitudes concerning tobacco use (refer to Figure 3). For example, government, provincial or regional policies regarding tobacco use (e.g., school-based tobacco control programs and policies), mass media campaigns, laws regarding selling tobacco to minors (e.g., tobacco retailer regulations), and employment rates, which are associated with the SES of neighbourhoods.

The second stream represents characteristics in the immediate social environment surrounding the youth, such as, tobacco use by family members and peers. This stream is a social support system that discourages or contributes to the social pressure that adolescents feel to experiment with tobacco. The third is the intrapersonal stream and it represents the adolescents’ basic personality (e.g., self-efficacy and behavioural control) and biological makeup (e.g., nicotine biological sensitivities, age, gender) that strengthens or weakens an adolescent’s ability to resist pressures to initiate smoking (Flay et al., 1999). This category includes transient affective states (such as depression, low self-esteem), attitudes, social skills, resistance and refusal skills (Flay et al., 1999). The intrapersonal factors moderate the direction or strength of the characteristics from other streams (Flay et al., 1999).

In addition the TTI also includes several tiers of levels of influence, that is, proximal, distal and ultimate influences as shown in Figure 3. The lowest tier is intentions (e.g., smoking intentions or being susceptible to smoking in the future), social norms and beliefs/attitudes/perceptions (e.g., perception of school connectedness, perception of the existence and enforcement of antismoking school rules) and self-efficacy behavioural control. This tier represents the most immediate or proximal level of influence. Proximal factors have direct effects and thus are the strongest predictors of smoking intentions or initiations (Flay et al., 1999) because they reflect adolescents’ more immediate social environment (Wen et al., 2009). The

distal factors usually contribute indirectly to smoking initiation by contributing directly to adolescent's tobacco-related attitudes (knowledge and values), social normative beliefs (perceived norms and motivation to comply) and self-efficacy (social skills and self-determination).

The final level is the “ultimate” tier. In contrast to the proximal or distal tiers, this tier is, broader in scope, beyond the easy control of adolescents and deeply rooted in the adolescent's environment, personality, or biological makeup. Often most of these factors are difficult to change but are likely to have enduring impact if changed. Thus, the understanding of these factors is important in guiding the design and implementation of effective tobacco control strategies in schools. Interactions between streams can increase or reduce both risks and/or protection factors (Flay et al., 1999). For example, a positive sense of self can protect against poor neighbourhood characteristics. The TTI supports Bandura's (1986) concept of reciprocal determinism, which claims that causes and effects are in a continuous cycle (each behaviour changes the causes and the changed causes lead to the same, similar or different behaviour over time).

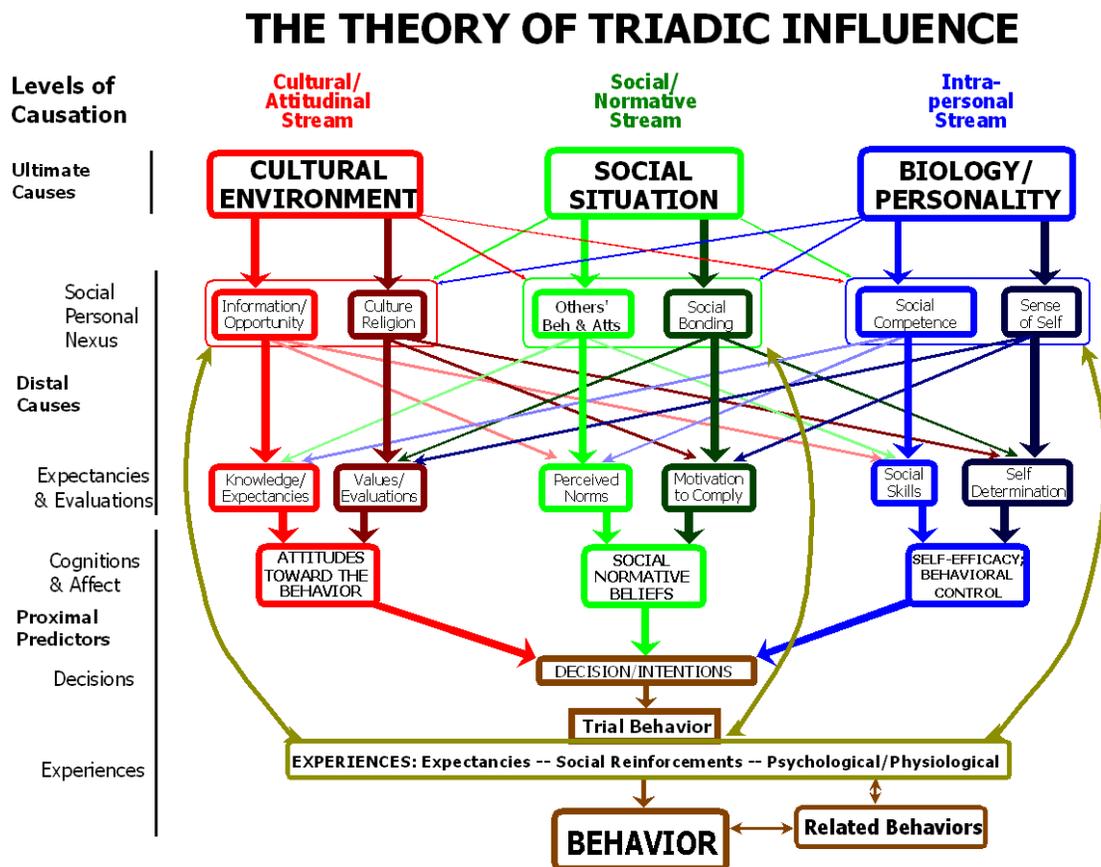


Figure 3: A schema of the theory of triadic influence. Permission to use schema was granted by Professor Flay (personal communication, August 16, 2011)

The main strength of the TTI is that it is comprehensive and targets broader and multiple influences of behaviour and was developed for smoking behaviour (Flay, 2005). TTI applies the broad concepts of ecological theory to particular behaviour such as smoking. Additionally, it incorporates main constructs from other theories as summarized in Table F12 (Appendix F). Unlike other theories, the TTI also allows for interaction across the six streams and provides more opportunity to investigate constructs that encourage or discourage tobacco use among adolescents (Flay et al, 1999). Moreover, TTI offers testable predictions and insights about the causes of health-related behaviours such as tobacco use (Flay & Petraitis, 1994).

### **2.3 Prevalence of tobacco use among adolescents in Canada**

Findings from the 2008-2009 Canadian Youth Smoking Survey (2008 YSS) showed that about 12% of Canadian youth aged 15-19 were current smokers (Youth Smoking Survey, 2010). More than two-thirds of current smokers (68%) had ever tried quitting smoking cigarettes. Among those who had never smoked a cigarette, 30% were susceptible to initiating smoking. Thirty-three percent of the youth surveyed reported that they had ever tried a cigarette (even a few puffs), while 5.1% reported currently experimenting with cigarettes (Youth Smoking Survey, 2010).

### **2.4 Rationale for targeting adolescents**

Lifetime smoking commences as naïve experimentation at adolescence which frequently develops into a strong addictive habit that is difficult to break (DiFranza et al., 2007). Research shows that nearly all (88%) first use of cigarettes occur by 18 years of age, and the vast majority become addicted to nicotine by young adulthood (Anda et al., 1999; Centers for Disease Control and Prevention, 2010b; Mowery et al., 2000; U.S. Department of Health and Human Services, 2012). In addition, recent studies show that addiction to nicotine occurs faster in adolescents than in adults (O'Loughlin, Karp, Koulis, Paradis, & Difranza, 2009). In this study, some adolescents experienced nicotine dependence within a day of first inhaling (O'Loughlin, Karp, Koulis, Paradis, & Difranza, 2009). The tobacco industry also exploits the adolescents search for identity by developing unique brands that fulfill the image and lifestyle aspirations of adolescents (Dewhirst & Sparks, 2003).

Tobacco use is also associated with the development of problematic health risk behaviours such as the use of alcohol and other illegal drugs (Baumeister & Tossmann, 2005; Centers for Disease Control and Prevention, 2010b; Chen et al., 2002; Newcomb, Maddahian, & Bentler, 1986), which significantly increases the disease burden in adulthood (American Lung Association, 2011). Studies also show that

individuals who initiate smoking at an early age are more likely to smoke as adults than those who initiate at an older age (Chassin, Presson, Rose, & Sherman, 1996; Chassin, Presson, Sherman, & Edwards, 1990). Thus, preventing adolescents from initiating tobacco use is a public health priority (U.S. Department of Health and Human Services, 2012).

## 2.5 Smoking stages

Research supports the concept that adolescents smoking behaviour consists of distinct smoking stages. A recent review by Chassin and colleagues (2009) that examined developmental stages of cigarette smoking identified six (Bernat, Erickson, Widome, Perry, & Forster, 2008; Chassin, Presson, Pitts, & Sherman, 2000; Maggi, Hertzman, & Vaillancourt, 2007; Orlando, Tucker, Ellickson, & Klein, 2004; Stanton, Flay, Colder, & Mehta, 2004), five (Abroms, Simons-Morton, Haynie, & Chen, 2005; Colder, et al., 2001; Lessov-Schlaggar et al., 2008), four (Audrain-McGovern et al., 2004; Brook, Pahl, & Ning, 2006; Juon, Ensminger, & Sydnor, 2002; Karp, O'Loughlin, Paradis, Hanley, & Difranza, 2005; Riggs, Chou, Li, & Pentz, 2007; Vitaro, Wanner, Brendgen, Gosselin, & Gendreau, 2004), three (Soldz & Cui, 2002; White, Nagin, Replogle, & Stouthamer-Loeber, 2004; White, Pandina, & Chen, 2002) smoking stages. However, two smoking stages were common across these studies and include light experimental smokers and chronic or stable smokers. Several studies did not include a non-smoking category (Colder et al., 2001; Karp et al., 2005; Lessov-Schlaggar et al., 2008; Stanton et al., 2004) or a quitter's category (Abroms et al., 2005; Audrain-McGovern, et al., 2004; Brook, et al., 2006; Maggi, et al., 2007; Orlando et al., 2004; Riggs et al., 2007; Soldz & Cui, 2002; Vitaro et al., 2004; White et al., 2004).

An earlier review by Mayhew and colleagues (2000) proposed a smoking trajectory that was a composite of models from the 1994 Surgeon General's Report (U.S. Department of Health and Human Services, 1994) and three studies (Flay, 1993; Leventhal & Cleary, 1980; Stern, Prochaska, Velicer, & Elder, 1987). Mayhew et al. (2000) categorized adolescents smoking behaviour into 6 stages. They include non-smoker in preparation stage (not susceptible), non-smoker in contemplation or preparation stage (susceptible), tried smoker, experimenter, regular and established/daily smoker (refer to Table A1 in Appendix A). The trajectory identified by Cameron et al. (1999) divides smokers into five categories i.e., being a non-smoker, trying smoking once, experimenting, becoming a regular smoker and finally quitting or former smoker (refer to Table A1 in Appendix A). Overall, the Mayhew et al. (2000) and the Cameron et al. (1999) smoking stages are the most comprehensive. Both stages complement each other. For instance, the Mayhew et al. (2000) trajectory specifies a susceptible stage (called "contemplation and preparation" stage) that is included in the present proposed study but is missing in the Cameron et al. (1999) stages. However, in the present study "never smoker," "experimenter," and "regular smoker" are more closely aligned to the

Cameron et al. (1999) stages than the Mayhew et al. (2000) definitions (refer to Table A1 in Appendix A). Characterizing adolescent smoking stages is important because prevention and intervention programs need to tailor their programs depending on the risk and protective factors of adolescents in different smoking stages.

## **2.6 Review of literature on student- and school-Level characteristics associated with adolescent smoking**

The association between student and school-level characteristics and adolescent smoking outcomes has been established empirically in several reviews prior to 2003 (Conrad, Flay, & Hill, 1992; Geckova, Van Dijk, Van Ittersum-Gritter, Groothoff, & Post, 2002; Tyas & Pederson, 1998) and individual studies published between 2002 to 2011 as presented in Table B2 (Appendix B). The following section summarizes 48 published studies (2002-2011) on student- (section 2.6.1) and school-level (section 2.6.2) factors that are associated with adolescent smoking status according to the three streams (i.e., intrapersonal, social context and socio-cultural environment) of the TTI.

### **2.6.1 Student-level factors associated with adolescent smoking behaviour**

#### **2.6.1.1 Intrapersonal factors by smoking stages**

In summary, Table B3 (Appendix B) shows known intrapersonal factors that are associated with adolescent smoking susceptibility among never smokers, experimental smoking and current smoking as explained below.

*Susceptibility:* The known intrapersonal factors that are associated with increased risk of smoking susceptibility among never smokers include being younger (Leatherdale, Brown, Cameron, & McDonald, 2005a; Okoli, Richardson, Ratner, & Johnson, 2009), female (Leatherdale et al., 2005a; Okoli, Richardson, Ratner, & Johnson, 2009), in a lower grade (Chen, Bottorff, Johnson, Saewyc, & Zumbo, 2008; Okoli et al., 2009; Yang, Leatherdale, & Ahmed, 2011), having positive attitudes toward smoking (Unger, Rohrbach, Howard-Pitney, Ritt-Olson, & Mouttapa, 2001), perceiving that friends would disapprove smoking (Smith, Bean, Mitchell, Speizer & Fries, 2007), self-perceived mental addiction (Okoli et al., 2009), higher depression scores (Carvajal, Downing, Hanson, Coyle, & Pederson, 2004; Okoli et al., 2009), low refusal self-efficacy (Carvajal et al., 2004), having access to pocket money (Guindon, Georgiades, & Boyle, 2008), low academic aspiration (Carvajal et al., 2004), having less knowledge of the harmful effects of secondhand smoke (Guindon, et al., 2008), consuming alcohol or illicit drugs (Okoli et al., 2009; Yang,

Leatherdale & Ahmed, 2011), and low levels of perceived enforcement of anti-smoking policies (Leatherdale et al., 2005a) .

*Experimental smoking:* The reported intrapersonal factors associated with increased risk of experimental smoking include being younger (O'Loughlin et al., 2009), low self-confidence to quit smoking (Grenard et al., 2006), coming from a single-parent family (O'Loughlin et al., 2009), susceptible to smoking e.g., intended to accept a cigarette if offered by a friend or intended to smoke in the next year (Grenard et al., 2006; Leatherdale et al., 2005b), thinking students at school got into trouble for breaking the school anti-smoking rules (Leatherdale et al., 2005b), consuming alcohol or use of tobacco products (O'Loughlin et al., 2009), access to pocket money (Mohan, 2005), low refusal self-efficacy (Ma et al., 2003), low school connectedness (Bond et al., 2007), low self-esteem (O'Loughlin et al., 2009; Grenard et al., 2006), impulsivity (O'Loughlin et al., 2009), poor academic performance (O'Loughlin et al., 2009), and reporting positive attitudes towards smoking (Brady et al., 2008).

*Current smoking:* Intrapersonal factors that are known to be associated with increased risk of current smoking include being older (Chan & Leatherdale, 2011; Hutchinson, Richardson, & Bottorff, 2008; Leatherdale and Burkhalter, 2012; Park, Dent, Abramsohn, Dietsch, & McCarthy, 2010; Tyc et al., 2004), being male (Kalesan, Stine, & Alberg, 2006), having depression (Hutchinson et al., 2008; Park, Dent, Abramsohn, Dietsch, & McCarthy, 2010), higher risk-taking behaviour (Tyc et al., 2004), having a weekly allowance (Wen et al., 2009), low self-esteem (Wen et al., 2009), not living with biological parents/not close with parents (Bjarnason et al., 2003; Wen, Van Duker, & Olson, 2009), (Grenard et al., 2006; Kalesan et al., 2006), students overestimating the percentage of youth their age who smoke (Murnaghan, Sihvonen, Leatherdale, & Kekki, 2009; Sabiston et al., 2009; Watts, Lovato, Card, & Manske, 2010; Wium et al., 2006), consuming alcohol or illicit drugs (Leatherdale and Ahmed, 2010; Leatherdale and Burkhalter, 2012; Leatherdale, Hammond & Ahmed, 2008; Patton, Coffey, Carlin, Sawyer, & Lynskey, 2005; West et al., 2010), low self-confidence to quit (Tyc et al., 2004), low school connectedness (Sabiston et al., 2009), low refusal self-efficacy (Ma et al., 2008), and low levels of perceived enforcement of anti-smoking policies (Lipperman-Kreda, Paschall, & Grube, 2009; Wium, Torsheim, & Wold, 2006).

#### 2.6.1.2 Social context factors by smoking stages

The social context factors that are associated with adolescent smoking susceptibility among never smokers, experimental and established smoking are summarized in Table B3 –Appendix B and below.

*Susceptibility:* The social context factors that are associated with increased risk of smoking susceptibility among never smokers mainly include exposure to close friends who smoke (Chan & Leatherdale, 2011;

Guindon, Georgiades, & Boyle, 2008; Leatherdale et al., 2005a; Okoli et al., 2009; Smith et al., 2007; Yang et al., 2011) or family members who smoke ( Chan & Leatherdale, 2011; Guindon et al., 2008; Okoli et al., 2009; Yang et al., 2011), residing in homes where children are exposed to second-hand smoke (Guindon et al., 2008; Szabo, White, & Hayman, 2006) and being exposed to smoking at a job (Leatherdale et al., 2005a).

*Experimental smoking:* The existing social context factors associated with increased risk of experimental smoking mainly include exposure to smoking by family members (Ma et al., 2008; O’Loughlin et al., 2009) or friends who smoke (Grenard et al., 2006; Leatherdale et al., 2005b; Ma et al., 2003; O’Loughlin et al., 2009), or teachers who smoke (O’Loughlin et al., 2009), and residing in homes without a smoking ban (Szabo et al., 2006).

*Current smoking:* The social context factors associated with increased risk of current smoking include having friends who smoke (Bricker et al., 2006; Chan & Leatherdale, 2011; Chuang, Ennett, Bauman, & Foshee, 2009; Hutchinson et al., 2008; Khuder et al., 2008; Leatherdale, McDonald, Cameron, & Brown, 2005c; Sabiston et al., 2009; Wen, Van Duker, & Olson, 2009; West et al., 2010), family members who smoke (Bricker et al., 2006; Chan & Leatherdale, 2012; Chassin et al., 2008; Chuang et al., 2009; Hutchinson et al., 2008; Kalesan et al., 2006; Khuder et al., 2008; Leatherdale et al., 2005c; Sabiston et al., 2009; Tyc et al., 2004; Wen et al., 2009), and residing in homes without a total ban on smoking (Thomson, Siegel, Winickoff, Biener, & Rigotti, 2005).

## **2.6.2 School-level factors associated with adolescent smoking**

Adolescents spend a notable amount of their time in school; therefore, the socio-cultural environment (i.e., school and the neighbourhood surrounding the school) is an important factor for adolescent smoking outcomes (Flay et al., 1999). A systematic review of 17 multi-level studies of school contextual effects on student outcomes by Sellstrom and Bremberg (2005) showed that the intraclass correlation coefficient (ICC), defined as the ratio of the school level variance component to the sum of the school and error variance components, for four of the studies that focused on current smoking behaviour ranged between 7% and 12%. The same review (Sellstrom & Bremberg, 2006) also showed that school-level antismoking policies influenced students’ current smoking behaviour and it explained 4% to 40% of the between school variations.

Two studies by Leatherdale et al. (2005b; 2005c) found that a school that a student attends may predispose them to a greater risk for smoking. For example, a junior student (grade 9-11) who attended a school with a high prevalence of senior students (grade 12 and 13) who smoked, was more likely to be an

occasional smoker (versus never smoker) or regular smoker (versus occasional smoker) than was a similar student attending a school with a lower prevalence of senior students who smoked (Leatherdale et al., 2005c). The other study (Leatherdale et al., 2005b) showed that a junior student (grade 9-11) who attended a school with a high prevalence of older students (grade 12 and 13) who smoked, was more likely to be an experimental smoker than a similar student attending a school with a lower prevalence of older students who smoked. Therefore, it is imperative to examine the influence of school characteristics beyond individual student-level factors. Table B3 (Appendix B) shows a summary of the school-level factors (namely socio-cultural factors in TTI) that are associated with smoking susceptibility among never smokers, experimental smoking and current smoking in existing literature.

*Susceptibility:* The broader societal factors that are known to be associated with increased risk of adolescent susceptibility to smoking include the number of tobacco retailers that surround secondary schools (Chan & Leatherdale, 2011), attending a school where there was student smoking on the school periphery (Leatherdale et al., 2005a), and attending schools with a high prevalence of tobacco use (Guindon et al., 2008).

*Experimental smoking:* The societal factors that are associated with increased risk of experimental smoking include attending a school with a relatively high smoking rate in senior grades (grade 12 and 13) (Leatherdale et al., 2005b), and high density of retailers in urban schools (McCarthy et al., 2009).

*Current smoking:* The known societal factors that are associated with increased risk of adolescent current smoking include the number of tobacco retailers that surround secondary schools (Chuang et al., 2005; Henriksen et al., 2008; Kline, 2004; Leatherdale and Strath, 2007; Pearce et al., 2009; West et al., 2010), living in neighbourhoods with low SES (Chuang et al., 2009; Doku, Koivusilta, Rainio, & Rimpela, 2010; Duncan, Jones, & Moon, 1999; Pearce et al., 2009), attending schools that are located in rural areas (Chuang et al., 2009; Ma et al., 2003), schools with a high smoking rate among senior students (grade 10 and 13) (Guindon et al., 2008; Leatherdale et al., 2005c), school where students smoke in the periphery/on school property (Lovato et al., 2010; Sabiston et al., 2009), and schools with weaker policy intentions and implementation (Sabiston et al., 2009).

However, Murnaghan et al. (2007) and Lovato et al. (2010) studies showed opposite results. That is, a school with stronger enforcement (e.g., banning smoking on school property or having a higher bylaw enforcement officer presence) was associated with a small increased risk for smoking. Authors argued that this may be because schools with higher prevalence of smoking would have a greater need for strong enforcement. However, the cross-sectional nature of their studies did not allow for clarification of this explanation. Other broader factors that are known to predispose adolescents to current smoking include media factors such as smoking in movies (Charlesworth & Glantz, 2005; Guindon et al., 2008; Sargent,

2006), easy access (e.g., availability of and low price) of tobacco products (Feighery, Ribisl, Schleicher, Rebecca, & Halvorson, 2001) and pro-tobacco advertisements (Geckova et al., 2002; Guindon et al., 2008; Wakefield, Flay, Nichter, & Giovino, 2003) (Table B3 –Appendix B).

The next section is a brief summary of literature on three school-level factors that were explored in the present study. These factors include density of tobacco retailers (section 2.6.2.1) and neighbourhood socio economic status (SES) and location (rural versus urban) (section 2.6.2.2).

### 2.6.2.1 Density of tobacco retailers

Although Canada's federal law prohibits the sale of tobacco products to persons who are under the age of 18, studies show that many youth smokers still obtain their cigarettes from family or friends or non-compliant retailers (e.g., gas station stores, kiosks, convenience stores and grocery stores) that do not adhere to the federal or provincial prohibition laws (Chan & Leatherdale, 2011; Leatherdale and Strath, 2007). Underage smokers can also obtain cigarettes through the use of fake identification (Klonoff, Landrine, Lang, Alcaraz, & Figueroa-Moseley, 2001).

The study by Leatherdale and Strath (2007) found that underage youth who smoked were more likely to purchase their own cigarettes if there were more tobacco retailers near a school. However, the number of tobacco retailers was not associated with whether a student was a smoker (Leatherdale & Strath, 2007). A second Canadian study by Chan and Leatherdale (2011), showed that the number of tobacco retailers surrounding a school was associated with the likelihood of a never smoker being susceptible to smoking but not associated with occasional or daily smoking. Another study (Novak, Reardon, Raudenbush, & Buka, 2006) reported an association between higher tobacco retailer density and increased youth smoking. Additionally, Henriksen and colleagues' study (2008) showed that the prevalence of current smoking was 3.2 percentage points higher at schools in neighbourhoods with the highest tobacco outlet density than in neighbourhoods without any tobacco outlets. McCarthy and colleagues study (2009) also found that the density of retailers was associated with adolescent experimental smoking but not among established smokers.

Regarding distance of tobacco outlets, three studies (Chuang, et al., 2005; Pearce et al., 2009; West et al., 2010) found that individuals who resided in close proximity to a tobacco outlet were more likely to smoke than people who lived further away from the outlets. Despite evidence regarding the association between higher tobacco retailer density and increased youth smoking, there is still a paucity of research that simultaneously examines this association with adolescent smoking susceptibility and experimental smoking. Findings from the present study will contribute to empirical evidence that public health

practitioners can use to advocate and improve existing policies that will reduce tobacco access to adolescents.

#### 2.6.2.2 School location (rural/urban) and the SES of the school neighbourhood

There has been increasing research attention to the influence of neighborhoods on smoking behaviours. Neighborhoods are hypothesized to affect health of residents via a variety of mechanisms such as the availability of goods and services, community norms and values (Chuang et al., 2005). Several studies found that neighbourhood characteristics such as, SES (Chuang et al., 2005; Chuang et al., 2009; Doku et al., 2010; Duncan et al., 1999; Pearce et al., 2009) or location (i.e., rural or urban setting) (Chuang et al., 2009; Ma et al., 2008; Pearce et al., 2009; Sellstrom & Bremberg, 2006) were associated with smoking status. However, all these studies examined the association of neighbourhood factors with current smoking. None investigated the association between neighbourhood characteristics and smoking susceptibility or experimental smoking except for the study by Chan and Leatherdale (2011) which did not find an association between neighbourhood deprivation with smoking susceptibility and current smoking.

One inconsistent finding among these studies is the use of different variables as proxy measures for neighbourhood SES characteristics. For example, one study (Chuang et al., 2005), computed a composite neighbourhood SES score from five variables i.e., percentage less than high school education, percentage blue collar workers, percentage unemployed, median annual family income, and median housing value, based on the result of a principal component analysis. The score was created by summing the five variables and a higher score represents a higher neighbourhood SES. In a subsequent study, Chuang et al. (2009), derived neighbourhood SES from three indicators; household income, proportion of males who were jobless and proportion of residents who were under the poverty line. Chan and Leatherdale (2011) derived their neighbourhood disadvantage measure using the 2006 Census i.e., the percentage of families in the community that received government transfer payments e.g., social assistance. There is need to use standard SES measures to allow for comparability between studies. Overall, understanding the influence of neighbourhood characteristics is crucial in developing and modifying adolescent tobacco control strategies to “match” adolescents’ neighbourhoods (Chuang et al., 2005).

#### 2.6.3 Summary of literature review

Seven of the reviewed articles were from longitudinal studies (i.e., stronger designs) (Bricker et al., 2006; Chassin et al., 2005; Chassin et al., 2008; Dalton et al., 2003; Grenard et al., 2006; O’Loughlin et al., 2009; Patton et al., 2005) (refer to Table B3 in Appendix B). These studies showed that intrapersonal factors associated with a smoking initiation and current smoking included being younger, coming from a

single-parent family, having poor academic performance, use of alcohol and other tobacco products, low self-esteem, depression, stress, having intentions to smoke, self-perceived mental addiction, and impulsivity. Social context factors included having a parent or a sibling, or a peer who smokes. They also identified three socio-cultural factors associated with smoking initiation that is, exposure to smoking in mass media, attending a school with high smoking prevalence, and attending a school with low SES. None of the longitudinal studies examined the association of intrapersonal, social context and socio-cultural factors that were associated with adolescent smoking susceptibility.

Findings from the cross-sectional studies also showed consistent results regarding the bulk of the intrapersonal, social context and socio-cultural factors as summarized in Table B3 (Appendix B). For example, all the studies that investigated the association between adolescent smoking and social context factors, found that having parents, siblings or peers who smoke significantly predicted student's smoking behaviour. In addition, those that examined the following intrapersonal factors found significant associations with youth smoking. They include being male, having low academic achievement, low school connectedness, involvement in high risk behaviours (alcohol, drugs and unprotected sex), being depressed, having positive tobacco-related attitudes and inaccurate perceptions regarding the students smoking prevalence. The socio-cultural factors such as low school SES, urban location, high tobacco retailer density, smoking in media, high smoking prevalence schools, and school-based policies and/or programs were important predictors. Fortunately, most of these factors are modifiable. Although some of the intrapersonal factors identified from review, such as, age, family composition, and education level are unchangeable they offer valuable information for targeting and tailoring interventions.

#### **2.6.4 Identified research gaps from literature review**

In summary, the review identified important intrapersonal, social context and socio-cultural factors associated with adolescent smoking behaviour as presented in the previous section (2.6.3) and summarized in Table B3 (Appendix B). Two important research gaps were identified from the literature review namely: (1) a paucity of studies that simultaneously examined the association between school (e.g., school neighbourhood characteristics such as school SES, school location [rural versus urban], or density of tobacco retailers) and student characteristics with adolescent smoking behavior; especially using nationally representative data, and also (2) notably examining these factors among adolescents in different smoking stages. For example, none of the reviewed studies examined the association between school SES (except the Chan and Leatherdale study, 2011), or school location (rural vs. urban) with experimental smoking or smoking susceptibility. The three research questions in the present study were based on these identified gaps.

# Chapter 3

## METHODOLOGY

### 3.1 Methods

#### 3.1.1 Overview

This section provides an overview of the study designs and procedures of the three data sets that were linked to create one main secondary analysis dataset for this study. The data sets where data linkage occurred included:

- 1) 2008-2009 Canadian Youth Smoking Survey (designated as 2008 YSS) (section 3.2) provided student-level intrapersonal and social context data from grade 9-12
- 2) The 2006 Census data provided school-level neighbourhood SES and school location data (section 3.3).
- 3) The 2008/2009 Desktop Mapping Technologies Inc. (DMTI) Enhanced Points of Interest (EPOI) data file (ESRI, 2002) was used to provide school-level neighbourhood data on the number of tobacco retailers within a 1-km radius of each sampled school (section 3.4).

### 3.2 The Student-level Canadian Youth Smoking Survey

The 2008 YSS is nationally representative school-based survey of grade 6 to 12 youth in 10 Canadian provinces. The overall aim of the 2008 YSS is to reduce tobacco-related morbidity and morbidity by studying the factors that influence youth smoking behaviour and using these results to evaluate and improve youth tobacco control policies and programs (University of Waterloo, 2009).

#### 3.2.1 Study design

The 2008 YSS was based on a stratified multistage design. This section summarizes the steps that were followed when designing the YSS. Details of this study design can be found in the 2008 YSS Microdata User guide from the YSS website ([www.yss.uwaterloo.ca](http://www.yss.uwaterloo.ca)) and Elton-Marshall and colleagues article (2011b). In brief, a list of schools from the Department of Education from the 10 provinces was obtained. Schools from the three territories were not included. Additionally, youth that were residing in institutions (e.g., mental institutions), attending special schools (e.g., schools for visually-impaired or hearing-impaired individuals) and military bases or those living on First Nations reserves were also excluded. Within each

province stratification was done based on two classifications i.e., health region smoking rate classification; and the type of school (elementary or secondary) classification

In stage 1, the health region smoking rate stratum was estimated as follows: the Canadian Community Health Survey (CCHS) data was used to determine the smoking rate for 15-19 year olds in all health regions. Total eligible grade enrolment (using the list from the Provincial Department of Education) in a health region was used as a weight to calculate the median smoking rate for each province. School six-digit postal code was used to identify the health region for a school. Median smoking rate was used as benchmark to divide the schools into two strata i.e., one group was assigned to the “low” (schools located in health region with a smoking rate lower than the median smoking rate in the province) and the other stratum was assigned the “high” smoking rate (schools located in health region with smoking rate that was equal or higher than the benchmark median smoking rate) stratum. Ontario was treated slightly differently from all other provinces due to its size and the importance of being able to capture schools from the GTA even if there were refusals from the larger school boards in the city of Toronto (Elton-Marshall et al., 2011b). In Ontario, the Greater Toronto Area (GTA) comprised its own health region stratum (third health region stratum). Outside the GTA, the population of Ontario schools was divided in two health region strata similar to those in the other provinces (refer to Table C4 in Appendix C).

In stage 2, the schools were stratified into elementary or secondary schools strata (calculated based on whether there was a higher enrolment of students in grades 6 to 8 or 9 to 12) (refer to Table C5 in Appendix C). Elementary and secondary schools were sampled on a 2:1 ratio due to the smaller enrolment sizes of the elementary schools. Schools were also over-sampled in each province based on the provincial school recruitment rate from the 2004/2005 and 2006/2007 YSS cycles to ensure sufficient numbers of respondents (Elton-Marshall et al., 2011b) (refer to Table C6 in Appendix C).

A simple random sample of private schools was selected in each province from lists that were obtained from the provincial Department of Education websites. The number of schools originally selected was roughly proportional to the number of students enrolled in the private schools in that province as compared to the total in public schools. All grade 6 to 12 students from sampled schools were qualified to participate in the 2008 YSS survey. All protocols and materials were approved by the University of Waterloo Human Research Ethics Committee. In addition, all methods received ethics approval by the appropriate institutions, for example the provincial host institution, and school boards.

### **3.2.2 Sample size for present study**

The proposed study used data from students in secondary school (grade 9-12) for the following reasons:

- 1) Preliminary analysis findings from the 2008 YSS showed less variability in smoking status among elementary students compared to high school students (see weighted frequencies in Table D7 in Appendix D).
- 2) A large body of literature also shows that high school students have higher smoking rates compared to elementary students (Health Canada, 2011).
- 3) The data on alcohol and drugs are only available for grades 9-12.
- 4) Student- and school-level constructs are expected to vary between the two groups (elementary and high school students) since most high school students do not share the same schools with the elementary students.

The sample for the current study consisted of 29,296 students (Grade 9-12) from 133 schools. Overall, this survey had a 73.2% response rate (based on completed questionnaires (numerator) and eligible students (denominator) (University of Waterloo, 2009). Non-response was attributed to several factors including refusal by parents/guardians for their child to participate; refusal by students to participate (even though they had parental permission) or some students were absent from class on the day of data collection (University of Waterloo, 2009).

### **3.2.3 Study tools and procedures for 2008 YSS**

The 2008 YSS module (refer to questionnaire in Appendix G) included questions on students' demographics, smoking, alcohol use, drug use, attitudes, and social and physical environment. Parental permission (i.e., active information-passive permission) was required for students to participate in the survey. The active information-passive procedures entailed sending a detailed letter to student's home with information on the survey and a request for parents to call a toll-free number to inform the school if they did not want their child to participate (University of Waterloo, 2009).

The 2008 YSS questionnaire was administered to students during one class period. The survey took about 30-40 minutes to complete and participants were not given any compensation but their schools received some incentive. All participating schools received an honorarium of \$100 and a tailored School Feedback Report eight to 10 weeks after data collection. A trained site coordinator or data collector was always available at the school's main office to answer any questions that arose during the data collection exercise, to supply any necessary materials (e.g. extra pencils, extra questionnaires, etc.), and to package

completed questionnaires for return to the University of Waterloo. In order to ensure confidentiality, the following measures were followed: students did not write their names on the questionnaires, students placed completed forms in an envelope, which were then sealed and placed in a larger classroom envelope. The study researchers did not use names but codes in their databases and results were published in a group format only (University of Waterloo, 2009). Surveys were machine scanned using Optical Mark Reading (OMR) technology. Quality control measures (e.g. visual scanning, OMR scanning twice to find discrepancies) were used to ensure accuracy of the scanned data. An online survey implementation system (OSIS) permitted central management recruitment, implementation, analysis and feedback processes (Elton-Marshall et al., 2011b).

### **3.2.4 Weighting**

Sample weights were used in the 2008 YSS surveys for two main reasons. First, weights adjusted for sampling methodology; that is, stratification, two stages of selection, and unequal probabilities of selecting participants. Secondly, to compute representative population estimates of all participating grades in Canada (2,848,485 in 2008) from the 2008 YSS sample size, which was the total number of students who completed the 2008 YSS (51,922). The 2008 YSS survey weight (WTPP) was developed in two stages. First, a weight (W1) was computed to account for the school selection with health region and school strata. This was followed by a calculation of a second weight (W2) to adjust for student non-response. The weights were then standardized to the provincial grade and gender distribution so that the total number of students in these groups would equal the actual enrolments in these groups (University of Waterloo, 2009). The present study used this weight variable denoted as “WTPP” in the 2008 YSS SAS format file to compute a new variable for the grade 9 to 12 sample as shown in Table D8 (Appendix D).

### **3.3 Canadian 2006 Census data study design and procedures**

Canadian Census data are collected every five years. Statistics Canada provides web-based Census tract (CT) data that allows the public to access Census information using their postal codes (Statistics Canada, 2011). The Census tract is a small, relatively stable geographic area with a population ranging between 2,500 and 8,000 people that is expected to be homogenous in terms of socioeconomic characteristics (e.g., economic status and social living conditions) (Statistics Canada, 2010). Census tracts are located in large urban centres i.e., Census Metropolitan Areas (CMA) and Census agglomerations (CA) with an urban core population of 50,000 and above. The rest are considered to be rural. The school postal codes were used to identify the Census tracts of sampled schools and school location, that is, whether the school was located in

a rural or urban setting. Typically, a zero (0) in the second position of the postal code identifies a rural postal code (Statistics Canada, 2010). The file does not include a suburban classification.

Despite criticisms regarding using Census SES data, previous studies have relied upon the Census for neighbourhood SES variables because neighbourhood measures are not easily collected in a large scale (Sampson, Morenoff, & Gannon-Rowley, 2002). In the present study, the Canadian 2006 Census web-based site from Statistics Canada provided the median household income data that was used as a proxy measure to determine the SES of the neighbourhood in which schools were located. See more details in Section 3.5.3.2.

### **3.4 Tobacco retailers study design and procedures**

The 2008/09 DMTI-EPOI data provided the number of tobacco retailers that surround the sampled schools. The EPOI data file consists of a national database of more than 1.6 million Canadian business and recreational points of interest. The DMTI-EPOI data was obtained through geocoding the address for each school that participated in the 2008 YSS using Arcview 3.3 software (ESRI, 2002). This was followed by creating a 1-km buffer to assess how many tobacco retailers were located within these buffers (i.e., radius surrounding each school in which the different structures of the built environment were quantified). Finally this information was linked with the student-level data from each school. A 1-km radius was selected because it is estimated that it is representative of the distance most high school students would walk to and from their school (Chan & Leatherdale, 2011; Henriksen et al., 2008).

## **3.5 Study Measures**

### **3.5.1 Overview**

This section provides an overview of the measures that were used as dependent variables (section 3.5.2) and how they were defined and recoded (section 3.5.2.1). Next, predictor variables (section 3.5.3) from the three TTI categories; student-level intrapersonal predictors (section 3.5.3.1.1), social context predictors (section 3.5.3.1.2) and school-level socio-cultural predictors (section 3.5.3.2) are defined. The selection of variables for this study was based on the literature review that was conducted; TTI constructs, and the availability of variables in the three linked data sets (refer to Table B3 [last column] in Appendix B).

### **3.5.2 Dependent or outcome variables**

The outcome variables for this study was whether or not a never smoker student was a susceptible never smoker, whether or not a student was an experimental smoker and whether or not a student was a current smoker (i.e., occasional and daily smokers) among Canadian secondary school students from grades 9 to 12.

#### **3.5.2.1 Definition of student-level dependent variables**

The study variables were operationally defined consistent with the 2008-09 YSS Microdata user guide (University of Waterloo, 2009) and previous research. “Never smokers” (classified as “never tried” in Microdata user guide) were defined as students who reported that they had never smoked a cigarette, not even a puff. Smoking susceptibility was derived using the validated algorithm of Pierce et al. (1996). Only the “never smokers” (as defined earlier) were eligible to have a smoking susceptibility rating. Susceptibility was measured by asking students: (a) “Do you think in the future you might try smoking cigarettes?” (b) “If one of your best friends were to offer you a cigarette, would you smoke it?” and (c) “At any time during the next year do you think you will smoke a cigarette?” Students responded to these questioning on a 4-point Likert Scale (1=definitely yes, 2=probably yes, 3=probably not, 4=definitely not). Consistent with Pierce et al. (1996), students who answered ‘definitely not’ to all three questions were considered non-susceptible; the rest were considered susceptible.

Consistent with 2008 YSS (University of Waterloo, 2009), “experimental smokers” were defined as those students who reported smoking in the last 30 days preceding the survey but had not smoked 100 cigarettes in their lifetime (University of Waterloo, 2009). “Current smokers” were comprised of daily and occasional smokers. Consistent with the 2008 YSS (University of Waterloo, 2009), “occasional smokers” were defined as those students who had smoked at least 100 cigarettes in his/her lifetime and had smoked at least 1 cigarette during the 30 days preceding the survey. “Daily smokers” were defined as those students who had smoked at least 100 cigarettes in his/her lifetime and had smoked at least 1 cigarette per day for each of the 30 days preceding the survey (University of Waterloo, 2009).

### **3.5.3 Predictor variables**

Predictor variables for this study were categorized into the three TTI categories i.e., intrapersonal, social context and socio-cultural predictor variables. The specific variables were limited to student- and school-level factors that were identified from the literature review (section 2.5), TTI and were also available in the linked datasets in Table B3 (Appendix B).

### 3.5.3.1 Student-level predictors

#### 3.5.3.1.1 Intrapersonal predictors

Intrapersonal predictors included student demographic characteristics (i.e., gender, grade), amount of pocket money, ever use of alcohol and marijuana, self-esteem, school connectedness, tobacco-related attitudes and beliefs, perception of smoking rules, student's estimation of smoking prevalence and exposure to antismoking classes. Details of variables are summarized in Table E9 (Appendix E).

##### 3.5.3.1.1.1 Socio demographic variables

Four variables were used to describe the socio demographics of the sampled students i.e., gender (whether female or male), grade (0(reference)=Grade 9, 1= Grade 10, 2= Grade 11, 3= Grade 12), amount of money a student is given each week to spend or save (options included 1=0, 2=\$1 to \$5, 3=\$6 to \$10, 4=\$11 to \$20, 5=\$21 to \$40, 6=\$41 to \$100, 7=more than \$100, 8=I do not know how much money I get each week). The variable was treated in two ways. First, the variable was analyzed as is (including "*I do not know how much money I get each week*" response) to maximize the specificity of results and to avoid loss of information that may occur when variables are collapsed into fewer categories. Secondly, consistent with previous research (Leatherdale & Ahmed, 2010), amount of pocket money was collapsed into 3 categories i.e., (0=\$0, 1=\$1-20, 2=\$21 or more). During analysis the categories were modified as follows (0=\$0, 1=\$1-20, 2=\$21-\$100 and 3=\$101 or more) to capture and separate the students who reported that they were given more than 100\$ each week to spend.

##### 3.5.3.1.1.2 Behavioural questions

The self-esteem questions were derived from the 10-item self-report measure from the Rosenberg Self-Esteem scale (Rosenberg, 1965). The scale consists of 10 statements related to overall feeling of self-worth or self-acceptance. Following factor analysis of the full set of responses from previous cycles of YSS, the 2008 YSS used only three out of the ten items. Respondents were asked to choose the answer that described how they felt about three statements that they were given; "In general, I like the way I am." "When I do something, I do it well." "I like the way I look." Students responded on a 5-point Likert Scale ("1=true, 2=mostly true, 3=sometimes true/sometimes false, 4=mostly false and 5=false"). Responses were recoded as follows: 0 = False, 1 = Mostly false, 2 = Sometimes false / sometimes true, 3 = Mostly true, 4 = True. These values were summed up to give a final score that ranged from 0-12 (Table E9 in Appendix E). A higher score represented a higher self-esteem.

Alcohol use was defined as follows: Respondents were asked “Have you ever had a drink of alcohol; that is, more than just a sip?” Responses included 11 options (1 to 11): “1 = I have never drank alcohol, 2 = I did not drink alcohol in the last 12 months, 3 = I have only had a sip of alcohol, 4 = Every day, 5 = 4 to 6 times a week, 6 = 2 or 3 times a week, 7 = Once a week, 8 = 2 or 3 times a month, 9 = Once a month, 10 = Less than once a month, 11=I do not know.” To determine alcohol “ever use,” the variable was recoded as follows: “Non-use” comprised of those who reported that “I have never drank alcohol” (option 1=0) and the rest (option 2 to 10=1) were categorized as “current users.” The “*I do not know*” was not a valid response (University of Waterloo, 2009). Therefore this category was not included in any of the models (refer to Table E9 in Appendix E).

Regarding marijuana use, respondents were asked “in the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...)” Ten options (1 to 10) were given; “1 = I have never used marijuana, 2 = I have used marijuana but not in the last 12 months, 3 = Every day, 4 = 4 to 6 times a week, 5 = 2 or 3 times a week, 6 = Once a week, 7 = 2 or 3 times a month, 8 = Once a month, 9 = Less than once a month, 10=I do not know.” Recoding resulted in a binary variable assessing marijuana “ever use,” that is, “Non-use” comprised of those who reported that “I have never used marijuana” (option 1=0) and the rest (options 2 to 9=1) were categorized as “current users.” The “*I do not know*” was not a valid response (University of Waterloo, 2009). Therefore this category was not included in any of the models (refer to Table E9 in Appendix E).

#### 3.5.3.1.1.3 Attitudinal and knowledge questions

Six knowledge variables were used separately to assess the level of tobacco related knowledge i.e., “Do people have to smoke many years before it will hurt them?” “Is there danger to your health from an occasional cigarette?” “Does quitting smoking reduce health damage even after many years of smoking?” “Can people become addicted to tobacco?” “Can tobacco smoke be harmful to the health of the non-smoker?” and “Can smokers quit anytime they want?” Students responded either “Yes” or “No” or “I do not know” (refer to Table E9 [Appendix E]).

Five questions were used separately to assess student myths and beliefs i.e., “Do people who smoke become more popular?” “Do you think smoking is cool?” “Can smoking help people when they are bored?” “Does smoking help people relax?” and “Does smoking help people stay slim?” Students responded either “Yes” or “No” or “I do not know” (refer to Table E9 [Appendix E]).

#### 3.5.3.1.1.4 Perceived school connectedness

Perceived school connectedness was measured using five questions. Students were asked whether they: 1) felt close to people at school, 2) felt part of their school, 3) were happy at school, 4) felt that the teachers at school treated them fairly, and 5) felt safe at school. Students responded on a 4-point Likert Scale ('strongly agree, agree, disagree, and strongly disagree'). Responses were recoded into binary values as follows: 0= strongly disagree/ disagree, 1= strongly agree/agree. Consistent with previous research (Sabiston et al., 2009), these five items were summed to give a final score that ranged from 0 to 5. Higher scores represented greater perception of school connectedness (refer to Table E9 [Appendix E]).

#### 3.5.3.1.1.5 Student perception of anti-smoking school rule and smoking prevalence

Consistent with previous research (Sabiston et al., 2009), students were asked to rate "whether their school had a clear set of rules about smoking for students to follow." Students responded on a 4-point Likert Scale ('True, usually true, usually false and false') ranging from 1=True to 4=False and 5= 'I do not know'. Consistent with previous research (Sabiston et al., 2009), responses were recoded such that 1=true/usually true and 0=false /usually false. The 'I do not know' response was recoded into the '0' category because it is assumed that if the respondent had known about the anti-smoking rule they could have picked either the 'true' or 'usually true' response (refer to Table 9 [Appendix E]).

Students were asked to estimate the smoking prevalence at their school by asking them the following question "How many people in your grade, from your school, do you think smoked cigarettes?" They were given coded proportions (1=91 to 100%, 2=81-90%, 3=71-80%, 4=61-70%, 5=51-60%, 6=41-50%, 7=31-40%, 8=21-30%, 9=11-20%, 10=0-10%) to choose from.

#### 3.5.3.1.1.6 Anti-smoking education

Students were asked "How many classes did you have that talked about the effects of smoking?" Responses included 1=0 classes, 2=1 or 2 classes, 3=3 to 4 classes, 4= 5 or 6 classes, 5=7 or more classes. *I do not know* was not a valid response (University of Waterloo, 2009) , therefore this category was not included in any of the models. Depending on the distribution of responses, this response was recoded into three categories; such that 0=No classes; 1=1 or 2 classes; 2=3 or more classes (refer to Table E9 [Appendix E]).

### 3.5.3.1.2 Social context predictors

#### *Family members who smoke and smoking rules in the house*

Parental smoking was measured by asking students: “Do any of your parents, step-parents, or guardians smoke cigarettes?” (‘yes’/‘no’/‘I do not know’). This response was recorded so that 1=yes and 0=no or I do not know as presented in Table E10 (Appendix E). Siblings’ smoking was measured by asking: “Do any of your brothers or sisters smoke cigarettes?” (‘yes’/‘no’/ ‘I do not know’/ ‘I have no brothers or sisters’). This response was recorded so that 1=yes and 0=no or I do not know or I do not have brothers or sisters’. Number of close friends who smoke was measured by asking students: “How many of your closest friends smoke cigarettes?” Options included 0=none, 1=1 friend, 2=2 friends, 3=3 friends, 4=4 friends, 5 or more friends. The categories were not collapsed but left as coded.

Smoking rules in the house was measured by asking: “What are the rules about smoking in your home?” The responses ranged from 1=no one is allowed to smoke in home to 4=people are allowed to smoke anywhere. Responses were recoded such that 0=No one is allowed to smoke in my home and 1=special guests are allowed/people smoke in certain areas/people are allowed to smoke anywhere in my home. The number of people who smoked at home was assessed by asking “Excluding yourself, how many people smoke inside your home every day or almost every day?” Options included ‘0,1,2,3,4,5 or more people’. Details of these variables are presented in Table E10 (Appendix E).

### 3.5.3.2 School-level socio-cultural predictor variables

#### 3.5.3.2.1 School demographics (School neighbourhood SES and urban or rural setting)

Two school neighbourhood characteristics were linked with the 2008 YSS. School location was derived from school postal codes. This was a binary variable and was coded as 1=urban and 0=rural. The urban/rural school location variable was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard Census geographical areas (Statistics Canada, 2010) (see details in Table E11 [Appendix E]).

The Census also collects data on household income which is used to calculate the median household income. School neighbourhood SES was derived from the 2006 Census data using the Forward Sortation Area (FSA) in which the school is located. The FSA provided the first three digits of postal code and it was used to link Census data to the 2008 YSS data. The 2006 Census median household income data was used as a proxy measure for school neighbourhood SES as has been done in previous studies (Wen et al., 2009) (see details in Table E11 in Appendix E).

#### 3.5.3.2.2 Number of tobacco retailers surrounding the schools

The 2008/09 DMTI-EPOI data provides numeric data regarding the number of tobacco retailers that surround the sampled secondary schools. The 2008/09 Desktop Mapping Technologies Inc. [DMTI] and the Enhanced Points of Interest [EPOI] data provided numeric data regarding the number of tobacco retailers that were located within a 1-km radius of each school. The EPOI data file consists of a national database of more than 1.6 million Canadian business and recreational points of interest <http://www.dmtispatial.com>.

The process of linking the DMTI-EPOI data to the YSS student-level data using Arcview 3.3 software (ESRI, 2002) 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 school-level tobacco retailer density for each school to the student-level data from each school. Details of these measures are provided in Table E11 (Appendix E). A 1-km radius was selected because it is estimated that it is representative of the distance most high school students would walk to and from their school (Chuang et al., 2005).

### 3.5.4 Analyses

A multi-level logistic regression (Snijders & Bosker, 1999) was used to analyze data in this study. This type of analysis was chosen because it allows for an understanding of the separate and joint effects of student-level (level-1) and school-level (level -2) characteristics on smoking. Consistent with previous research (Leatherdale et al., 2005b), a four-step modeling procedure was used for analysis. Model 1 entailed computing a null model to assess whether there was significant within-cluster interdependence to warrant the use of a multilevel approach. Model 2 was developed to determine the school-level variables that would have a direct effect on the outcome variable. In Model 3, the strength of the direct effects of both the school- and student-level predictors was assessed using a random coefficient regression model. The main purpose of the final model (Model 4) was to assess the contextual interactions between the school-level and student-level predictor variables. Predictor variables that were not significant at  $p < .05$  were removed until the final model only contained predictor variables that were significant at  $p < .05$ . All analyses used SAS 9.2 statistical package (SAS Institute Inc, 2001).

To avoid redundancy, details of the analysis process were described in sections 3.5.4.2 and 3.5.5.1. The process was similar for all the three research questions. However, the only difference between these studies was the dependent variables which reflected the adolescent smoking stages. The next sections describe the

univariate (section 3.5.4.1), multivariate (section 3.5.4.2) and multi-level logistic regression analyses (section 3.5.5) that were used in this study.

#### 3.5.4.1 Univariate descriptive analyses

Basic summary descriptive statistics were calculated for the total sample of grade 9 to 12 students. Summary statistics were calculated for the student- and school-level predictor variables that were described in section 3.5.3 by smoking status (smoking susceptibility among never smokers, experimental smoking and current smoking). Survey weights were recalculated for grade 9 to 12 students and applied in the analysis to derive population estimates and to adjust for the sampling methodology. The specific SAS commands that were used are shown in Table D8 (Appendix D).

A univariate analysis was computed with each of the intrapersonal, social and socio-cultural predictor variables or constructs. Any variable that was significantly associated with the dependent variable at  $p < 0.10$  was retained for the multivariate model. However, the statistical analyses for the final model was based on the standard statistical level of significance ( $p < 0.05$ ).

#### 3.5.4.2 Multivariate analyses of the intrapersonal and social context characteristics

Prior to conducting the multi-level logistic regression analyses, a multiple logistic regression analysis was used to identify the student-level intrapersonal and social context characteristics that were associated with the dependent variable (smoking susceptibility among never smokers, experimental smoking or current smoking). The final model from the multiple logistic regression analyses was entered into the multi-level logistic regression models as described in section 3.5.5.1 (model 3). Below is a detailed explanation of how the multiple logistic regression analyses were conducted.

Consistent with the TTI, six models were built following the three levels of influence. The intrapersonal factors were the first to be examined since these factors have direct effects and are known to be the strongest predictors of student smoking initiation or intentions (Flay & Petraitis, 1994). This was followed by the social context and socio-cultural factors which are more distal and have indirect effects to youth smoking. Below are the details of how the analysis was done.

The student-level intrapersonal predictor variables included student demographic characteristics (gender and grade), amount of pocket money, behavioural (alcohol or marijuana use), tobacco-related knowledge and attitudes, self-esteem, perception of school rules and number who smoked in students' grade, school

connectedness, and anti-smoking classes. The social context variables were the smoking status of parents, siblings or peers, and rules regarding smoking in students' homes were also examined.

Six models were built to examine the student-level intrapersonal and social context variables that were associated with the dependent variables. Model 1 examined the association between the socio demographic variables (grade, gender, pocket money) and behavioural variables (self-esteem, alcohol and marijuana use) with the dependent variables. Significant variables at  $p < 0.1$  were retained for further analysis, the rest were removed. Model 2 examined the association between tobacco-related beliefs and knowledge with the dependent variable controlling for grade and gender. Predictor variables that were not significant at  $p < 0.1$  were removed one at a time until only those that met these criteria remained and were retained for further analysis. Model 3 examined the association between school connectedness (summed score) with the dependent variable controlling for grade and gender.

Model 4 examined the association between the number of anti-smoking classes a student attended with the dependent variable controlling for grade and gender. Model 5 examined the association between the social context predictor variables (parents, siblings or peers smoking status, and rules regarding smoking in students' homes) with the dependent variable controlling for grade and gender. Predictor variables that were significant at  $p < 0.1$  were retained for further analysis. Model 6 examined all the predictor variables that were retained for further analysis from models 1 to 5 in one model including grade and gender. Variables that were not significant were removed one at a time, based on the significance test values i.e., the largest  $p$  values were removed first until only those that were significant at  $p < 0.05$  remained in the model. All the significant variables were entered in the multi-level model as described in section 3.5.5.1 (specifically model 3).

### **3.5.5 Study 1: Smoking susceptibility among never smoker**

#### **3.5.5.1 Research Question 1**

In order to examine which school-level characteristics (school neighbourhood SES, location, and number of tobacco retailers) and student-level factors were associated with the likelihood of a student being a susceptible never smoker compared to a non-susceptible never smoker, a multi-level logistic regression was used. A four step modeling procedure was used.

*Model 1: To examine the random variation between-schools (Null model)*

A null model was computed to assess the proportion of the between-school variability in a never smoker's likelihood of being susceptible to smoking. The first step used PROC GLIMMIX to get initial

estimates that were used in the PROC NLMixed analysis. The latter estimates were used to calculate the intraclass correlation coefficient (ICC). If there had not been variability, a simple logistic regression could have been appropriate for analyzing the student's intrapersonal and social context predictors. But since, there was variability, the second model was developed.

*Model 2: Inclusion of direct effect of school-level predictor variables*

The previous model (Model 1) was used to determine the school-level variables (school neighbourhood SES, location, and the number of tobacco retailers surrounding school) that had a direct effect on the likelihood of a student being a susceptible never smoker compared to a non-susceptible never smoker. Each of the school variables was entered individually into the null model. That is, SES variable was entered into the null model alone to find out if it was associated with the dependent variable. Next, the school location (urban versus rural) was entered alone into model 1. The same procedure was repeated for the number of tobacco retailers surrounding the schools variable. The school-level variables that were significantly (at  $P < .05$ ) associated with the dependent variable were retained for the next level of analysis.

*Model 3: Inclusion of direct effect of school-level and student-level predictor variables*

This model was computed by entering the school-level predictor variables that were significantly associated with the dependent variable and the student-level predictor variables that were left in the final model (model 6 in the student-level analyses-see previous section 3.5.4.2) into one model. Predictor variables from the model that were not significant at  $p < .05$  were removed one at a time based on the significance test values (i.e., the largest  $p$  values were removed first) until the model only comprised of predictor variables that were significant at  $p < .05$ .

*Model 4 Final Model: Inclusion of direct effect of school-level, student-level, and contextual interaction predictor variables*

The main purpose of this final model was to assess the contextual interactions between the school-level and student-level predictor variables. Interaction models between the school-level and student-level predictor variables were computed. These interaction variables were then entered into the final model from the previous model 3. Predictor variables that were not significant at  $p < .05$  were removed (unless an interaction variable is significant) one at a time based on the significance test values (i.e., the largest  $p$  values were removed first) until the final model only comprised predictor variables that were significant at  $p < .05$ .

### **3.5.6 Study 2: Experimental smoker versus never smoker**

#### **3.5.6.1 Research Question 2**

In order to examine which school-level characteristics (school neighbourhood SES, location, and number of tobacco retailers) and student-level factors were associated with the likelihood of a student being an experimental smoker compared to a never smoker, a multi-level logistic regression was used. A similar four step modeling procedure as described in study 1 (section 3.5.5.1) was used.

### **3.5.7 Study 3: Current smoker versus an experimental smoker**

#### **3.5.7.1 Research Question 3**

In order to examine which school-level characteristics (school neighbourhood SES, location, and tobacco retailers) and student-level factors were associated with the likelihood of a student being a current smoker compared to an experimental smoker, a multi-level logistic regression was used. A similar four step modeling procedure as was described in study 1 (section 3.5.5.1) was used.

The following three chapters (Chapter 4, 5 and 6) show key results from the three studies. Results were sent to three different peer-reviewed journals and are currently under review. Permission from publishers to reprint submitted peer-reviewed manuscripts were sought and granted. A written permission was not required.

## **Chapter 4**

### **RESULTS**

**Results for study 1: We do not smoke but some of us are more susceptible than others: A multi-level analysis of a sample of Canadian youth in grades 9 to 12**

**We do not smoke but some of us are more susceptible than others: A multi-level analysis of a sample of Canadian youth in grades 9 to 12**

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## 4.1 Summary

The purpose of this paper was to examine which student- and school-level factors differentiated susceptible never smokers from non-susceptible never smokers among a nationally representative sample of Canadian students in secondary schools. We linked student-level data from the 2008/09 Canadian Youth Smoking Survey with school-level data from the 2006 Census, and one built environment characteristic, and examined this data using multilevel logistic regression analyses. The likelihood of a never smoker being susceptible to smoking significantly varied across schools [ $\sigma^2 u_0 = 0.05$  [0.01],  $P=0.0002$ ]. Our study identified that students were more likely to be susceptible never smokers if they were: in lower grades, reported low self-esteem, used alcohol or marijuana, had close smoking friends, came from homes without a total ban on smoking, and held positive attitudes towards smoking. Additionally, the number of tobacco retailers that were located within 1-km radius of each school was marginally associated with the dependent variable.

**Keywords:** Adolescents; Tobacco use; Susceptibility; Multilevel logistic regression; Factors

## **4.2 Introduction**

Experts agree that tobacco use continues to be the leading global cause of preventable illness and premature death in the world (American Lung Association, 2011; U.S. Department of Health and Human Services, 2012; World Health Organization, 2011). More than 37 000 people in Canada and 443 000 people in the United States of America die annually from tobacco-caused diseases such as cancer, respiratory infections, diabetes, and coronary heart disease (Centers for Disease Control and Prevention, 2010; Health Canada, IARC, 2004; Parkin et al., 2011). Tobacco use has also been found to be associated with alcohol use (Baumeister & Tossmann, 2005), precedes and increases the risk of illicit drug use (U.S. Department of Health and Human Services, 2012). Since nearly all (88%) first use of cigarettes occurs by 18 years of age, and the vast majority of these teens become addicted to nicotine by young adulthood (U.S. Department of Health and Human Services, 2012), an important cancer control priority is preventing adolescents from initiating tobacco use.

Existing evidence supports the theory that adolescent smoking behaviour consists of distinct smoking trajectories (Cameron et al., 1999; Chassin, Curran, Presson, Sherman, & Wirth, 2009; Mayhew, Flay, & Mott, 2000). Distinguishing adolescent smoking stages is important because tobacco control practitioners need to adapt their programs depending on the risk and protective factors of adolescents in different smoking stages. Prior to trying smoking, it has been suggested that youth who do not smoke become susceptible to trying smoking, that is, they lack a firm commitment to remain smoke-free (Pierce, Choi, Gilpin, Farkas, & Merrit, 1996). Smoking susceptibility has been found to be a strong predictor of experimental smoking (Pierce et al., 1996; Wilkinson et al., 2008). Considering that the first step of initiating smoking involves having the intention or contemplating the idea of trying smoking (U.S. Department of Health and Human Services, 2012), understanding the factors that differentiate a susceptible never smoker from a non-susceptible never smoker is critical to shaping future tobacco control programs that will dissuade students who are never smokers from smoking. Studying susceptibility is a means to that end.

### **4.2.1 School- and student-level factors associated with smoking susceptibility**

The Theory of Triadic Influence (TTI) (Flay & Petraitis, 1994) is one of the most comprehensive models that researchers have used to try to understand the complex factors and environment in which adolescents initiate and maintain smoking. The TTI postulates that youth smoking behaviour is influenced by a complex system of factors that are categorized into three “streams” of influence namely the intrapersonal

stream (individual factors), social context stream (an individual's immediate environment factor), and the socio-cultural environment stream (broader society factors) (Flay & Petraitis, 1994).

Known intrapersonal factors that are associated with smoking susceptibility among never smokers include being younger (Chen, Bottorff, Johnson, Saewyc, & Zumbo, 2008; Leatherdale, Brown, Cameron, & McDonald, 2005a; Okoli, Richardson, Ratner, & Johnson, 2009), being in a lower grade (Okoli et al., 2009; Yang, Leatherdale, & Ahmed, 2011), having positive attitudes toward smoking (Leatherdale et al., 2005a), consuming alcohol or illicit drugs (Okoli et al., 2009; Yang et al., 2011) and low self-esteem (Byrne, Byrne, & Reinhart, 1995).

The social context factors associated with smoking susceptibility among never smokers mainly includes exposure to close friends (Guindon, Georgiades, & Boyle, 2008; Leatherdale et al., 2005a; Okoli et al., 2009; Yang et al., 2011) or family members who smoke (Guindon et al., 2008; Okoli et al., 2009; Yang et al., 2011), and residing in homes where children are exposed to second-hand smoke (Guindon et al., 2008; Szabo, White, & Hayman, 2006). Broader societal factors that are known to be associated with adolescent susceptibility to smoking include the number of tobacco retailers that surround secondary schools (Chan & Leatherdale, 2011), attending a school where there was student smoking on the school periphery (Leatherdale et al., 2005a), attending schools with high prevalence of tobacco use (Guindon et al., 2008), and school-based policies and programs (Aveyard, Markham, & Cheng, 2004; Dobbins, DeCorby, Manske, & Goldblatt, 2008; Flay, 2009).

#### **4.2.2 The present study**

Although previous studies have investigated how student and school factors are associated with adolescent smoking susceptibility, little is known regarding the influence of school location (urban versus rural) and the socioeconomic status (SES) of the community surrounding a school on students' smoking susceptibility when adjusting for other student-level factors. Since these school-level factors have previously (Chuang, Ennet, Bauman, & Foshee, 2009; Doku, Koivusilta, Rainio, & Rimpela, 2010; McCarthy, Mistry, Lu, Patel, Zheng, & Dietsch, 2009) been found to be associated with occasional or daily smoking, we are interested in finding out if these factors are also associated with smoking susceptibility among adolescent never smokers. The purpose of our study was to concurrently examine which school neighbourhood factors and student-level characteristics differentiate susceptible never smokers from non-susceptible never smokers.

## **4.3 Methods**

### **4.3.1 Design**

The YSS is a valid and reliable machine-readable, pencil and paper nationally representative school-based survey that is used to measure the determinants of youth smoking behaviour (University of Waterloo, 2009). Detailed information on the sample design, procedures, methods, and survey rates for the YSS is available in Elton-Marshall and colleagues (2011b) publication. In brief, the target populations consisted of all young Canadian residents in the appropriate grades attending public and private schools in all 10 Canadian provinces; youth residing in the Territories were excluded from the target populations, as were youth living in institutions or on First Nation Reserves and youth attending special schools or schools on military bases.

The sample design was based on a stratified multistage design with schools as primary sampling units and classes as secondary sampling units. The sample design featured three levels of stratification: province, health region (schools that were located in a region that was above the median smoking rate or located in a region below the median smoking rate) and school type (elementary or secondary). Due to its size, Ontario and Alberta provinces had a third level of the health region stratum in their major metropolitan area.(University of Waterloo, 2009)

Two stages of survey weights were applied to adjust for sampling methodology and for student non-response (University of Waterloo, 2009). First a weight (W1) was computed to account for the school selection with health region and school type strata. A second weight (W2) adjusted for student non-response. The weights were then standardized to the provincial grade and gender distribution so that the total number of students in these groups would equal the actual enrolments in these groups (University of Waterloo, 2009). Parental permission was required for students to participate. The survey took about 30-40 minutes and to ensure confidentiality, questionnaires were completed anonymously and placed in an envelope that was sealed and placed in a larger classroom envelope. The University of Waterloo Office and Research and Ethics approved the YSS.(University of Waterloo, 2009)

### **4.3.2 Participants**

Our study used cross-sectional data from the 2008-09 Canadian Youth Smoking Survey (YSS) (University of Waterloo, 2009). This survey was administered to 29 296 students from grades 9 to 12 from all the 10 provinces in Canada. Our study used only a subset of students who were never smokers (n=15 982) from 133 secondary schools.

### **4.3.3 Measures**

Consistent with the 2008-09 YSS, “never smokers” (classified as “never tried” smoker in the Microdata user guide) was defined as students who reported that they had never smoked a cigarette, not even a puff (University of Waterloo, 2009). Smoking susceptibility was derived using the validated algorithm of Pierce et al. (1996). Only the “never smokers” were eligible to have a smoking susceptibility rating. Susceptibility was measured by asking students: (a) “Do you think in the future you might try smoking cigarettes?” (b) “If one of your best friends were to offer you a cigarette, would you smoke it?” and (c) “At any time during the next year do you think you will smoke a cigarette?” Students responded to these questions on a 4-point Likert Scale. Consistent with Pierce et al. (1996) students who answered ‘definitely not’ to all three questions were considered non-susceptible; the rest were considered susceptible.

All variable selection for student-level correlates was guided by TTI (Flay & Petraitis, 1994). The intrapersonal factors (gender, grade, self-esteem, alcohol, marijuana use, tobacco knowledge and attitude measures), and social context measures (friends smoking status and rules about smoking in the home) for our study were coded as listed in Table 4.1. We linked two school neighborhood characteristics namely the location (rural versus urban) and median household income with the 2008-09 YSS dataset. Consistent with previous research, (Chuang, Cubbin, Ahn, & Winkleby, 2005; Wen, Van Duker, & Olson, 2009) school location and the median household income data (proxy measure for school neighbourhood SES) was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard 2006 Census geographical areas (Statistics Canada, 2010) as described in Table 4.1.

The 2008/09 Desktop Mapping Technologies Inc. [DMTI] and the Enhanced Points of Interest [EPOI] data (ESRI, 2002) provided numeric data regarding the number of tobacco retailers that were located within a 1-km radius of each school. The EPOI data consists of a national database of more than 1.6 million Canadian business and recreational points of interest. The process of 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 school-level tobacco retailer density for each school to the student-level data from each school. Details of these measures are provided in Table 4.1.

### **4.3.4 Data analyses**

We used multi-level logistic regression (Snijders & Bosker, 1999) to analyze the data because it allows for an understanding of the separate and joint effects of student-level (level-1) and school-level (level-2)

characteristics on susceptibility to smoking among never smokers. Consistent with previous research (Leatherdale et al., 2005a; Leatherdale, Cameron, Brown, & McDonald, 2005b), we used a three-step modeling procedure. Model 1 entailed computing a null model to assess whether there was significant within-cluster interdependence to warrant the use of a multilevel approach. Model 2 was developed to determine the school-level variables that would have a direct effect on the likelihood of a student being a susceptible never smoker compared to a non-susceptible never smoker. In Model 3, the strength of the direct effects of both the school and student-level predictors was assessed using a random coefficient regression model. Predictor variables that were not significant at  $p < .05$  were removed until the final model only contained predictor variables that were significant at  $p < .05$ . All analyses used SAS 9.2 statistical package (SAS Institute Inc, 2001).

## **4.4 Results**

### **4.4.1 Student characteristics**

Of the full sample of grade 9 to 12 students ( $n=29\ 296$ ), more than half ( $n=15\ 982$ ; 54.9%) were classified as never smokers (Table 4.2). From this sample of never smokers, 29.3% ( $n=4683$ ) were categorized as *susceptible never smokers* and 70.7% ( $n=11\ 299$ ) were categorized as *non-susceptible never smokers*. Descriptive statistics comparing adolescents who were susceptible never smokers with those who were non-susceptible never smokers are shown in Table 4.2. Fifty-one percent of this sample ( $n=15\ 982$ ) were male. The prevalence of susceptible never smokers was not different by gender ( $\chi^2=2.82$ ,  $df=1$ ,  $P=0.0928$ ). Overall, the proportion of never smokers who were susceptible decreased from grade 9 to 12. The percentage of never smokers who were susceptible increased as the number of smoking friends increased from 1 to 5 friends. The proportion of susceptible never smokers who used marijuana (38.5%) or alcohol (32.6%) was higher compared to the proportion of susceptible never smokers who did not use marijuana (26.8%) or alcohol (18.9%). Table 4.2 shows a summary of other individual-level factors including, tobacco-related knowledge and attitudes, self-esteem, and rules about smoking inside homes.

### **4.4.2 School characteristics**

Sixty-nine out of 133 secondary schools were located in urban areas. The average prevalence of susceptible never smokers within a school was 27.1% (range, 0%-58.3%). The mean number of tobacco retailers within a 1-km radius of each secondary school was 5.8 (range, 0-49). The mean household income was \$56 424 (range, \$30 784-\$97 706).

#### 4.4.3 Multi-level analysis of current smoking

Table 4.3 presents results of the multi-level logistic regression analyses. The results from the null model (Model 1) showed a significant between-school random variation in the likelihood of a never smoker being susceptible to smoking [ $\sigma^2 u_0 = 0.05$  [0.01],  $P=0.0002$ ]; the school a student attended accounted for 3.9% of the variability in a student's probability of being a susceptible never smoker versus a non-susceptible never smoker.

Model 2 results showed that the number of tobacco retailers that were located within 1-km radius of each school was associated ( $P<0.05$ ) with the odds of a student being a susceptible never smoker versus a non-susceptible never smoker. Model 3 identified the student-level characteristics that were significantly associated with the odds of a student being a susceptible never smoker versus a non-susceptible never smoker when adjusting for the number of tobacco retailers surrounding the schools. Table 4.3 shows the Adjusted Odds ratios (AOR), 95% Confidence Intervals and the associated significance levels.

Model 3 suggests that there were no gender differences (AOR 1.08, 95% CI 0.99-1.17), in the likelihood of a student being a susceptible never smoker versus a non-susceptible never smoker. Overall, the odds of a student being a susceptible never smoker versus a non-susceptible never smoker increased with: belief that smoking is cool (AOR 3.71, 95% CI 2.85-4.83), belief that smoking can help people relax (AOR 1.54, 95% CI 1.41-1.68), (b) belief that smoking helps people when bored (AOR 1.42, 95% CI 1.28-1.57), (c) belief that people who smoke become more popular (AOR 1.31, 95% CI 1.13-1.51), (d) belief that smokers can quit any time they want (AOR 1.16, 95% CI 1.07-1.26), and, (e) low self-esteem (AOR 0.87, 95% CI 0.85-0.88).

The estimated odds of an alcohol user being a susceptible never smoker versus a non-susceptible never smoker was twice (AOR 2.06, 95% CI 1.85-2.29) that of a student who did not use alcohol. A marijuana smoker was more likely (AOR 1.40, 95% CI 1.26-1.56) to be a susceptible never smoker compared with students who did not smoke marijuana. The likelihood of a student being a susceptible never smoker versus a non-susceptible never smoker decreased with: (a) increasing school grades i.e., Grade 12 versus grade 9 (AOR 0.37, 95% CI 0.32-0.42) and Grade 10 versus grade 9 (AOR 0.75, 95% CI 0.68-0.84); (b) belief that there is danger to your health from an occasional cigarette (AOR 0.51, 95% CI 0.46-0.56), and (c) belief that people have to smoke many years before it will hurt them (AOR 0.74, 95% CI 0.67-0.82).

In terms of social context predictors, the odds of a student being susceptible never smoker versus a non-susceptible never smoker was not associated with having a smoking parent or sibling (results not shown). The odds of a student being a susceptible never smoker versus a non-susceptible never smoker increased significantly as the number of closest friends who smoke cigarettes increased, that is, AOR ranged from 1.33 (one close friend smokes versus no friend smokes) to AOR 1.58 (three close friends who smoke versus

no friend smokes). Students who reported that people were allowed to smoke at their home were more likely (AOR 1.36, 95% CI 1.19-1.55) to be susceptible never smokers compared to students who said that people were not allowed to smoke in their homes.

Model 3 also showed that the number of tobacco retailers that were located within 1-km radius of each school was marginally associated ( $P=0.08$ ) with the odds of a student being a susceptible never smoker versus a non-susceptible never smoker. Between-school variation remained significant even after adjusting for student-level factors.

## 4.5 Discussion

A prerequisite for the development of effective school-based smoking prevention programs or policies starts with an understanding of the factors that predispose adolescents to smoking. Our study showed four key findings. First, almost a third (29.3%) of non-smoking Canadian youth were at elevated risk of becoming future smokers because they were susceptible to smoking. This highlights the need for ongoing tobacco prevention programming strategies despite declining smoking prevalence rates among youth (U.S. Department of Health and Human Services, 2012). Second, consistent with existing research on youth smoking behaviour (Chan & Leatherdale, 2011; Leatherdale et al., 2005a; Yang et al., 2011), our study identified that the susceptible never smoker rates varied significantly across schools. Our results suggest that the characteristics of the school a student attends is related to the likelihood of a never smoker being susceptible to smoking.

Thirdly, consistent with past research (Chan & Leatherdale, 2011) the number of tobacco retailers that were located within 1-km radius of each school was marginally associated with the likelihood of a student being a susceptible never smoker versus a non-susceptible never smoker. In contrast, the other two school-level variables (location and the SES of community surrounding the schools) that we examined were inconsistent with previous research (Chuang et al., 2009; Doku et al., 2010) that reported significant associations with occasional and daily smoking.

Fourthly, students were more likely to be susceptible never smokers as opposed to non-susceptible never smokers if they were: in lower grades, reported low self-esteem, used alcohol or marijuana, had close friends who smoked, came from homes without a total ban on smoking, and held positive attitudes towards smoking. We will explore some plausible explanations and implications of our findings.

#### **4.5.1 School-level factors and implications**

Contrary to previous literature (Chuang et al., 2009; Doku et al., 2010) on factors related to smoking, our study identified that the location of the schools (urban versus rural) and the socioeconomic status of the neighbourhoods where the schools were located were not associated with the likelihood of a student being a susceptible never smoker versus a non-susceptible never smoker. These may have been due to the fact that the aforementioned studies (Chuang et al., 2009; Doku et al., 2010) examined students who had initiated smoking (occasional or daily smokers) unlike our study that focused on never smokers. Thus, our findings suggest that out of the three school-level variables examined; only the number of tobacco retailers that surround the secondary schools seems to be important in predicting susceptibility. Perhaps school location and the SES of neighbourhood where secondary schools are located are more critical for students who have already initiated tobacco use (Chuang et al., 2005; Henriksen, Feighery, Schleicher, Cowling, McCarthy et al., 2009; Novak, Reardon, Raudenbush, & Buka, 2006; Pearce, Hiscock, Moon, & Barnett, 2009; West et al., 2010) and not students who are still contemplating whether to begin smoking or not.

The finding regarding the number of tobacco retailers located within a 1-km radius of each school warrants attention because although we found a marginally association with our dependent variable, other studies have found stronger associations between the number of tobacco retailers and adolescent smoking susceptibility (Chan & Leatherdale, 2011), experimentation (McCarthy et al., 2009), and current smoking (Henriksen et al., 2008; West et al., 2010). These findings support earlier (Chan & Leatherdale, 2011; Henriksen et al., 2008; McCarthy et al., 2009; Pearce et al., 2009) appeals that urge policy makers to back policies that prevent tobacco retailers from being situated close to schools. Longitudinal studies need to be conducted among susceptible never smokers and non-susceptible never smokers to verify our cross-sectional findings which are limited by temporal sequence.

#### **4.5.2 Student-level intrapersonal and social context factors**

Our study identified several student intrapersonal or social context factors that differentiated susceptible never smokers from non-susceptible never smokers. In terms of our intrapersonal findings, consistent with previous research (Kawabata, Cross, Nishioka, & Shimai, 1999), our study found that students with high self-esteem were less likely to be susceptible never smokers. A low self-esteem implies self-dissatisfaction and self-rejection, and has been known to predispose adolescents to adopt risky behaviours including cigarette smoking (Connor, Poyrazli, Ferrer-Wreder, & Grahame, 2004; Wild, Flisher, Bhana, & Lombard, 2004).

Consistent with previous research (Anderson, Pollak, & Wetter, 2002; Leatherdale et al., 2005a) and TTI (Flay & Petraitis, 1994), students who reported attitudes and beliefs that were pro-smoking (e.g., believing that smoking relieves boredom or helps people relax) were more likely to be susceptible never smokers. Our study found that knowing that there is danger to your health from an occasional cigarette or knowing that people have to smoke for many years before it harms them were protective factors as was found in other studies (Anderson et al., 2002). Adolescents' perceptions and beliefs represent the most proximal level of influence because it reflects the adolescent's basic personality, that is, whether they are able to resist pressures to initiate smoking behaviour (Flay & Petraitis, 1994).

Our empirical finding that students who used marijuana and alcohol were at increased risk of being susceptible never smokers (vs. non-susceptible never smokers) is consistent with existing research (Okoli et al., 2009; Yang et al., 2011). These findings also support what is known about adolescent multi-substance or multi-risk behaviour (Elton-Marshall, Leatherdale, & Burkhalter, 2011a; Leatherdale & Ahmed, 2010; Okoli, Richardson, Ratner, & Johnson, 2008; Ringwalt et al., 2008; Wiefferink et al., 2006) and emphasis on multifaceted integrated intervention strategies that targets substance abuse in addition to tobacco prevention.

Our social context finding regarding having friends who smoked is consistent with existing evidence (Guindon et al., 2008; Leatherdale et al., 2005a; Yang et al., 2011) and TTI (Flay & Petraitis, 1994). TTI claims that an adolescent's behaviour is influenced by their immediate social environment such as having smoking friends or family members who reinforce the behaviour and model the outcomes associated with the behaviour (Flay & Petraitis, 1994). However, our study did not find support for the influence of smoking family members which is inconsistent with TTI and previous studies (Guindon et al., 2008; Okoli et al., 2009). It appears that secondary school students who are susceptible to smoking tend to be influenced more significantly by their peers and the influence of parents and siblings declines with age.

Generally, having friends who smoke creates more opportunities for offers of cigarettes (Baumeister & Tossman, 2005), makes smoking appear more normative and may make a student more likely to want to experiment with smoking (Bandura, 1986). Consistent with existing research (Okoli et al., 2009; Szabo et al., 2006), our study showed that students who reported that people were allowed to smoke in their homes were more likely to be susceptible never smokers compared to students who reported the opposite.

Our finding that the odds of a student being a susceptible never smoker versus a non-susceptible never smoker decreased with increasing grades was consistent with previous research (Chan & Leatherdale, 2011; Chen et al., 2008; Leatherdale et al., 2005a; Okoli et al., 2009). These may be likely due to the fact that the students in higher grades may already have initiated smoking and thus are no longer susceptible (Chan & Leatherdale, 2011). Unlike previous evidence (Chen et al., 2008; Leatherdale et al., 2005a; Okoli

et al., 2009; Unger, Rohrbach, Howard-Pitney, Ritt-Olson, & Mouttapa, 2001; Yang et al., 2011) on susceptible adolescents, our study showed that the odds of a student being a susceptible never smoker versus a non-susceptible never smoker was not associated with gender.

#### **4.5.3 Implications of the student-level intrapersonal and social context factors**

The intrapersonal and social context results underscores the continued need to develop school-based tobacco use prevention policies and/or programs that: enhance students' self-esteem; are grade-sensitive, address tobacco use misinformation and substance use, and include interventions targeting smoking friends, and students that come from homes without rules prohibiting smoking in home. Students also need to be encouraged to pursue friendships with non-smoking peers who will model the benefits of being tobacco free. Smoking prevention policies and programs also need to be tailored to cater for students in different smoking stages (Cameron et al., 1999; Chassin et al., 2009; Mayhew et al., 2000). Additional resources may be required to design interventions for never smokers who have low self-esteem because it is associated with acquisition of several risk factors including tobacco use (Connor et al., 2004; Kawabata et al., 1999; Wild et al., 2004). Our findings also highlight the need to ensure that smoking prevention strategies in secondary schools target both the never smokers who are susceptible to smoking and also their smoking peers that put them at greatest risk (Leatherdale et al., 2005b; Leatherdale et al., 2005c). These findings stress the importance of reaching out to students who come from homes without rules prohibiting smoking in home.

In order to mitigate youth risk behaviours such as the use of alcohol or marijuana, and to change misinformation regarding tobacco use, our study supports emerging consensus that schools curricula should use a comprehensive approach (Joint Consortium for School Health., 2009) which consists of four pillars; teaching and learning; school policies; social and physical environment; and community partnerships and services. This comprehensive approach caters for both the academic needs of a student and also targets his/her immediate social and physical environments which are known to predispose adolescents to experimenting with cigarettes (Flay & Petraitis, 1994). Moreover, research has shown that this approach (Joint Consortium for School Health., 2009) is also effective in creating a school culture that gives students a sense of belonging, boosts their self-esteem, equips them with relevant anti-smoking knowledge and skills to resist substance use, and links them with community resources that deters never smokers from initiating smoking.

#### **4.5.4 Limitations**

Our study has several strengths and limitations. The strengths include the use of nationally representative data of Canadian adolescents in different smoking stages. The study is also guided by a relevant theory i.e., TTI which is a comprehensive theory that offers testable predictions and insights regarding the causes of health-related behaviours including tobacco use (Flay & Petraitis, 1994). For our data analysis, we used a 2-level multi-level logistic regression which is an appropriate method because it accounts for the clustering of students within the same school, and thus produces accurate standard errors and reduces the likelihood of Type 1 error (Snijders & Bosker, 1999).

The use of cross-sectional data limits the results to associations only. Future studies employing longitudinal data would permit a better examination of causal inferences. While self-report data employed are subject to response bias, in the YSS, efforts were taken to ensure student confidentiality and that the data was reliable and valid (Cameron et al., 2007; Elton-Marshall et al., 2011b; Lovato et al., 2010) The exclusive reliance on Census data for school SES (proxy measure) has been criticized, instead of the use of multiple neighbourhood measures such as physical and socio-demographic indicators are preferred (Chuang et al., 2005).

#### **4.5.5 Conclusions**

Our study showed that smoking susceptibility rates varied across Canadian secondary schools. The number of tobacco retailers that were located within 1-km radius of each school was marginally associated with the odds of a student being a susceptible never smoker versus a non-susceptible never smoker. In contrast, the other two school-level variables (i.e., school location and the SES of community surrounding the schools) that we examined were not associated with smoking susceptibility when adjusting and even when not adjusting for student-level factors. Our results showed that students were more likely to be susceptible never smokers as opposed to non-susceptible never smokers if they were: in lower grades, reported low self-esteem, used alcohol or marijuana, had close friends who smoked, came from homes without rules prohibiting smoking in home, and held positive attitudes towards smoking, specifically if they believed that smoking is cool, helps people relax, relieves boredom, and makes people more popular, and that smokers can quit any time they want. A better understanding of these school and student factors will provide new insight for public health practitioners interested in developing effective smoking prevention strategies that target youth in different stages of smoking in the future.

## **Acknowledgements**

The Youth Smoking Survey is a product of the pan-Canadian capacity building project funded through a contribution agreement and contract between Health Canada and the Propel Centre for Population Health Impact from 2004 to 2011. The YSS consortium includes Canadian tobacco control researchers from all provinces and provided training opportunities for university students at all levels. The views expressed herein do not necessarily represent the views of Health Canada. Dr. Scott Leatherdale is a Cancer Care Ontario Research Chair in Population Studies funded by the Ontario Ministry of Health and Long-term Care.

## **Conflict of interest statement**

None to declare.

Table 4.1: A list of the variables included in the analysis

TTI domain	Specific question asked or how variable was derived	Coding for analysis
<b>Intrapersonal factors</b>		
Gender	Are you female or male?	0=female and 1=Male
Grade	What grade are you in?	9, 10, 11, 12
Alcohol use	In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? Options included: 1 = I have never drank alcohol, 2 = I did not drink alcohol in the last 12 months, 3 = I have only had a sip of alcohol, 4 = Every day, 5 = 4 to 6 times a week, 6 = 2 or 3 times a week, 7 = Once a week, 8 = 2 or 3 times a month, 9 = Once a month, 10 = Less than once a month, 11 = I do not know-was not a valid response, so these students were not included in the analyses)	0 = I have never drank alcohol 1= Any use (option 2 to 10)
Marijuana use	In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...). Options included: 1 = I have never used marijuana, 2 = I have used marijuana but not in the last 12 months, 3 = Every day, 4 = 4 to 6 times a week, 5 = 2 or 3 times a week, 6 = Once a week, 7 = 2 or 3 times a month, 8 = Once a month, 9 = Less than once a month, 10 = I do not know -not a valid response)	0 = I have never used marijuana 1= Any use (option 2 to 9)
<b>Knowledge</b>		
	Do people have to smoke many years before it will hurt them?	0=No or I don't know 1=yes
	Is there danger to your health from an occasional cigarette?	0=No or I don't know 1=yes
	Can smokers quit any time they want?	0=No or I don't know 1=yes
<b>Beliefs</b>		
	Can smoking help people when they are bored?	0=No or I don't know 1=yes
	Do people who smoke become more popular?	0=No or I don't know 1=yes
	Do you think smoking is cool?	0=No or I don't know 1=yes
Self-esteem	This a derived value from the Rosenberg Self-Esteem scale (Rosenberg, 1965) to measure overall self-esteem using 3 questions. Students were asked to respond to these questions: 1) In general, I like the way I am, 2) When I do something, I do it well, 3) I like the way I look. The responses were given on a 5-point Likert Scale i.e., true, mostly true, sometimes true/sometimes false, mostly false and false and recoded into numeric values as shown in column three. These values were summed up to give a final score that ranged from 0-12. A higher score represented a higher self-esteem.	0 = False 1 = Mostly false 2 = Sometimes false / sometimes true 3 = Mostly true 4 = True
<b>Social context</b>		
Friends smoke	How many of your closest friends smoke cigarettes? Options included 0, 1, 2, 3, 4, 5 or more friends	0=0, 1=1, 2=2, 3=3, 4=4, 5=5 or more
Smoking rules in the home	What are the rules about smoking in your home? Options included 1=No one is allowed to smoke in my home, 2= special guests, 3=people are allowed to smoke only in certain areas, 4=people are allowed to smoke anywhere in home	0=No one is allowed to smoke in my home 1= People are allowed (option 2 to 4)

TTI domain	Specific question asked or how variable was derived	Coding for analysis
Number of people who smoke at home	Excluding yourself, how many people smoke inside your home every day or almost every day? Options included 1=None, 2=1 person, 3=2 people, 4=3 people, 5=4 people, 6=5 or more people	0= None smokes 1=One or more than one
<b>Socio-cultural factors</b>		
Location of school (rural versus urban)	School location was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard Census geographical areas (Statistics Canada, 2010). Areas that consist of populations of 50,000 and above are considered to be urban, the rest are rural	0=rural 1=urban
SES of neighbourhood where schools are located	Median household income: The 2006 Census median household income data was used as a proxy measure for school-level socioeconomic status (SES) as has been done in previous studies (Chuang et al., 2005). This variable was a continuous variable and the unit change was in intervals of \$10,000 CAD for ease of interpretation.	Numeric data by units of \$10,000
Tobacco retailer density	The 2008/09 Desktop Mapping Technologies Inc. [DMTI] and the Enhanced Points of Interest [EPOI] data provided numeric data regarding the number of tobacco retailers that were located within a 1-km radius of each school. The EPOI data file consists of a national database of more than 1.6 million Canadian business and recreational points of interest <a href="http://www.dmtispatial.com">http://www.dmtispatial.com</a> .  The DMTI-EPOI data was obtained through geocoding the address for each school that participated in the YSS using Arcview 3.3 software (ESRI, 2002). This was followed by creating a 1-Km buffer to assess how many tobacco retailers were located within these buffers (i.e., radius surrounding each school in which the different structures of the built environment were quantified). A 1-Km radius was selected because it is estimated that it is representative of the distance most high school students would walk to and from their school (Chuang et al., 2005)	Numeric (each 1 unit change)

Table 4.2: Descriptive statistics (weighted) for secondary student sample who were susceptible never smokers (n=4683) and non-susceptible never smokers (n=11 299)

Characteristics		susceptible never smokers % (n=4683)	non-susceptible never smokers % (n=11 299)	Chi square (weighted $\chi^2$ )
<b>Gender</b>				
	Male	29.9%	70.1%	$\chi^2=2.82$ , df =1, $P =0.0928$
	Female	28.7%	71.3%	
<b>Grade</b>				
	Grade 9	34.5%	65.5%	$\chi^2=192.69$ , df =3, $P <.0001$
	Grade 10	30.6%	69.4%	
	Grade 11	28.7%	71.3%	
	Grade 12	20.0%	80.0%	
<b>Alcohol use</b>				
	No	18.9%	81.1%	$\chi^2= 262.66$ , df =1, $P <.0001$
	Yes	32.6%	67.4%	
<b>Marijuana use</b>				
	No	26.8%	73.2%	$\chi^2=149.98$ , df =1, $P <.0001$
	Yes	38.5%	61.5%	
<b>Knowledge on tobacco</b>				
Do people have to smoke many years before it will hurt them?				
	No	38.4%	61.6%	$\chi^2= 164.34$ , df =1, $P <.0001$
	Yes	26.9%	73.1%	
Is there a danger to your health from an occasional cigarette?				
	No	40.7%	59.3%	$\chi^2= 327.71$ , df =1, $P <.0001$
	Yes	25.4%	74.6%	
Can smokers quit any time they want?				
	No	27.3%	72.7%	$\chi^2= 20.8$ , df =1, $P <.0001$
	Yes	30.6%	69.4%	
<b>Beliefs</b>				
Can smoking help people when they are bored?				
	No	25.7%	74.3%	$\chi^2= 349.21$ , df =1, $P <.0001$
	Yes	42.6%	57.4%	
Does smoking help people relax?				
	No	23.5%	76.5%	$\chi^2= 297.85$ , df =1, $P <.0001$
	Yes	36.2%	63.8%	
Do people who smoke become more popular?				
	No	28.1%	71.9%	$\chi^2= 119.16$ , df =1, $P <.0001$
	Yes	42.7%	57.3%	
Do you think smoking is cool?				
	No	28.3%	71.7%	$\chi^2= 256.66$ , df =1, $P <.0001$
	Yes	65.5%	34.5%	
<b>Mean self-esteem score (SD)</b>		8.89 (2.18)	9.55 (1.95)	$t=18.86$ , $P <.0001$

**Number of smoking friends**

Yes, 0	25.9%	74.1%	$\chi^2=237.74, df=5, P <.0001$
Yes, 1	35.3%	64.7%	
Yes, 2	37.3%	62.7%	
Yes, 3	41.9%	58.1%	
Yes, 4	31.7%	68.3%	
Yes, 5	42.2%	57.8%	

**What are the rules about smoking  
in your home**

No one is allowed to smoke	27.9%	72.1%	$\chi^2=55.76, df=1, P <.0001$
People are allowed to smoke	34.8%	65.2%	

**How many people smoke inside  
your home every day or almost  
every day?**

None (0)	28.7%	71.3%	$\chi^2=17.38, df=1, P <.0001$
One or more people (>0)	33.0%	67.0%	

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Table 4.3: Multi-level logistic regression analysis of the student- and school-level variables that are related to the odds of being a susceptible never smoker versus a non-susceptible never smoker

Characteristics		Model 1	Model 2	Model 3	Final model (Model 3)	
		Model Estimates (Standard Error)			Adjusted Odds Ratios (95% CI)	P Values
Fixed Intercept		-0.96 (0.03)	-0.92 (0.03)	0.27 (0.12)		
<b>Intrapersonal factors</b>						
Gender	Female (Ref)	-				
	Male			0.07 (0.04)	1.08 (0.99, 1.17)	0.0839
Grade	Grade 9 (Ref)	-				
	Grade 10			-0.29 (0.05) **	0.75 (0.68, 0.84)	<.0001
	Grade 11			-0.57 (0.06) **	0.57 (0.51, 0.63)	<.0001
	Grade 12			-0.99 (0.07) **	0.37 (0.32, 0.42)	<.0001
Do you think smoking is cool?						
	No (Ref)	-				
	Yes			1.31 (0.14) **	3.71 (2.85, 4.83)	<.0001
Does smoking help people relax?						
	No (Ref)	-				
	Yes			0.43 (0.04) **	1.54 (1.41, 1.68)	<.0001
Can smoking help people when they are bored?						
	No (Ref)	-				
	Yes			0.35 (0.05) **	1.42 (1.28, 1.57)	<.0001
Do people who smoke become more popular?						
	No (Ref)	-				
	Yes			0.27 (0.07) *	1.31 (1.13, 1.51)	0.0002
Can smokers quit any time they want?						
	No (Ref)	-				
	Yes			0.15 (0.04) *	1.16 (1.07, 1.26)	0.0004
Do people have to smoke many years before it will hurt them?						
	No (Ref)	-				
	Yes			-0.30 (0.05) **	0.74 (0.67, 0.82)	<.0001
Is there a danger to your health from an occasional cigarette?						
	No (Ref)	-				
	Yes			-0.67 (0.05) **	0.51 (0.46, 0.56)	<.0001
Alcohol use	No (Ref)	-				
	Yes			0.72 (0.05) **	2.06 (1.85, 2.29)	<.0001
Marijuana use	No (Ref)	-				
	Yes			0.34 (0.06) **	1.40 (1.26, 1.56)	<.0001
	Self-esteem score			-0.14 (0.01) **	0.87 (0.85, 0.88)	<.0001
<b>Social Context factors</b>						
	No friend smokes (Ref)	-				
	1 friend smokes			0.29 (0.06) **	1.33 (1.18, 1.50)	<.0001
	2 Friends smoke			0.44 (0.08) **	1.56 (1.34, 1.81)	<.0001
	3 Friends smoke			0.46 (0.10) **	1.58 (1.29, 1.94)	<.0001
	4 Friends smoke			0.11 (0.18)	1.11 (0.78, 1.59)	0.5584
	5 friends smoke			0.39 (0.09) **	1.48 (1.24, 1.77)	<.0001

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What are the rules about smoking in your home?				
No one is allowed to smoke (Ref)	-			
People are allowed to smoke		0.30 (0.07) **	1.36 (1.19, 1.55)	<.0001
How many people smoke inside your home				
No one smokes (Ref)	-			
One or more people smoke inside		-0.26 (0.08) *	0.77 (0.67, 0.89 )	0.0005
<b>School-level factors (examined one at a time)</b>				
Location	Rural (Ref)	-	-	
	Urban		0.10 (0.06)	
Tobacco retailer density		0.08 (0.04)*	0.01 (0.004)	1.01 (1.00, 1.02 ) 0.0800
Median household income (each \$10,000 unit change)		0.037 (0.02)		
Random variance	0.05 (0.01)	0.048 (0.01)	0.035 (0.01)	0.035 (0.01)
	<i>P</i> =0.0002			
<hr/>				
<b>Intra-Class Correlation (a)</b>	0.0153			
$\frac{\sigma^2_u}{\sigma^2_u + \pi^2/3}$	(1.53%)			
<b>Explained variance (b)</b>		4.3%	31.0%	31.0%
<hr/>				
(a) Measures of the proportion of the total variance that occurs between-schools				
(b) Proportion of variance between schools explained by the school-level predictor variables.				
** <i>P</i> <0.0001				
* <i>P</i> <0.05				
Ref: This is the reference category				

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## **Chapter 5**

**Results for study 2: What differentiates experimental smokers from their non-smoking classmates? A multi-level analysis of Canadian youth in grades 9 to 12**

## **What differentiates experimental smokers from their non-smoking classmates? A multi-level analysis of Canadian youth in grades 9 to 12**

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## 5.1 Summary

**Background:** Adult smoking typically commences as naïve experimentation during adolescence.

Understanding the characteristics of experimental smoking among youth is critical in designing prevention programs that will deter adolescents from experimenting. This study examined which student- and school-level factors differentiated experimental smokers from never smokers among a nationally representative sample of Canadian students in grades 9 to 12.

**Methods:** Student-level secondary data from Canada's nationally representative 2008-2009 Youth Smoking Survey was linked with school-level data from the 2006 Census, and one built environment characteristic, and examined using multi-level logistic regression analyses.

**Results:** Experimental smoking rates varied [ $\sigma^2 u_0 = 0.23 [0.05]$ ,  $P < 0.0001$ ] across schools. The location (AOR 0.62, 95% CI 0.46-0.82) of the school (urban vs. rural) and the neighbourhood SES (AOR 0.88, 95% CI 0.79- 0.98) where schools were located were associated with odds of a student being an experimental smoker versus a never smoker when adjusting for student characteristics. Students were more likely to be experimental smokers if they were in grades 10 or 11, reported low school connectedness, used alcohol or marijuana, believed that smoking can help people relax, received pocket money each week, and had a family member or close friend who smoked cigarettes.

**Conclusions:** Findings suggest that school-based tobacco prevention programs need to be grade-sensitive, increase students' attachment to their school, address substance use, tobacco-related beliefs and use of pocket money. They should also include interventions targeting smoking friends and family members. Schools located in rural areas or low SES neighbourhoods may require additional resources.

**Keywords:** Tobacco use, Adolescents, Experimental smoking, Multi-level logistic regression, Canada

## 5.2 Introduction

Despite the evidence of the harmful outcomes of smoking, youth smoking rates remain high in North America (American Lung Association, 2011; Health Canada, 2011; U.S. Department of Health and Human Services, 2012; World Health Organization, 2011). Estimates indicate that more than 16% and 20% of all annual deaths in Canada and the United States (U.S.) respectively result from tobacco-related diseases (Centers for Disease Control and Prevention, 2010; Health Canada, 2011; Parkin et al., 2011).

Lifetime smoking often commences as naïve experimentation during adolescence which frequently develops into a strong addictive habit that is difficult to break (DiFranza et al., 2007). Research shows that nearly all (88%) of established regular adult smokers initiated smoking during their teenage years (U.S. Department of Health and Human Services, 2012). Researchers support the concept that adolescent smoking behaviour consists of distinct smoking trajectories (Cameron et al., 1999; Chassin, et al., 2009; Mayhew et al., 2000). Characterizing adolescent smoking stages is important because public health practitioners and educators need to design their prevention and intervention programs to match the risk and protective factors of adolescents in different smoking stages (e.g., susceptible never smoker, experimenter, regular and established/daily smoker).

A majority of studies focus on regular and established smoking stages (e.g. Chassin et al., 2008; Hutchinson et al., 2008; Lovato et al., 2007; Murnaghan et al., 2008; Murnaghan et al., 2009; Sabiston et al., 2009; Watts et al., 2010). A focus on the other smoking stages, such as experimental smoking could advance the field. Considering that approximately 70-75% of students will experiment with a cigarette at least once before completing grade 12 (Centres for Disease Control and Prevention, 2003; Orlando et al., 2004) and about a third of these adolescents will progress to current smoking (Substance Abuse and Mental Health Services Administration, 2007), understanding the factors that differentiate experimental smokers from never smokers is critical to informing the development of future tobacco-control programs that will discourage students who do not smoke from experimenting with cigarettes.

Many researchers have used the Theory of Triadic Influence (TTI) (Flay and Petraitis, 1994) to understand the complex factors associated with adolescent smoking behaviour. TTI postulates that youth smoking behaviour is influenced by a combination and interaction of intrapersonal, social context, and broader societal influences. Reported intrapersonal risk factors associated with increased risk for experimental smoking include being younger (O'Loughlin et al., 2009), low refusal self-efficacy (Ma et al., 2008), consuming alcohol or illicit drugs (O'Loughlin et al., 2009), access to pocket money (Mohan, 2005), low school connectedness (Bond et al., 2007), perceiving clear school rules about smoking (Leatherdale et al., 2005b), and reporting positive attitudes towards smoking (Brady et al., 2008). Existing social context influences mainly include exposure to smoking by family members (Ma et al., 2008; O'Loughlin et al.,

2009) or friends who smoke (Grenard et al., 2006; Leatherdale et al., 2005b; O’Loughlin et al., 2009), and residing in homes without a smoking ban (Szabo et al., 2006).

The broader societal factors that are associated with experimental smoking include attending a school with a relatively high smoking rate in senior grades (Leatherdale et al., 2005b) and high density of retailers in urban schools (McCarthy et al, 2009). Other societal factors associated with *established* (not experimental) smoking include school location (Chuang et al., 2009; Pearce et al., 2009; Sellstrom and Bremberg, 2006), neighborhood socioeconomic status (SES) (Chuang et al., 2009; Doku et al., 2010; Duncan et al., 1999; Pearce et al., 2009), and school-based policies and/or programs (Aveyard et al., 2004; Dobbins et al., 2008; Flay, 2009; Lovato et al., 2007; Lovato et al., 2010; Murnaghan et al., 2007; Murnaghan et al., 2008; Murnaghan et al., 2009; Park et al., 2010; Sabiston et al., 2009).

Nevertheless, little is known regarding the influence of school location (urban versus rural), tobacco retailer density, and the SES of the community surrounding a school on students’ experimental smoking when adjusting for other student-level factors. Since these school-level factors have previously been found to be associated with *established* smoking (Chuang et al., 2009; Doku et al., 2010; Duncan et al., 1999; Henriksen et al., 2008; Novat et al., 2006; Pearce et al., 2009; Sellstrom and Bremberg, 2006; West et al., 2010), the present study was interested in finding out if these factors are also associated with *experimental* smoking among adolescents. The purpose of this study was to examine which school neighbourhood and student-level characteristics differentiate experimental smokers from never smokers. Understanding these factors will contribute to existing knowledge and provide new insight for public health practitioners and educators interested in developing effective smoking prevention strategies that target youth in different stages of smoking in the future.

## **5.3 Methods**

### **5.3.1 Design**

The 2008-2009 Youth Smoking Survey (2008 YSS) is a valid and reliable machine-readable, pencil and paper nationally representative school-based survey that is used to measure the determinants of youth smoking behaviour (University of Waterloo, 2009). See Elton-Marshall et al (2011b) for detailed information on the survey development, design, survey weights and data collection protocol for the 2008 YSS. In brief, the target populations consisted of all young Canadian residents in the appropriate grades attending public or private schools in all 10 Canadian provinces; youth residing in the Territories were excluded from the target populations, as were youth living in institutions or on First Nation Reserves and youth attending special schools or schools on military bases. The sample design was based on a stratified

multistage design. Two stages of survey weights were applied to adjust for sampling methodology and for student non-response (Elton-Marshall, 2011b; University of Waterloo, 2009). Parental permission was required for students to participate. The survey took about 20-30 minutes and to ensure confidentiality, completed questionnaires were placed in an envelope that was sealed and placed in a larger classroom envelope. The University of Waterloo Office and Research and Ethics approved survey methods. Refer to [www.yss.uwaterloo.ca](http://www.yss.uwaterloo.ca) for additional details on the 2008 YSS methods.

### **5.3.2 Participants**

The secondary school portion of 2008 YSS was administered to 29,296 grades 9 to 12 students attending 133 schools from all 10 Canadian provinces. The present study used only the subset of 18,072 students who were experimental or never smokers.

### **5.3.3 Data sources and measures**

*2.3.1. Outcome variables.* Consistent with previous research (Cameron et al., 2007; Lovato et al., 2007; Lovato et al., 2010; McCarthy et al., 2009) “experimental smokers” were defined as any students who had smoked in the last 30 days preceding the survey but had not smoked 100 cigarettes in their lifetime. This group was compared with “never smoker” students defined as students who reported that they had never smoked a cigarette, not even a puff.

*2.3.2. Student- and school-level predictors.* All variable selection was guided by TTI (Flay and Petraitis, 1994). The intrapersonal factors (gender, grade, alcohol, marijuana use, pocket money, school connectedness, tobacco knowledge and attitude measures, and perception of school smoking rules) and social context measures (parents, siblings and friends smoking status) were coded as listed in Table 5.1. Two school neighbourhood characteristics (location and median household income) were linked with the 2008 YSS dataset. Consistent with previous research (Chuang et al., 2005; Wen et al., 2009), school location and the median household income data (proxy measure for school neighbourhood SES) was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard 2006 Census geographical areas (Statistics Canada, 2010) as described in Table 5.1. The 2008/09 Enhanced Points of Interest [EPOI] data file from Desktop Mapping Technologies Inc. [DMTI] (ESRI, 2002) provided numeric data regarding the number of tobacco retailers located within a 1-km radius of each school (Table 5.1).

### 5.3.4 Statistical data analyses

Multi-level logistic regression (Snijders and Bosker, 1999) was used to analyze the data because it allows for an understanding of the separate and joint effects of student-level (level-1) and school-level (level-2) characteristics on experimental smoking. Consistent with previous research (Leatherdale et al., 2005b), a four-step modeling procedure was used. Model 1 entailed computing a null model to assess whether there was significant within-cluster interdependence to warrant the use of a multilevel approach. Model 2 was developed to determine the school-level variables that would have a direct effect on the likelihood of a student being an experimental smoker compared to a never smoker. In Model 3, the strength of the direct effects of both the school- and student-level predictors was assessed using a random coefficient regression model. The main purpose of the final model (Model 4) was to assess the contextual interactions between the school-level and student-level predictor variables. Predictor variables that were not significant at  $p < .05$  were removed until the final model only contained predictor variables that were significant at  $p < .05$ . All analyses used SAS 9.2 statistical package (SAS Institute Inc, 2001).

## 5.4 Results

### 5.4.1 Student- and school-level characteristics

Of the full sample of grade 9 to 12 students, 16,044 (54.8%) were classified as *never smokers* and 2028 (6.9%) were classified as *experimental smokers*. Table 5.2 shows descriptive statistics comparing adolescents who were experimental smokers with those who were never smokers. Fifty-one percent of the sample was male. The prevalence of experimental smoking was not different by gender ( $\chi^2=0.02$ ,  $df=1$ ,  $p=0.8941$ ). With that exception, all other student characteristics tested were significant. The proportion of students who were experimental smokers increased: from grade 9 to 12; as the number of smoking friends increased from 1 to 5 friends; and as the amount of pocket money given to students to spend increased (Table 5.2). The percentage of students who used marijuana (36.8%) or alcohol (14.2%) who are experimenters was strikingly higher compared to the percentage of students who did not use marijuana (2.4%) or alcohol (1%) who are experimenters.

Sixty-nine out of 133 secondary schools (total sample) were located in urban areas. The average experimental smoking rate among grade 9-12 students in the 133 secondary schools was 6.2% (range, 0%-17.4%). The average experimental smoking rate was lower in urban schools (5.7%) versus rural schools (6.6%). The percentage of students (11.1%;  $n=1325/11,977$ ) in urban schools who were experimental smokers was not significantly different compared with the percentage of students in rural schools (11.5%;  $n=703/6095$ ) who were experimental smokers. The mean number of tobacco retailers within a 1-Km radius

of the secondary schools was 5.8 (range, 0-49). The mean of the household income was \$56,424 (range, \$30,784-\$97,706).

#### 5.4.2 Multi-level analysis of current smoking

Table 5.3 presents results of the multi-level logistic regression analyses. The results from the null model (Model 1) showed a significant between-school random variation in the likelihood of experimental smoking among grade 9 to 12 students [ $\sigma^2 u_0 = 0.23$  [0.05],  $P < 0.0001$ ] where the estimates suggest that the school a student attended accounted for 6.5% of the variability in their likelihood of being an experimental smoker versus a never smoker. Model 2 results showed that school location was important, as students in urban schools were less likely to be experimental smokers (vs. never smoker) ( $B = -0.30$ ;  $SE = 0.10$ ;  $P = 0.0042$ ) compared to students in rural schools. This neighbourhood characteristic explained 12% of the between-school variability in the likelihood of a student being an experimental smoker. The number of tobacco retailers within a 1-km radius surrounding a school was not associated with experimental smoking ( $P = 0.5295$ ). Additionally, the median household income that was used as a proxy measure for school neighbourhood SES was marginally associated with the likelihood of a student being an experimental smoker versus a never smoker ( $B = -0.07$ ;  $SE = 0.04$ ;  $P = 0.1006$ ).

Model 3 identified the student-level characteristics that were significantly associated with the odds of a student being an experimental smoker when adjusting for school-level characteristics. As shown in Model 3 of Table 5.3, the location (AOR 0.62, 95% CI 0.46-0.82) of the school (urban vs. rural) and the neighbourhood SES (AOR 0.88, 95% CI 0.79- 0.98) where schools were located were significantly associated with the odds of a student being an experimental smoker even after adjusting for the student-level individual characteristics. None of the contextual interactions in Model 4 (results not shown) were associated with the outcome variable. The final model suggests that there were no gender differences (AOR 1.00, 95% CI 0.86-1.16), in the likelihood of a student being an experimental smoker versus a never smoker. The odds of a student being an experimental smoker decreased when a student attended a school in an urban area (AOR 0.62, 95% CI 0.46-0.82) or in a neighbourhood with a higher SES (AOR 0.88, 95% CI 0.79-0.98) compared to a student who attended a school that was located in a rural area or in a neighbourhood with lower SES.

In terms of student-level findings, being in a grade lower than 12 decreased the likelihood of being an experimental smoker (versus a never smoker) i.e., Grade 10 versus grade 9 (AOR 0.74, 95% CI 0.60-0.92); Grade 11 versus grade 9 (AOR 0.70, 95% CI 0.56-0.88). On the other hand, the odds of a student being an experimental smoker versus a never smoker increased with: (a) the amount of pocket money students had available to spend i.e., students who reported CD\$1-\$20 versus no pocket money (AOR 1.59, 95% CI 1.20-

2.11); students who reported having more than CD \$100 versus no pocket money (AOR 2.22, 95% CI 1.66-2.98), (b) belief that smoking can help people relax (AOR 3.37, 95% CI 2.86-3.97), (c) a student's perception that there were clear school rules on smoking (AOR 1.56, 95% CI 1.27-1.92), (d) low school connectedness (AOR 0.87, 95% CI 0.83-0.92) and (e) alcohol use (AOR 3.51, 95% CI 2.41-5.12). Marijuana use appears very important as the odds of a student being an experimental smoker was more than 15 times higher (AOR 15.4, 95% CI 12.9-18.2) if a student reported using marijuana.

In terms of social context predictors, a student who reported that their parents (AOR 1.30, 95% CI 1.11-1.51) or siblings (AOR 1.46, 95% CI 1.22-1.73) smoked cigarettes was at an increased risk of being an experimental smoker (versus a never smoker). Additionally, the odds of a student being an experimental smoker increased significantly as the number of closest friends who smoke cigarettes increased, that is, AOR ranged from 3.68 (one close friend smokes versus no friend smokes) to AOR 10.57 (four close friends who smoke versus no friend smokes). Between schools variation is not accounted for by these student-level factors. School-to-school variation remains significant even after adjusting for student-level factors.

## 5.5 Discussion

An important smoking prevention strategy is to dissuade non-smoking adolescents from experimenting with cigarettes. This is important as research has identified that some youths experienced nicotine dependence even within a day of first inhaling cigarette smoke (O'Loughlin et al, 2009). The present study identified four notable findings important for informing future tobacco control prevention programming. First, consistent with existing research on youth smoking behaviour (Aveyard et al., 2004; Leatherdale et al., 2005b), this study identified that the likelihood of a student being an experimental smoker significantly varied across schools. This suggests that the characteristics of the school a student attends can increase their likelihood of experimental smoking above and beyond their individual characteristics.

Second, this study identified two school-level characteristics (rural vs. urban location and school neighbourhood SES) that explained a meaningful amount of the between school variability in experimental smoking when controlling for individual-level characteristics. That is, the odds of a student being an experimental smoker decreased when a student attended a school in an urban or high SES neighbourhood compared to a student who attended a school that was located in a rural or low SES neighbourhood. Previous studies (Chuang et al., 2009; Doku et al., 2010; Duncan et al., 1999; Pearce et al., 2009; Sellstrom and Bremberg, 2006) found an association of these two school-level factors with *established smoking* but this study is among the few studies that found an association with *experimental smoking*. However, there is

need for stronger and more in-depth studies to help public health practitioners identify specific characteristics (preferable amenable ones) in these schools (rural and low SES neighbourhoods) that predispose students to experimental smoking beyond existing evidence (Chuang et al., 2009; Doku et al., 2010; Duncan et al., 1999; Pearce et al., 2009; Sellstrom and Bremberg, 2006). Moreover, since school location and neighbourhood SES only explained part of the between school variability. The use of surveillance activities to explore and evaluate other types of school-level data such as the strength of school-based tobacco control programs and/or policies (Lovato et al., 2010) including external influences like media and linkages with the community would shade more light on the unexplained variability and advance the field.

Inconsistent with existing literature on experimental smoking (McCarthy et al., 2009), the number of tobacco retailers that surrounded secondary schools was not associated with the outcome variable. This finding may suggest that the number of tobacco retailers surrounding a school is perhaps more important for students who are *established* smokers (Henriksen et al., 2008; Novat et al., 2006; West et al., 2010) than for students who are still experimenting with cigarettes. Other studies that have used the 2008 YSS data found that regular smokers were more likely to use retail sources of cigarettes, while experimenters used social sources (e.g., borrowing cigarettes from friends or family) rendering the location of retailers less important in the present study (Health Canada, 2010).

Third, the intrapersonal-level findings (i.e., grade, attitudes, pocket money, anti-smoking rules, alcohol and marijuana use, and school connectedness) from this study were consistent with existing literature. For example, consistent with existing research (Brady et al., 2008; Flay and Petraitis, 1994), students who reported attitudes and beliefs that were pro-smoking (e.g., believing that smoking can help people relax) were more likely to be experimental smokers. This is not surprising because the TTI posits that adolescents' perceptions and beliefs represent the most proximal level of influence because it reflects the adolescent's ability to resist pressures to initiate and progress into advanced smoking behaviour (Flay and Petraitis, 1994).

Consistent with another study (Mohan, 2005), the amount of pocket money students had available was associated with experimental smoking. Parents and guardians who give their adolescent children pocket money need to understand how this money is spent. The finding regarding student's perception of anti-smoking school rules is consistent with what other researchers (Murnaghan et al., 2008; Sabiston et al., 2009) found, that is, that tobacco control school policies or rules are not effective on their own; there is need to for adequate enforcement. This study did not assess enforcement, however, a plausible explanation of this finding is that smokers tend to notice policies because they are relevant to them compared to a never smoker.

Alcohol use as a predictor of the outcome variable was consistent with previous studies (O’Loughlin et al., 2009). The most striking finding in this study was that the odds of a student being an experimental smoker (versus a never smoker) was more than 15 times higher (AOR 15.4, 95% CI 12.9-18.2) if a student reported using marijuana. Although it is not possible to determine the direction (i.e., temporal sequence) of the association i.e., whether marijuana use precedes tobacco use or vice versa using cross-sectional data, this finding highlights and contributes to what is already known about adolescent multi-substance or multi-risk behaviour (Elton-Marshall et al., 2011a; Leatherdale and Ahmed, 2010; Okoli et al., 2008; Ringwalt et al., 2008; Wiefferink et al., 2006). These findings suggest that preventing substance use (Marijuana and alcohol use) in schools should be a priority.

School health experts recommend that schools curricula should use a comprehensive approach (Joint Consortium for Schools Health, 2009; New Brunswick Student Wellness Strategy [NBWS]), 2009) because research has shown that this approach is effective in improving both the student’s educational outcomes and encourages healthy social behaviours and a positive mental health that enables the student to resist substance abuse and feel more connected to the school. Consistent with previous research (Bond et al., 2007), students who felt more connected to their school were less likely to be experimental smokers. An adolescent’s social attachment (Hirschi, 1998) to the school is likely protective of initiating risky behaviour such as tobacco use. It is also consistent with current efforts in Canada (e.g., NBWS) to address “upstream” issues in school settings to create environments and provide skills to enable the youth to resist any form of substance use. Overall, school connectedness might be a force to counter tobacco, alcohol and marijuana use among adolescents (NBWS, 2009).

Fourth, the results from the social context influences of smoking friends and family are consistent with existing evidence (Leatherdale et al., 2005b; Ma et al., 2008; O’Loughlin et al., 2009) and support the TTI (Flay and Petraitis, 1994) which claims that an adolescent’s behaviour is influenced by their immediate social environment such as having smoking friends or family members who reinforce the behaviour and model the outcomes associated with the behaviour. Generally, having friends or family members who smoke creates more opportunities for offers of cigarettes (Baumeister and Tossman, 2005), makes smoking appear more normative and acceptable (Flay and Petraitis, 1994; Khuder et al., 2008), and provides more social sources of cigarettes (Sunders, 2011; West et al., 2010), all of which make a student more likely to experiment with smoking (Bandura, 1986). This information emphasizes the need to ensure that tobacco control strategies in secondary schools target both the subpopulation of students at risk of being experimental smokers and also their smoking family members and friends that put them at greatest risk (Leatherdale et al., 2005b; Leatherdale et al., 2005c).

The odds of a student being an experimental smoker versus a never smoker increased as students grades increased from grade 9 to 11 as was the case in existing literature that examined *established* smoking (Substance Abuse and Mental Health Services Administration, 2007). These findings suggest that school-based prevention strategies should be implemented early when students are in lower grades and sustained into high school years. Unlike previous research (Ma et al., 2008) this study showed that gender was not associated with the outcome variable.

This study has several strengths and limitations. The strengths include the use of nationally representative data of Canadian adolescents in different smoking stages. The study is also guided by a relevant theory i.e., TTI which is a comprehensive theory that offers testable predictions and insights regarding the causes of health-related behaviours including tobacco use (Flay and Petraitis, 1994). For data analysis, a 2-level multi-level logistic regression was used to account for the clustering of students within the same school, which produces accurate standard errors and reduces the likelihood of Type 1 error (Snijders and Bosker, 1999).

The use of cross-sectional data limits the results to associations only. Future studies employing randomized longitudinal data would permit causal inferences. While self-report data employed are subject to response bias, in the YSS, efforts were taken to ensure student confidentiality and that the data was reliable and valid (Cameron et al., 2007; Elton-Marshall et al., 2011b; Lovato et al., 2010). The exclusive reliance on Census data for school SES (proxy measure) has been criticized, instead the use of multiple neighbourhood measures such as physical and socio-demographic is preferred (Chuang et al., 2005).

In spite of these limitations, these findings contribute to the growing knowledge on the student- and school-level characteristics that influence experimental smoking among secondary school students. Specifically, that the characteristics (e.g., location) of a school a student attends can increase the likelihood of experimental smoking above and beyond individual-level influences. Therefore, this study highlights the importance of designing school-based tobacco control prevention policies and programs that are grade-sensitive, increase students' attachment to their school, address substance use, tobacco-related beliefs and use of pocket money. They should include interventions targeting smoking friends, family members and schools located in rural or low SES neighbourhoods.

Table 5.I: A list of the variables included in the analysis

TTI domain	Specific question asked or how variable was derived	Coding for analysis
<b><i>Intrapersonal</i></b>		
Grade	What grade are you in?	9, 10, 11, 12
Gender	Are you female or male?	0=female and 1=Male
Pocket money	About how much money do you usually get each week to spend on yourself or save?	0 = \$0 1= \$1 to \$20 2= \$21 to \$100 3= >\$100
Alcohol use	In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? Options included: 1 = I have never drank alcohol, 2 = I did not drink alcohol in the last 12 months, 3 = I have only had a sip of alcohol, 4 = Every day, 5 = 4 to 6 times a week, 6 = 2 or 3 times a week, 7 = Once a week, 8 = 2 or 3 times a month, 9 = Once a month, 10 = Less than once a month, (11 = I do not know-was not a valid response, so these students were not included in the analyses)	0 = I have never drank alcohol 1= Any use (options 2 to 10)
Marijuana use	In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...). Options included: 1 = I have never used marijuana, 2 = I have used marijuana but not in the last 12 months, 3 = Every day, 4 = 4 to 6 times a week, 5 = 2 or 3 times a week, 6 = Once a week, 7 = 2 or 3 times a month, 8 = Once a month, 9 = Less than once a month, 10 = I do not know -not a valid response)	0 = I have never used marijuana 1= Any use (options 2 to 9)
School connectedness	Five items assessed this factor. Students were asked whether they: 1) felt close to people at school, 2) felt part of their school, 3) were happy at school, 4) felt that the teachers at school treated them fairly, and 5) felt safe at school. The responses were given on a 4-point Likert Scale i.e., strongly agree, agree, disagree, strongly disagree and recoded as shown in second column.  Consistent with previous literature (Sabiston et al, 2009), the five items of the school connectedness score were summed to give a final score that ranged from 0 to 5. Higher scores represented greater perception of school connectedness.	0= strongly disagree/ disagree 1= strongly agree/agree
Knowledge	Do people have to smoke many years before it will hurt them?	0= no or I do not know 1= yes
	Is there danger to your health from an occasional cigarette?	0= no or I do not know 1= yes
Beliefs	Does smoking help people relax?	0= no or I do not know 1= yes
School rules	This school has a clear set of rules about smoking for students to follow. The responses were given on a 4-point Likert Scale i.e., True, usually true, usually false, false and recoded as shown in second column.	0= usually false/false /I do not know 1= true/ usually true

**Social context**

Parents smoke	Do any of your parents, step-parents, or guardians smoke cigarettes?	0= no or I do not know 1= yes
Sibling(s) smokes	Do any of your brothers or sisters smoke cigarettes?	0= no or I do not know or no brothers or sisters 1=Yes
Friend(s) smokes	How many of your closest friends smoke cigarettes? Options included 0, 1, 2, 3, 4, 5 or more friends	0=0, 1=1, 2=2, 3=3, 4=4, 5=5 or more

**Socio-cultural**

Location	School location was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard Census geographical areas (Statistics Canada, 2010). Areas that consist of populations of 50,000 and above are considered to be urban, the rest are rural	0=rural 1=urban
SES	Median household income: The 2006 Census median household income data was used as a proxy measure for school-level socioeconomic status (SES) as has been done in previous studies (Chuang et al., 2005). This variable was a continuous measure and the unit change was in intervals of \$10,000 CAD for ease of interpretation.	Numeric data by units of \$10,000
Tobacco retailer density	<p>The 2008/09 Desktop Mapping Technologies Inc. [DMTI] and the Enhanced Points of Interest [EPOI] data provided numeric data regarding the number of tobacco retailers that surrounded the sampled secondary schools. The EPOI data file consists of a national database of more than 1.6 million Canadian business and recreational points of interest <a href="http://www.dmtispatial.com">http://www.dmtispatial.com</a>.</p> <p>The DMTI-EPOI data was obtained through geocoding the address for each school that participated in the YSS using Arcview 3.3 software (ESRI, 2002). This was followed by creating a 1-Km buffer to assess how many tobacco retailers were located within these buffers (i.e., radius surrounding each school in which the different structures of the built environment were quantified). A 1-Km radius was selected because it is estimated that it is representative of the distance most high school students would walk to and from their school (Chuang et al., 2005).</p>	Numeric (each 1 unit change)

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Table 5.2: Descriptive statistics (weighted) for secondary school students' sample who were experimental smokers (n=2028) and Never smokers (n=16,045)

Characteristics	Experimental smokers % (n=2028)	Never smokers % (n=16,045)	Chi square (weighted $\chi^2$ )
Gender			
Male	11.2%	88.8%	$\chi^2=0.02$ , df=1, $P=0.8941$
Female	11.3%	88.8%	
Grade			
Grade 9	8.4%	91.6%	$\chi^2=132.64$ , df=3, $P<.0001$
Grade 10	9.7%	90.3%	
Grade 11	12.5%	87.5%	
Grade 12	15.7%	84.3%	
Pocket Money			
\$0	4.8%	95.2%	$\chi^2=295.03$ , df=3, $P<.0001$
\$1-\$20	8.8%	91.2%	
\$21-\$100	14.6%	85.4%	
>\$100	17.4%	82.6%	
Alcohol use			
No	1.0%	99.0%	$\chi^2= 530.35$ , df=1, $P<.0001$
Yes	14.2%	85.8%	
Marijuana use			
No	2.4%	97.6%	$\chi^2=3,982.09$ , df=1, $P<.0001$
Yes	36.8%	63.2%	
Knowledge on tobacco			
Do people have to smoke many years before it will hurt them?			
No	15.9%	84.1%	$\chi^2= 107.69$ , df=1, $P<.0001$
Yes	9.9%	90.1%	
Is there danger to your health from an occasional cigarette?			
No	15.6%	84.4%	$\chi^2= 116.63$ , df=1, $P<.0001$
Yes	9.7%	90.3%	
Beliefs			
Does smoking help people relax?			
No	4.4%	95.6%	$\chi^2= 862.35$ , df=1, $P<.0001$
Yes	18.4%	81.6%	
Mean school connectedness score (SD)	3.75(1.47)	4.20 (1.27)	$t=14.81$ , $P<.0001$
Perception of clear smoking rules			
No	7.9%	92.1%	$\chi^2=54.82$ , df=1, $P<.0001$
Yes	12.1%	87.9%	
At least one parent smokes			
No	8.4%	91.7%	$\chi^2=277.18$ , df=1, $P<.0001$
Yes	16.6%	83.4%	
At least one sibling smokes			
No	9.3%	90.7%	$\chi^2=399.17$ , df=1, $P<.0001$
Yes	22.8%	77.2%	
Friend(s) smoke			
Yes, 0 friend	2.4%	97.6%	$\chi^2=3146.89$ , df=5, $P<.0001$
Yes, 1 friend	16.6%	83.4%	
Yes, 2 friends	25.5%	74.5%	
Yes, 3 friends	36.2%	63.8%	
Yes, 4 friends	32.4%	67.6%	
Yes, 5 friends	41.6%	58.4%	

Table 5.3: Multi-level logistic regression analysis of the student- and school-level variables that are related to the odds of being a an experimental smoker versus a never smoker

Characteristics	Model 1	Model 2	Model 3	Final model (Model 3)	
	Model Estimates (Standard Error)			Adjusted Odds Ratios (95% CI)	P Values
Fixed Intercept	-2.13 (0.06)	-1.97 (0.07)	-5.77 (0.29)		
<b><i>Intrapersonal factors</i></b>					
Gender	Female (Ref) -				
	Male		0.001 (0.08)	1.00 (0.86,1.16)	0.9876
Grade	Grade 9 (Ref) -				
	Grade 10		-0.29 (0.11) *	0.74 (0.60,0.92 )	0.0073
	Grade 11		-0.35 (0.11) *	0.70 (0.56, 0.88 )	0.0023
	Grade 12		-0.21 (0.12 )	0.81 ( 0.64, 1.04)	0.1023
Money	0\$ (Ref) -				
	\$1-\$20		0.47 (0.14) *	1.59 (1.20, 2.11 )	0.0013
	\$21-\$100		0.71 (0.14) **	2.03 (1.54, 2.68 )	<.0001
	>\$100		0.80 (0.15) **	2.22 ( 1.66, 2.98)	<.0001
Smoking helps people relax	No (Ref) -				
	Yes		1.21 (0.08) **	3.37 (2.86, 3.97 )	<.0001
People have to smoke many years before it hurts them?	No (Ref) -				
	Yes		-0.41 (0.09) **	0.66 (0.56, 0.79 )	<.0001
Is there danger to your health from an occasional cigarette?	No (Ref) -				
	Yes		-0.48 (0.08) **	0.62 (0.52, 0.73 )	<.0001
There are clear school rules on smoking	No( Ref) -				
	Yes		0.45 (0.10) **	1.56 (1.27, 1.92 )	<.0001
Alcohol use	No (Ref) -				
	Yes		1.26 ( 0.19) **	3.51 ( 2.41, 5.12)	<.0001
Marijuana use	No (Ref) -				
	Yes		2.73 ( 0.09) **	15.4 ( 12.93, 18.23)	<.0001
Mean connectedness score			-0.14 ( 0.03) **	0.87 (0.83, 0.92 )	<.0001
<b><i>Social Context factors</i></b>					
At least one parent smokes	No (Ref) -				
	Yes		0.26 (0.08) *	1.30 (1.11, 1.51 )	0.0009
At least one sibling smokes	No (Ref) -				
	Yes		0.38 (0.09) **	1.46 (1.22, 1.73 )	<.0001
No friend smokes (Ref) -					
	1 Friend smokes		1.30 (0.11) **	3.68 ( 2.96, 4.59)	<.0001
	2 Friends smoke		1.77 (0.11) **	5.87 (4.69, 7.34)	<.0001
	3 Friends smoke		2.15 (0.13) **	8.57 (6.60, 11.14)	<.0001
	4 Friends smoke		2.36 (0.20) **	10.57 (7.13, 15.66)	<.0001
	5 Friends smoke		2.25 ( 0.11) **	9.52 (7.60, 11.93)	<.0001
<b><i>School-level factors</i></b>					
Location	Rural (Ref) -	-			
	Urban	-0.30 (0.10)* (P =0.004)	-0.48 (0.14)* (P=0.0009)	0.62 (0.46, 0.82)	0.0009
Tobacco retailer density (each 1 unit change)		-0.01 (0.01) (P =0.5295)			
Median household income (each \$10,000 unit change)		-0.07 (0.04) (P=0.1006)	-0.13 (0.06)* (P=0.0256)	0.88 (0.79, 0.98)	0.0256

Random variance	0.23 (0.05) P<.0001	0.20 (0.04)		0.29 (0.07)
Intra-Class Correlation (a)	0.065 (6.5%)	0.057	0.023	0.023
$\frac{\sigma^2_u}{\sigma^2_u + \pi^2/3}$				
Explained variance (b)		11.97%		

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(a) Measures of the proportion of the total variance that occurs between-schools

(b) Proportion of variance between schools explained by the school-level predictor variables.

\*\* $P < 0.0001$

\*  $P < 0.05$

Ref: This is the reference category

## **Chapter 6**

**Results for Study 3: Using student and school factors to differentiate adolescent current smokers from experimental smokers in Canada: A multilevel analysis**

**Using student and school factors to differentiate adolescent current smokers from experimental smokers in Canada: A multilevel analysis**

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## 6.1 Summary

*Objective:* In order to understand the factors that differentiate adolescents who have tried smoking from those who have become established smokers, this study examined which student- and school-level factors differentiated current smokers from experimental smokers among a nationally representative sample of Canadian secondary school students.

*Method:* Student-level secondary data from the 2008-2009 Youth Smoking Survey was linked with school-level data from the 2006 Census and one built environment characteristic, and examined using multilevel logistic regression analyses.

*Results:* The current smoking rates varied ( $P < 0.001$ ) across schools. The number of tobacco retailers surrounding the schools was associated with current smoking when adjusting for student characteristics. Additionally, students were more likely to be current smokers if they were: male, in higher grades, believed that smoking can help when they are bored, reported low school connectedness, used marijuana, had a sibling or close friend who smoked, and had no smoking bans at home.

*Conclusions:* These study findings suggest that school anti-smoking strategies need to target males, increase students' attachment to their school, address tobacco-related beliefs, and include interventions targeting smoking siblings and friends. The government should consider zoning restrictions to limit sales of tobacco products near schools.

**Keywords:** adolescence; current smoking; factors; multilevel logistic regression; Canada

## 6.2 Introduction

Undeniably tobacco remains a leading cause of preventable morbidity and death in North America and it is estimated that more than 37,000 in Canada and 443,000 people in the United States (U.S.) die annually from tobacco-caused diseases (Health Canada, 2011; U.S. Department of Health and Human Services, 2012). Research supports the concept that adolescent smoking behaviour consists of distinct smoking trajectories (Cameron et al., 1999; Chassin et al., 2009; Mayhew et al., 2000). Characterizing adolescent smoking trajectories is important because prevention and intervention programs need to tailor their programs depending on the risk and protective factors of adolescents in different smoking stages (e.g., susceptible never smoker, experimenter, regular and established/daily smoker).

Researchers have used several theories including the Theory of Triadic Influence (TTI) (Flay and Petraitis, 1994) to try to understand the complex factors and environment in which adolescents initiate and maintain smoking. TTI posits that youth smoking behaviours are a result of a combination and interaction of individual or intrapersonal, social context, and broader societal influences. Intrapersonal factors that are known to be associated with increased risk for current smoking include being older (Leatherdale and Burkhalter, 2012; Hutchinson et al., 2008; Park et al., 2004), being male (Kalesan et al., 2006), consuming alcohol or illicit drugs (Leatherdale and Burkhalter, 2012; Leatherdale et al., 2008; West et al., 2010), low school connectedness (Sabiston et al., 2009), and low refusal self-efficacy (Ma et al., 2008). The social context influences mainly include exposure to friends (Bricker et al., 2006; Lipperman-Kreda et al., 2009; Sabiston et al., 2009) or family members who smoke (Khuder et al., 2008; Leatherdale et al., 2005c; Lipperman-Kreda et al., 2009; Sabiston et al., 2009; Wen et al., 2009) and residing in homes without a total ban on smoking (Thomson et al., 2005).

Broader societal factors that are associated with increased risk for adolescent current smoking include the number of tobacco retailers that surround secondary schools (Chuang et al., 2005; Henriksen et al., 2008; Kline, 2004; Leatherdale and Strath, 2007; West et al., 2010), living in neighborhoods with low socioeconomic status (SES) (Chuang et al., 2009; Doku et al., 2010; Pearce et al., 2009), attending schools in rural areas (Chuang et al., 2009; Sellström and Bremberg, 2006), schools with a high smoking rate among senior students (Leatherdale et al., 2005c), school where students smoke in the periphery/on school property (Lovato et al., 2010; Sabiston et al., 2009), and schools with weaker policy intentions and implementation (Sabiston et al., 2009).

However, fewer studies (McCarthy et al., 2009) have concurrently examined the student and school-level factors that differentiate current smokers from *experimental* smokers (not *never smokers* as is done by most studies). The purpose of this study was to contribute and expand on previous research by examining which school- and student-level characteristics differentiated current smokers from *experimental* smokers.

Understanding these factors will provide new insight for stakeholders interested in developing effective tobacco control strategies that will deter students who are still trying smoking from progressing to established smoking.

## **6.3 Methods**

### **6.3.1 Design**

The 2008-2009 Youth Smoking Survey (2008 YSS) is a valid and reliable machine-readable, pencil and paper nationally representative school-based survey that is used to measure the determinants of youth smoking behaviour (University of Waterloo, 2009). See Elton-Marshall et al. (2011b) and refer to [www.yss.uwaterloo.ca](http://www.yss.uwaterloo.ca) for detailed information on the survey development, design, survey weights, response rates and data collection protocol for the 2008 YSS.

### **6.3.2 Participants**

The secondary school portion of 2008 YSS was administered to 29,296 grades 9 to 12 students attending 133 schools from all 10 Canadian provinces. The present study used only the subset of 5,440 who were current and experimental smokers.

### **6.3.3 Measures and data sources**

This study only used data from students who reported current (occasional or daily smokers) and experimental smoking. Consistent with previous research (Cameron et al., 2007; Lovato et al., 2007; Lovato et al., 2010) “occasional smokers” were defined as those students who had smoked at least 100 cigarettes in his/her lifetime and had smoked at least 1 cigarette during the 30 days preceding the survey. “Daily smokers” were defined as those students who had smoked at least 100 cigarettes in his/her lifetime and had smoked at least 1 cigarette per day for each of the 30 days preceding the survey. This group was compared with students who were “experimental smokers” defined as any students who had smoked in the last 30 days preceding the survey but had not smoked 100 cigarettes in their lifetime (McCarthy et al., 2009).

All variable selection was guided by existing literature and TTI (Flay and Petraitis, 1994). The intrapersonal (gender, grade, alcohol and marijuana use, school connectedness, tobacco-related knowledge and attitudes) and social context measures (parents, siblings and friends smoking status, and smoking rules

in the house) were coded as listed in Table 6.1. Two school neighbourhood characteristics (location and median household income) were linked with the 2008 YSS dataset. Consistent with previous research (Chuang et al., 2005; Wen et al., 2009), school location and the median household income data (proxy measure for school neighbourhood SES) was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard 2006 Census geographical areas (Statistics Canada, 2010) as described in Table 6.I. The 2008/09 Enhanced Points of Interest [EPOI] data file from Desktop Mapping Technologies Inc. [DMTI] (ESRI, 2002) provided numeric data regarding the number of tobacco retailers located within a 1-km radius of each school (Table 6.1).

### 6.3.4 Data analyses

Multilevel logistic regression (Snijders and Bosker, 1999) was used to analyze the data because it allows for an understanding of the separate and joint effects of student-level (level-1) and school-level (level-2) characteristics on current smoking. Consistent with previous research (Leatherdale et al., 2005b), a four-step modeling procedure was used. Model 1 entailed computing a null model to assess whether there was significant within-cluster interdependence to warrant the use of a multilevel approach. Model 2 was developed to determine the school-level variables that would have a direct effect on the likelihood of a student being a current smoker versus an experimental smoker. In Model 3, the strength of the direct effects of both the school- and student-level predictors was assessed using a random coefficient regression model. The main purpose of the final model (Model 4) was to assess the contextual interactions between the school-level and student-level predictor variables. Predictor variables that were not significant at  $p < .05$  were removed until the final model only contained predictor variables that were significant at  $p < .05$ . All analyses used SAS 9.2 statistical package (SAS Institute Inc, 2001).

## 6.4 Results

### 6.4.1 Descriptive results

Of the full sample of grade 9 to 12 students, 3412 were classified as *current smokers* and 2,028 were classified as *experimental smokers*. Table 6.2 shows descriptive statistics comparing adolescents who were current smokers with those who were experimental smokers. Fifty-six percent of the sample was male. The prevalence of current smoking was significantly higher among males (66.2%) than females (58.4%) ( $\chi^2=35.31$ ,  $df=1$ ,  $P < .0001$ ). Overall, the proportion of students who were current smokers increased from

grade 9 to 12 and also as the number of smoking friends increased from 1 to 5 friends. The ever use of alcohol and marijuana was high (97.3% and 87.8% respectively). Sixty-nine out of 133 secondary schools were located in urban areas. The average current smoking rate among grade 9-12 students in the 133 secondary schools was 11.6 % (range, 0%-39.1%). The mean number of tobacco retailers within a 1-Km radius of the schools was 5.8 (range, 0-49). The mean of the household income was \$56, 424 (range, \$30,784-\$97,706).

#### 6.4.2 Multilevel results

Table 6.3 presents results of the multilevel logistic regression analyses. The results from the null model (Model 1) showed a significant between-school random variation in the likelihood of current smoking among grade 9 to 12 students [ $(\sigma^2 u_0 = 0.13 [0.04], P < .001$ ], where the estimates suggest that the school a student attended accounted for 3.9% of the variability in their likelihood of being a current smoker versus an experimental smoker. Model 2 results showed that the number of tobacco retailers within a 1-Km radius surrounding a school was positively associated ( $P=0.044$ ) with current smoking. This neighbourhood characteristic explained 5.8% of the between-school variability in the likelihood of a student being a current smoker versus an experimental smoker.

The median household income that was used as a proxy measure for neighbourhood SES where a secondary school was located was not associated ( $P=0.2204$ ) with the likelihood of a student being a current smoker versus an experimental smoker. School location in terms of whether the school was in an urban or rural area was not significantly associated ( $P = 0.9246$ ) with odds of a student being a current smoker versus an experimental smoker.

Model 3 identified the student-level characteristics that were significantly associated with the odds of a student being a current smoker versus an experimental smoker when adjusting for one school-level variable (i.e., the number of tobacco retailers). This model also showed that the number of tobacco retailers surrounding a school remained significantly (AOR 1.03, 95% CI 1.01-1.05) associated with the odds of a student being a current smoker even after controlling for student-level individual characteristics. None of the two-way contextual interactions between the school-level and student-level predictor variables (including gender) in Model 4 (results not shown) were associated with the outcome variable.

The final model suggests that male students were more likely to be current smokers (versus experimental smokers) than female students (AOR 1.30, 95% CI 1.13-1.50). The odds of a student being a current smoker increased with: (a) school grade i.e., Grade 10 versus grade 9 (AOR 1.81, 95% CI 1.45-2.26); Grade 12 versus grade 9 (AOR 2.38, 95% CI 1.88-2.99), (b) belief that smoking can help people when they

are bored (AOR 1.81, 95% CI 1.57-2.08 ), and (c) a decrease in school connectedness (AOR 0.91, 95% CI 0.86-0.95 ). The odds of a marijuana smoker being a current smoker was 1.36 times higher than for a student who did not use marijuana.

In terms of social context predictors, a student who reported that their sibling (AOR 1.33, 95% CI 1.15-1.55) smoked cigarettes was at an increased risk of being a current smoker. The odds of a student being a current smoker was not associated with having a smoking parent (results not shown). Additionally, the odds of a student being a current smoker increased significantly as the number of closest friends who smoke cigarettes increased, that is, AOR ranged from 1.45 (two close friends smoke versus no friend smokes) to AOR 4.90 (five close friends who smoke versus no friend smokes). The odds of a student being a current smoker was about four times higher (AOR 3.66, 95% CI 3.10-4.33) if a student reported that they ‘ever’ smoked inside their home. Between schools variation is not accounted for by these student-level factors. School-to-school variation remained significant even after adjusting for student-level factors.

## **6.5 Discussion**

### **6.5.1 Discussion**

Considering that approximately 70-75% of students will experiment with a cigarette at least once before completing grade 12 (Centres for Disease Control and Prevention, 2003; Orlando et al., 2004) and about a third of these adolescents will progress to current smoking (Substance Abuse and Mental Health Services Administration [SAMHSA], 2007), future tobacco control programs need to develop programs that will disrupt experimenting students from becoming established smokers. Two notable findings from this study provide some evidence that progression to current smoking may be associated with (a) the characteristics of the school a student attends and (b) student-level intrapersonal and social context factors.

First, this study identified that the likelihood of a student being a current smoker versus an experimental smoker significantly varied across schools. This suggests that the characteristics of the school a student attends can increase their likelihood of being a current smoker. Although the school a student attended accounted for a modest 3.9% of the variability in their likelihood of being a current smoker versus an experimental smoker, it represents a substantial amount of variation when distributed across the broader student population (Chan and Leatherdale, 2011).

The number of tobacco retailers surrounding schools was associated with likelihood of a student being a current smoker compared to an experimental smoker. This finding is consistent with previous studies (Leatherdale and Strath, 2007; Henriksen et al., 2008) except for McCarthy and colleagues study (2009) which found that the density of tobacco retailers was associated with adolescent experimental smoking but

not established smoking. Generally, tobacco retailers in a neighbourhood increases availability and visibility (advertisements) of tobacco products (Henriksen et al., 2008) and is associated with a greater likelihood that student smokers would buy cigarettes rather than obtain from social sources (Leatherdale and Strath, 2007). Thus, finding from the present study supports tobacco control recommendation that communities need to adhere to the zoning restrictions to limit sales of tobacco products near schools (Kline, 2004).

Additionally, in order to advance the field, more light needs to be shed regarding the remaining unexplained school-level variability. This can be done using surveillance activities to explore other types of school-level data, such as the strength of school-based tobacco control programs and policies (Lovato et al., 2010) including external influences like media (Dalton et al., 2003), tobacco product marketing (Guindon et al., 2008), and linkages with the community.

Second, this study identified several student intrapersonal or social context factors that differentiated current smokers from *experimental* smokers. Most previous studies have investigated similar student-level factors that are associated with the likelihood of being a current smoker versus a *never smoker* but this study is among the few studies (McCarthy et al., 2009) that have simultaneously compared the individual and school-level characteristics of current smokers versus *experimental smokers*. Results from this study showed that students were more likely to be current smokers as opposed to experimental smokers if they were: male, in higher grades, believed that smoking can help when they are bored, reported low school connectedness, used marijuana, had siblings or close friends who smoked, and had no smoking bans at home. Most of these findings were consistent with what others have found in literature. A few examples are highlighted.

In this study, students who felt more connected to their school were less likely to be current smokers as was found by Sabiston et al. (2009). An adolescent's social attachment to the school seemed to be protective of progression to more advanced smoking. The empirical finding that students who used marijuana were at an increased risk of current smoking versus experimental smoking contributes to what is known about adolescent multi-substance or multi-risk behaviour (Elton-Marshall et al., 2011; Leatherdale and Ahmed, 2010; Okoli et al., 2008; Wiefferink et al., 2006). This study supports emerging consensus that schools curricula should use a Comprehensive School Health approach because research has shown that this approach is effective in creating a school culture that gives students a sense of belonging, equips them with relevant skills to resist substance use, and links them with community resources that reach out to their smoking family members (Joint Consortium for School Health, 2009).

This study also found empirical support for the social context influences of smoking friends and/or family members (i.e., siblings and not parents) on adolescent current smoking status. This finding is

consistent with previous studies (Leatherdale et al., 2005a; Sabiston et al., 2009) and also supports the TTI and other behavioural theories (Bandura, 1986) which claim that an adolescent's behaviour is influenced by their immediate social environment such as having smoking friends or family members who reinforce the behaviour and model the outcomes associated with the behaviour. However, one different finding from this study was that it seemed that students who had advanced in smoking tended to be influenced more significantly by their siblings and not their parents. Having friends or family members who smoke creates more opportunities for offers of cigarettes (Baumeister and Tossmann, 2005), makes smoking appear more normative and acceptable (Flay and Petraitis, 1994; Khuder et al., 2008), and provides more social sources of cigarettes (Saunders, 2011; West et al., 2010), all of which make a student more likely to smoke (Bandura, 1986). These finding emphasizes the need to target both the subpopulation of students at risk of being current smokers and also their smoking family members and friends that put them at greatest risk (Leatherdale et al., 2005a; Leatherdale et al., 2005b). Students need to be encouraged to forge friendships with non-smoking peers who will model the benefits of being tobacco free.

In the present study, males were more likely to be current smokers as found in previous studies (Corrao et al., 2000; Mackay and Eriksen, 2002). Additionally, the odds of a student being a current smoker increased as students grades increased as was the case in other studies (Johnston et al., 2008; SAMHSA, 2007). These findings suggest that tobacco control strategies should be sensitive to gender and be implemented early when students are in lower grades preferably, before students begin high school and sustained into high school years.

### **6.5.2 Limitations and strengths**

The strengths of this study include the use of nationally representative data of Canadian adolescents in the experimental and current smoking stages. The study is also guided by a relevant theory i.e., TTI which is a comprehensive theory that offers testable predictions and insights regarding the causes of health-related behaviours including tobacco use (Flay and Petraitis, 1994). For data analysis, a 2-level multilevel logistic regression was used to account for the clustering of students within the same school, which produces accurate standard errors and reduces the likelihood of Type 1 error (Snijders and Bosker, 1999).

The use of cross-sectional data limits the results to associations only. Future studies employing rigorous longitudinal data would permit causal inferences. While self-report data employed are subject to response bias, in the YSS, efforts were taken to ensure student confidentiality and that the data was reliable and valid (Cameron et al., 2007; Elton-Marshall et al., 2011b; Lovato et al., 2010). The exclusive reliance on Census data for school SES (proxy measure) has been criticized, instead the use of multiple neighbourhood measures such as physical and socio-demographic is preferred (Chuang et al., 2005).

### **6.5.3 Conclusions**

This study showed that current smoking rates varied across Canadian secondary schools. The number of tobacco retailers surrounding a school was associated with current smoking when adjusting for student-level factors. Results showed that students were more likely to be current smokers as opposed to experimental smokers if they were: male, in higher grades, believed that smoking can help when they are bored, reported low school connectedness, used marijuana, had siblings or close friends who smoked, and had no smoking bans at home. Understanding these factors will provide more insight to guide stakeholders interested in developing effective tobacco control strategies that will deter students who are still trying smoking from progressing to establish smoking.

### **Funding**

The Youth Smoking Survey is funded by Health Canada. Dr. Scott Leatherdale is a Cancer Care Ontario Research Chair in Population Studies funded by the Ontario Ministry of Health and Long-term Care. Health Canada and the Ontario Ministry of Health and Long-term Care had no further role in study design, collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

### **Conflict of interest statement**

All authors declare that they have no conflict of interest.

### **Acknowledgement**

The Youth Smoking Survey is a product of the pan-Canadian capacity building project funded through a contribution agreement and contract between Health Canada and the Propel Centre for Population Health Impact from 2004 to 2011. The YSS consortium includes Canadian tobacco control researchers from all provinces and provided training opportunities for university students at all levels. The views expressed herein do not necessarily represent the views of Health Canada.

Table 6.I: A list of the variables included in the study and how they were coded for analysis. Canadian Youth Smoking Survey 2008

TTI domain	Specific question asked or how variable was derived	Coding for analysis
<b><i>Intrapersonal</i></b>		
Grade	What grade are you in?	9, 10, 11, 12
Gender	Are you female or male?	0=female and 1=Male
Alcohol use	In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? Options included: 1 = I have never drank alcohol, 2 = I did not drink alcohol in the last 12 months, 3 = I have only had a sip of alcohol, 4 = Every day, 5 = 4 to 6 times a week, 6 = 2 or 3 times a week, 7 = Once a week, 8 = 2 or 3 times a month, 9 = Once a month, 10 = Less than once a month, (11 = I do not know-was not a valid response, so these students were not included in the analyses)	0 = I have never drank alcohol 1= Any use (options 2 to 10)
Marijuana use	In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...). Options included: 1 = I have never used marijuana, 2 = I have used marijuana but not in the last 12 months, 3 = Every day, 4 = 4 to 6 times a week, 5 = 2 or 3 times a week, 6 = Once a week, 7 = 2 or 3 times a month, 8 = Once a month, 9 = Less than once a month, 10 = I do not know -not a valid response)	0 = I have never used marijuana 1= Any use (options 2 to 9)
School connectedness	Five items assessed this factor. Students were asked whether they: 1) felt close to people at school, 2) felt part of their school, 3) were happy at school, 4) felt that the teachers at school treated them fairly, and 5) felt safe at school. The responses were given on a 4-point Likert Scale i.e., strongly agree, agree, disagree, strongly disagree and recoded as shown in second column. Consistent with previous literature (Sabiston et al, 2009), the five items of the school connectedness score were summed to give a final score that ranged from 0 to 5. Higher scores represented greater perception of school connectedness.	0= strongly disagree/ disagree 1= strongly agree/agree
Knowledge	Does quitting smoking reduce health damage even after many years of smoking?	0= no or I do not know 1= yes
Beliefs	Can smoking help people when they are bored?	0= no or I do not know 1= yes
<b><i>Social context</i></b>		
Parents smoke	Do any of your parents, step-parents, or guardians smoke cigarettes?	0= no or I do not know 1= yes
Sibling(s) smokes	Do any of your brothers or sisters smoke cigarettes?	0= no or I do not know or no brothers or sisters 1=Yes
Friend(s) smokes	How many of your closest friends smoke cigarettes? Options included 0, 1, 2, 3, 4, 5 or more friends	0=0, 1=1, 2=2, 3=3, 4=4, 5=5 or more
Smoking inside home	Do you ever smoke inside your home? Options included: 1=Yes, 2=No, 3= I do not smoke (not included in analyses)	0= No 1=Yes

**Socio-cultural**

Location	School location was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard Census geographical areas (Statistics Canada, 2010). Areas that consist of populations of 50,000 and above are considered to be urban, the rest are rural	0=rural 1=urban
SES	Median household income: The 2006 Census median household income data was used as a proxy measure for school-level socioeconomic status (SES) as has been done in previous studies (Chuang et al., 2005). This variable was a continuous measure and the unit change was in intervals of \$10,000 CAD for ease of interpretation.	Numeric data by units of \$10,000
Tobacco retailer density	<p>The 2008/09 Desktop Mapping Technologies Inc. [DMTI] and the Enhanced Points of Interest [EPOI] data provided numeric data regarding the number of tobacco retailers that surrounded the sampled secondary schools. The EPOI data file consists of a national database of more than 1.6 million Canadian business and recreational points of interest <a href="http://www.dmtispatial.com">http://www.dmtispatial.com</a>.</p> <p>The DMTI-EPOI data was obtained through geocoding the address for each school that participated in the YSS using Arcview 3.3 software (ESRI, 2002). This was followed by creating a 1-Km buffer to assess how many tobacco retailers were located within these buffers (i.e., radius surrounding each school in which the different structures of the built environment were quantified). A 1-Km radius was selected because it is estimated that it is representative of the distance most high school students would walk to and from their school (Chuang et al., 2005).</p>	Numeric (each 1 unit change)

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Table 6.2: Descriptive statistics (weighted) for secondary school students' sample who were current smokers (n=3412) and experimental smokers (n=2028). Canadian Youth Smoking Survey 2008

Characteristics		Current smokers % (n=3412)	Experimental smokers % (n=2028)	Chi square (weighted $\chi^2$ )
Gender				
	Male	66.2%	33.8%	$\chi^2=35.31$ , df=1, $P < .0001$
	Female	58.4%	41.6%	
Grade				
	Grade 9	54.2%	45.8%	$\chi^2=36.99$ , df=3, $P < .0001$
	Grade 10	64.6%	35.4%	
	Grade 11	64.0%	36.0%	
	Grade 12	65.1%	35.0%	
Alcohol use				
	No	71.7%	28.4%	$\chi^2= 5.11$ , df=1, $P =0.0238$
	Yes	62.2%	37.8%	
Marijuana use				
	No	49.9%	50.1%	$\chi^2=51.38$ , df=1, $P < .0001$
	Yes	64.6%	35.4%	
Knowledge on tobacco				
Does quitting smoking reduces health damage after many years of smoking				
	No	59.7%	40.4%	$\chi^2= 13.46$ , df=1, $P=0.002$
	Yes	64.7%	35.4%	
Beliefs				
Smoking helps people when bored				
	No	51.3%	48.7%	$\chi^2= 245.57$ , df=1, $P < .0001$
	Yes	72.2%	27.8%	
Mean school connectedness score (SD)		3.51(1.56)	3.75 (1.47)	$t=5.58$ , $P < .0001$
Parents smoke				
	No	54.7%	45.3%	$\chi^2=96.09$ , df=1, $P < .0001$
	Yes	67.9%	32.1%	
Siblings smoke				
	No	57.6%	42.4%	$\chi^2=97.78$ , df=1, $P < .0001$
	Yes	71.1%	28.9%	
Friends smoke				
	Yes, 0 friend	38.4%	61.6%	$\chi^2=847.92$ , df=5, $P < .0001$
	Yes, 1 friend	26.6%	73.4%	
	Yes, 2 friends	49.5%	50.5%	
	Yes, 3 friends	52.8%	47.2%	
	Yes, 4 friends	66.8%	33.2%	
	Yes, 5 friends	79.8%	20.3%	
I smoke inside my home				
	No	53.0%	47.4%	$\chi^2=475.09$ , df=1, $P < .0001$
	Yes	83.1%	16.9%	

Table 6.3: Multilevel logistic regression analysis of the student- and school-level variables that are related to the odds of being a current smoker versus an experimental smoker. Canadian Youth Smoking Survey 2008

Characteristics		Model 1	Model 2	Model 3	Final model (Model 3)	
					Model Estimates (Standard Error)	
Fixed Intercept		0.55 (0.05)	0.51 (0.07)	-1.86 (0.21)		
<b>Intrapersonal factors</b>						
Gender	Female (Ref)	-				
	Male			0.26 (0.07) *	1.30 (1.13,1.50)	0.0003
Grade	Grade 9 (Ref)	-				
	Grade 10			0.59 (0.11) **	1.81 (1.45, 2.26 )	<.0001
	Grade 11			0.68 (0.11) **	1.97 (1.58, 2.45 )	<.0001
	Grade 12			0.87 (0.12) **	2.38 ( 1.88, 2.99)	<.0001
Smoking helps when bored						
	No (Ref)	-				
	Yes			0.60 (0.07) **	1.81 (1.57, 2.08 )	<.0001
Marijuana use						
	No (Ref)	-				
	Yes			0.31 ( 0.11) *	1.36 ( 1.09, 1.71)	0.0069
Mean connectedness score				-0.10 ( 0.03) **	0.91 (0.86, 0.95 )	<.0001
<b>Social Context factors</b>						
Siblings smokes						
	No (Ref)	-				
	Yes			0.29 (0.08) **	1.33 (1.15, 1.55 )	0.0002
No friend smokes (Ref)		-				
	1 friend smokes			-0.76 (0.16) **	0.47 ( 0.34, 0.64)	<.0001
	2 Friends smoke			0.37 (0.14) *	1.45 (1.10, 1.91)	0.0091
	3 Friends smoke			0.42 (0.15) *	1.52 (1.14, 2.03)	0.0048
	4 Friends smoke			1.02 (0.18) **	2.71 (1.89, 3.88)	<.0001
	5 friends smoke			1.59 ( 0.13) **	4.90 (3.80, 6.31)	<.0001
I smoke inside my home						
	No (Ref)	-				
	Yes			1.30 (0.09) **	3.66 (3.10, 4.33 )	<.0001
<b>School-level factors</b>						
Tobacco retailer density (each 1 unit change)			0.02 (0.01)*	0.03 (0.01)*	1.03 (1.01, 1.05)	0.0165
Median household income (each \$10,000 unit change)			-0.07 (0.05)			
Location						
	Rural (Ref)	-	-			
	Urban		-0.01 (0.15)			
Random variance		0.13 (0.04)	0.13 (0.04)	0.08 (0.03)	0.08 (0.03)	
<b>Intra-Class Correlation</b> <sup>a</sup>		0.039	0.036	0.023	0.023	
$\frac{\sigma^2_u}{\sigma^2_u + \pi^2/3}$						
<b>Explained variance</b> <sup>b</sup>			5.8%	41.2%	41.2%	

<sup>a</sup> Measures of the proportion of the total variance that occurs between-schools.

<sup>b</sup> Proportion of variance between schools explained by the school-level predictor variables.

\*\* $P < 0.0001$

\*  $P < 0.05$

Ref: This is the reference category

## Chapter 7

### DISCUSSIONS AND RECOMMENDATIONS

#### 7.1 General overview of the three studies

A prerequisite for the development of effective school-based smoking prevention programs and/or policies starts with an understanding of the factors that predispose adolescents to smoking. The purpose of this dissertation was to examine which student- and school-level factors differentiated (1) susceptible never smokers from non-susceptible never smokers, (2) experimental smokers from never smokers, and (3) current smokers from experimental smokers among a nationally representative sample of 29,296 Canadian students in 133 schools in grades 9-12. Understanding these factors will provide much needed information for policy makers to use in designing tobacco control strategies that will prevent never smokers from experimenting and deter those who have initiated smoking from progressing to established smoking. Each of the three studies included in this thesis have a separate discussion section (refer to section 4.5, 5.5 and 6.5). Below is a summary of the overall study.

##### 7.1.1 School-level characteristics

Overall as hypothesized in the present study, student-level and school-level characteristics were associated with smoking susceptibility, experimental smoking and current smoking among secondary school students in Canada (see Table 7.1). The smoking susceptibility among never smokers, experimental smoking and current smoking rates varied across schools as was found in other studies (Chan & Leatherdale, 2011; Leatherdale et al., 2005a; Leatherdale et al., 2005b; Leatherdale et al., 2005c; Yang et al., 2011) that used earlier cycles of the YSS data. This finding highlights the importance of examining the influence of school factors beyond individual student-level characteristics.

Among the three school neighbourhood characteristics examined (i.e., school neighbourhood SES, rural/urban location and the number of tobacco retailers located within a 1-km radius of each school), two were significantly associated with adolescent smoking behaviour. Specifically, the present study showed that the odds of a student being an experimental smoker decreased when a student attended a school in an urban or high SES neighbourhood compared to a student who attended a school that was located in a rural or low SES neighbourhood (Table 7.1). Previous studies (Chuang et al., 2009; Doku et al., 2010; Duncan et al., 1999; Pearce et al., 2009; Sellstrom and Bremberg, 2006) found associations of these two school-level factors with *established* (current) smoking but this present study is among the few studies that found an association with *experimental* smoking. Generally, neighborhoods are hypothesized to affect the health of

residents via a variety of mechanisms such as the availability of goods and services (e.g., there are more convenient stores that sell cigarettes in low SES neighbourhoods), community norms and values (e.g., some disadvantaged neighbourhood ‘cultures’ support high-risk behaviour) which are known to predispose youth to smoking (Chuang et al., 2005). Perhaps, schools situated in urban settings or within high SES communities have more resources that contribute to the well-being of adolescents (e.g., discouraging smoking initiation) compared to schools in rural settings or in low SES neighbourhoods. There is need for stronger and more in-depth studies to help public health practitioners identify specific characteristics (preferable amenable ones) in these schools (rural and low SES neighbourhoods) that predispose students to experimental smoking.

The number of tobacco retailers that were located within 1-km radius of each school was associated with the odds of a student being a current smoker (versus an experimental smoker). This school-level factor was also associated with the odds of a student being susceptible to smoking. These findings are consistent with past evidence (Chan & Leatherdale, 2011; Leatherdale and Strath, 2007; Henriksen et al., 2008) except for McCarthy and colleagues' study (2009) which found that the density of tobacco retailers was associated with adolescent *experimental* smoking but not current smoking. One plausible explanation for these findings could be similar to what other studies that used the 2008 YSS data found, that is, that regular smokers were more likely to use retail sources of cigarettes, while experimenters used social sources (e.g., borrowing cigarettes from friends or family) rendering the location of retailers less important in the present study (Health Canada, 2010). Tobacco retailers in a neighbourhood are known to increase availability and visibility (advertisements) of tobacco products (Henriksen et al., 2008).

### **7.1.2 Student-level characteristics**

Several student-level intrapersonal and social context characteristics were associated with smoking susceptibility among never smokers, experimental smoking and current smoking as shown in Table 7.1. Most of these student-level findings were consistent with earlier studies as discussed in more detail in section 4.5, 5.5 and 6.5. However, a few of these factors will be highlighted. In the present study, being in a lower grade was associated with the likelihood of a student being susceptible to smoking and was also associated with the likelihood of a student being an experimental smoker. Additionally, the odds of a student being a current smoker increased with grades (age). This finding on students' grades is consistent with previous evidence (Chan & Leatherdale, 2011; Hutchinson, Richardson, & Bottorff, 2008; Leatherdale and Burkhalter, 2012; Park, Dent, Abramssohn, Dietsch, & McCarthy, 2010; Tyc et al., 2004) and also supports Cameron et al. (1999) and Mayhew and colleagues' (2000) concept that adolescents smoking behaviour consists of several stages. Prior to trying smoking, it has been suggested that young adolescents

(e.g., in elementary school or grade 9) who do not smoke become susceptible to trying smoking, that is, they lack a firm commitment to remain smoke-free (Pierce et al., 1996). As they move to higher grades, the students who were susceptible to smoking may begin experimenting and about a third of them ((Substance Abuse and Mental Health Services Administration, 2007; U.S. Department of Health and Human Services, 2012) progress to established smoking by the time they are in grade 12.

Alcohol use was associated with two smoking stages i.e., the odds of a student being susceptible to smoking and also associated with the odds of a student being an experimental smoker as was shown in previous studies (Okoli et al., 2009; O’Loughlin et al., 2009; Yang, Leatherdale & Ahmed, 2011). Consistent with existing research (Leatherdale and Ahmed, 2010; Leatherdale and Burkhalter, 2012; Leatherdale et al., 2008; O’Loughlin et al., 2009; Okoli et al., 2009; Patton et al 2005; West et al., 2010; Yang et al., 2011), the use of marijuana was an important predictor for all the smoking stages especially the experimental stage. One striking finding was that the odds of a student being an experimental smoker versus a never smoker was more than 15 times higher (AOR 15.4, 95% CI 12.9-18.2) if a student reported using marijuana. This finding is important because of existing evidence (Patton et al., 2005) which showed that marijuana was a gateway drug to tobacco use. Patton and colleagues (2005) study among teen non-smokers found that a one report of weekly cannabis use predicted more than an eightfold increase in the odds of later initiation of tobacco use (OR 8.3; 95% CI 1.9–36). Although it is not possible to determine the temporal sequence of the association i.e., whether marijuana use precedes tobacco use or vice versa using this present study’s cross-sectional data, this finding highlights and contributes to what is already known about adolescent multi-substance or multi-risk behaviour (Elton-Marshall et al., 2011a; Leatherdale and Ahmed, 2010; Okoli et al., 2008; Ringwalt et al., 2008; Wiefferink et al., 2006).

Having positive attitudes towards smoking was associated with the likelihood of a student being in any of the smoking stages especially the odds of being susceptible to smoking as supported by past literature (Brady et al., 2008; Unger et al., 2001) and TTI. TTI posits that adolescents’ perceptions and beliefs represent the most proximal level of influence because it reflects the adolescent’s basic personality, that is, whether they are able to resist pressures to initiate smoking behaviour (Flay & Petraitis, 1994). A high score for perceived school connectedness was associated either with the decrease in the likelihood of a student being an experimental smoker or with a decrease in the likelihood of student being a current smoker. This finding is consistent with what others have reported (Bond et al., 2007; Sabiston et al., 2009). Bond and colleagues’ study (2007) showed that low school connectedness was associated with an increased risk for regular smoking in later adolescence. An adolescent’s social attachment to the school seems to be protective of smoking initiation or progression to more advanced smoking.

In terms of the social context factors, having friends who smoke was associated with the likelihood of a student being in any of the three smoking stages examined. This finding is consistent with TTI (Flay & Petraitis, 1994) and also with previous research (Bricker et al., 2006; Chan & Leatherdale, 2011; Grenard et al., 2006; Guindon, Georgiades, & Boyle, 2008; Hutchinson et al., 2008; Khuder et al., 2008; Leatherdale et al., 2005a; 2005b; 2005c; Ma et al., 2003; O’Loughlin et al., 2009; Okoli et al., 2009; Sabiston et al., 2009; Smith et al., 2007; Wen, Van Duker, & Olson, 2009; West et al., 2010; Yang et al., 2011) . Generally, having friends or family members who smoke creates more opportunities for students to receive offers of cigarettes (Baumeister and Tossmann, 2005), makes smoking appear more normative and acceptable (Flay and Petraitis, 1994; Khuder et al., 2008), and provides more social sources of cigarettes (Sunders, 2011; West et al., 2010), all of which make a student more likely to experiment with smoking (Bandura, 1986).

In addition, having at least one family member who smoked increased the likelihood of a student being in any of the three smoking stages except smoking susceptibility. TTI claims that an adolescent’s behaviour is influenced by their immediate social environment such as having smoking friends or family members who reinforce the behaviour and model the outcomes associated with the behaviour (Flay & Petraitis, 1994).

Table 7.1: Overall findings (Adjusted Odds Ratios [AOR]) of multi-level logistic analyses examining student-and school-level characteristics associated ( $p<.05$ ) with youth smoking behaviour

Characteristics		Susceptible vs. non-susceptible never smokers % (n=16,044)(AOR)	Experimental vs. Never Smokers (n=18,072) (AOR)	Current smokers vs. Experimental Smokers (n=5,440) (AOR)
<b>Intrapersonal factors</b>				
Gender (Ref=female)		Not Significant (NS)	NS	↑ 1.30
Grade (Ref=Grade 9)	Grade 10	↓ 0.75	↓ 0.74	↑ 1.81
	Grade 11	↓ 0.57	↓ 0.70	↑ 1.97
	Grade 12	↓ 0.37	↓ 0.81	↑ 2.38
<b>Pocket money to spend/save (Ref=\$0)</b>				
	\$1-\$20		↑ 1.59	
	\$21-\$100		↑ 2.03	
	>\$100		↑ 2.22	
Alcohol use (Ref=No)		↑ 2.06	↑ 3.51	
Marijuana use (Ref=No)		↑ 1.40	↑ 15.4	↑ 1.36
<b>Knowledge on tobacco</b>				
Do people have to smoke many years before it will hurt them? (Ref=No)		↓ 0.74	↓ 0.66	
Is there a danger to your health from an occasional cigarette? (Ref=No)		↓ 0.51	↓ 0.62	
Smokers quit any time they want? (Ref=No)		↑ 1.16		
<b>Beliefs</b>				
Can smoking help people when they are bored? (Ref=No)		↑ 1.42		↑ 1.81
Does smoking help people relax? (Ref=No)		↑ 1.54	↑ 3.37	
Do people who smoke become more popular? (Ref=No)		↑ 1.31		
Do you think smoking is cool? (Ref=No)		↑ 3.71		
Mean self-esteem score		↓ 0.87		
School connectedness score			↓ 0.87	↓ 0.91
School has clear set of rules about smoking (Ref=No)			↑ 1.56	
<b>Social context factors</b>				
At least one parent smokes			↑ 1.30	
At least one sibling smokes			↑ 1.46	↑ 1.33
Number of friends who smoke (0=Ref)	Yes, 1	↑ 1.33	↑ 3.68	↓ 0.47
	Yes, 2	↑ 1.56	↑ 5.87	↑ 1.45
	Yes, 3	↑ 1.58	↑ 8.57	↑ 1.52
	Yes, 4	NS	↑ 10.57	↑ 2.71
	Yes, 5	↑ 1.48	↑ 9.52	↑ 4.90
People are allowed to smoke in my home (Ref=No one is allowed to smoke in my home)		↑ 1.36		
Number of people who smoke at home (Ref=0 or none)		↓ 0.77		
I smoke inside my house (Ref=No)				↑ 3.66
<b>Social cultural factors</b>				
	Location (Ref=Rural)		↓ 0.62	
	Number of tobacco retailers (each retailer)	↑ 1.01		↑ 1.03
	Median household income (each \$10,000 unit change)		↓ 0.88	

Table 7.2: Overall findings (Adjusted Odds Ratios [AOR]) of multi-level logistic analyses including ALL student-and school-level factors associated ( $p < .05$ ) with youth smoking behaviour\*

Characteristics		Susceptible vs. non-susceptible never smokers % (n=16,044)(AOR)	Experimental vs. Never Smokers (n=18,072) (AOR)	Current smokers vs. Experimental Smokers (n=5,440) (AOR)
<b>Intrapersonal factors</b>				
Gender (Ref=female)		↑0.10	NS	NS
Grade (Ref=Grade 9)	Grade 10	↓ 0.79	NS	↑ 1.45
	Grade 11	↓ 0.55	NS	↑ 1.71
	Grade 12	↓ 0.35	NS	↑ 1.61
Pocket money to spend/save (Ref=\$0)				
	\$1-\$20	NS	↑ 2.18	↓ 0.33
	\$21-\$100	NS	↑ 2.38	↓ 0.43
	>\$100	NS	↑ 2.97	↓ 0.38
Alcohol use (Ref=No)		↑ 1.98	↑ 4.30	NS
Marijuana use (Ref=No)		↑ 1.43	↑ 14.22	↑ 1.54
<b>Knowledge on tobacco</b>				
Do people have to smoke many years before it will hurt them? (Ref=No)		↓ 0.76	↓ 0.62	NS
Is there a danger to your health from an occasional cigarette? (Ref=No)		↓ 0.54	↓ 0.69	NS
Smokers quit any time they want? (Ref=No)		↑ 1.18	NS	NS
<b>Beliefs</b>				
Can smoking help people when they are bored? (Ref=No)		↑ 1.37	↑ 1.19	↑ 1.77
Does smoking help people relax? (Ref=No)		↑ 1.54	↑ 3.11	NS
Do people who smoke become more popular? (Ref=No)		↑ 1.25	NS	↓ 0.61
Do you think smoking is cool? (Ref=No)		↑ 4.50	NS	↑ 2.50
Mean self-esteem score		↓ 0.87	↓ 0.89	NS
School connectedness score		NS	↓ 0.83	↓ 0.92
School has clear set of rules about smoking (Ref=No)		NS	↑ 1.56	NS
<b>Social context factors</b>				
At least one parent smokes		NS	↑ 1.23	NS
At least one sibling smokes		↑ 1.23	↑ 1.51	↑ 1.31
Number of friends who smoke (0=Ref)	Yes, 1	↑ 1.34	↑ 5.64	↓ 0.47
	Yes, 2	↑ 1.40	↑ 7.67	↑ 1.50
	Yes, 3	↑ 1.49	↑ 8.73	NS
	Yes, 4	NS	↑ 8.12	↑ 2.47
	Yes, 5	↑ 1.36	↑ 10.7	↑ 5.03
People are allowed to smoke in my home (Ref=No one is allowed to smoke in my home)		↑ 1.36	↑ 1.42	↓ 0.78
Number of people who smoke at home (Ref=0 or none)		↓ 0.78	NS	NS
I smoke inside my house (Ref=No)		NA	NA	↑ 3.66
<b>Social cultural factors</b>				
	Location (Ref=Rural)	NS	NS	NS
	Number of tobacco retailers (each retailer)	NS	NS	NS
	Median household income (each \$10,000 unit change)	NS	NS	NS

**Note:** NS- means that the estimate was not statistically significant at  $p < .05$ . NA- means not applicable because this question was only relevant to respondents who were smokers

\* In this model all the student and school variables were forced into the final model. The AOR of this table (7.2) were calculated from Glimmix only (Table 7.1 - AOR were calculated from Glimmix and Proc NLMixed estimates) because the Proc NLMixed analysis did not converge due to the large number of forced variables in the final model.

Table 7.2 summarizes the findings from the multi-level analyses when all the student- and school-level variables were forced into the final model. Overall, most of the findings were similar to those of Table 7.1 except for the school-level variables that were no longer statistically ( $p < .05$ ) associated with the three dependent variables when all the student-level variables were controlled for. Additionally, a student's grade was not associated with the likelihood of a student being an experimental smoker (versus never smoker), and the amount of pocket money that students were given was inversely associated with the odds of a student being a current smoker (versus experimental smoker). The results from Table 7.2 should be interpreted cautiously because (unlike the AOR in Table 7.1 which used estimates from Glimmix and Proc NLMixed analyses) only the Glimmix estimates were used to calculate the AOR. The Proc NLMixed analysis did not converge because of the large number of variables that were forced into the final model (Table 7.2).

## **7.2 Implications for research**

Each of the three studies included in this thesis have a separate implication section (refer to section 4.5, 5.5, 6.5). This part of the dissertation draws implications from the overall study.

The overall research implications include the following considerations: First, since results from this study showed that the likelihood of susceptibility among never smokers, experimental smoking and current smoking significantly varied across schools; the use of multilevel logistic regression to analyze data should be encouraged (instead of using models that ignore the clustering of individuals within schools) because it allows for an understanding of the separate and joint-effects of student (level 1) and school level (level 2) characteristics on smoking outcomes. It is imperative to examine the influence of school characteristics beyond individual student-level characteristics. The multi-level analysis allows researchers to comprehend why students with similar characteristics may not have similar behaviours in all schools.

Second, there is need for longitudinal studies to verify the findings of these three studies that are limited by temporal sequence. For example, prospective studies can be used to follow up students so that the temporal sequence between school- and student-level risk factors and smoking behaviour of students can be determined. This is important especially for the susceptibility stage because one of the research gaps identified was that none of the longitudinal studies reviewed examined the intrapersonal, social context and socio-cultural factors that were associated with adolescent smoking susceptibility. One way of achieving this is to use a longitudinal study design to evaluate changes that occur when adolescents move from being a non-susceptible never smoker to established smoking. It is also important to confirm the influence of amenable risk factors (e.g., pocket money, self-esteem, school connectedness, alcohol and marijuana use, tobacco-related knowledge and attitudes) that public health practitioners can attend to. In additions, the

identification of unchangeable risk factors such as gender or grade (age) offers valuable information for targeting interventions to at-risk population.

Third, findings from this study showed that although three school-level factors were included in the analysis there was still a noticeable percentage of variation between schools that was unaccounted for by unmeasured confounders like school-based programs and/or policies that are known to be associated (Lovato et al., 2007; Lovato et al., 2010; Murnaghan et al., 2008; Murnaghan et al., 2007; Park et al., 2010; Sabiston et al., 2009; Watts et al., 2010) with adolescents' smoking behaviour. In order to advance the field, surveillance activities can be used to explore other types of school-level measures such as the strength of school-based tobacco control programs and/or policies (Lovato et al., 2010), external factors like pro-tobacco mass media (Dalton et al., 2003), accessibility, availability of and price of tobacco products (Feighery, Ribisl, Schleicher, Rebecca, & Halvorson, 2001), tobacco product marketing (Geckova et al., 2002; Guindon et al., 2008; Wakefield, Flay, Nichter, & Giovino, 2003) and linkages with the community. Some of these school-level factors, and geospatial information to document retail outlets selling tobacco products, recreation facilities and fast food outlets will soon be included in the YSS questionnaire. This additional information will help shed more light on how these external environments (i.e., the socio-cultural context stream in the TTI) influence adolescents' health (Youth Smoking Survey, 2012).

Fourth, the literature review indicated that the definitions of smoking stages and SES were inconsistent across studies (see Table A1 in Appendix A and Table B2 in Appendix B). The definitions used in the present study are consistent with some studies but not others. There is need to use standard smoking status definitions and SES measures to allow for comparability between studies. Fortunately, work has begun towards achieving these "core indicators and measures" (Kroeker, Manske & Rynard, 2012).

### **7.3 Implications for tobacco control programs and/or policies**

Best practices guidelines on smoking prevention recommend a comprehensive approach which encourages the use of a range of interventions such as school-based prevention programs, mass media counter-advertising, community-based strategies, tax policies, smoke-free environments, cessation strategies, and tobacco industry denormalization (Centers for Disease Control and Prevention, 2007; O'Connor, Cohen, & Osterlund, 2001; Tauras et al., 2005). Individual studies and meta-analyses show that school-based anti-smoking programs and policies are effective in decreasing youth smoking rates (Kolbe, Kann, & Brener, 2001; Moore et al., 2001; Pentz, Sussman, & Newman, 1997; Sussman, 2001; Wakefield et al., 2000). However, this benefit is eroded over time (Thomas & Perera, 2006).

Despite this limitation, school-based tobacco control strategies are fundamental because adolescents spend most of their waking day at school (Leatherdale, McDonald, 2005). Several studies have examined

how school-based tobacco control programs and policies are associated with established smoking (Lovato et al., 2007; Lovato et al., 2010; Murnaghan et al., 2008; Murnaghan et al., 2007; Park et al., 2010; Sabiston et al., 2009; Watts et al., 2010) and experimental smoking (O'Loughlin et al., 2009). Findings from the present study contribute to existing literature on adolescent smoking behaviour. This information can be used to guide policy makers to develop tobacco control strategies that target youth in different stages of smoking in the future. Below are some practical ways that findings from this study can guide this process:

First, results from this study showed that almost a third (29.3%) of Canadian youth who had never smoked were at elevated risk for becoming future smokers because they were susceptible to smoking. This highlights the need for ongoing tobacco prevention programming strategies despite declining smoking prevalence rates among youth (U.S. Department of Health and Human Services, 2012). Since resources are limited, findings from this study can be used to target students that are at an increased risk of being susceptible to smoking. For example, results from the present study suggest that non-smoking students with the following individual characteristics should be targeted: those that report positive attitudes towards smoking, use alcohol or marijuana, have a low self-esteem, have friends who smoke or those who report no smoking bans at home.

It is important that the school-based strategies used are evidence-based interventions which are targeted to at-risk population to avoid what happened to the Hutchinson Smoking Prevention Project (HSPP) (Peterson, Kealey, Mann, Marek, & Sarason, 2000). HSPP was a 15-year randomized trial in the United States that evaluated a school-based social influence prevention program. However, results from this trial did not find a significant difference in the prevalence of daily smoking between the control and experimental districts. The National Cancer Institute blamed the unexpected findings on the use of an ineffective strategy such as using a curriculum-based social influence program only. They concluded that other strategies that have been shown to be effective in preventing youth smoking such as Life Skills Training should have been used in the context of a more comprehensive tobacco control program i.e., strictly enforced school tobacco-free policies, active parent and community involvement, cessation services for students and staff, and coordination with community and media efforts to reduce tobacco use (National Cancer Institute, 2000). The findings from this present study also support a multi-pronged comprehensive approach including targeting school-level factors.

Second, study results showed that the characteristics of the school a student attends may increase their likelihood of a student being in any of the examined smoking stages. Although the school a student attended accounted for a modest percentage of the variability, in line with population health, small changes overtime collectively across all Canadian secondary schools will translate to thousands of lives saved from tobacco-related deaths in the future.. This means that appropriate well targeted strategies to schools may

produce small but impactful changes (prevention or cessation efforts) in the smoking behaviour of the student population in Canada.

Third, the finding that the number of tobacco retailers that were located within 1-km radius of each school was associated with the odds of a student being a current smoker (versus an experimental smoker) or a susceptible never smoker (versus a non-susceptible never smoker) supports tobacco control recommendations regarding the zoning restrictions to limit sales of tobacco products near schools (Chan & Leatherdale, 2011; Henriksen et al., 2008; Kline, 2004; McCarthy et al., 2009; Pearce et al., 2009). Zoning laws in the U.S., specifically regarding limiting the concentration of alcohol retailers in neighbourhoods led to a reduction of alcohol consumption (National Research Council and Institute of Medicine, 2003). There is interest in adapting this strategy in tobacco control (Henriksen et al., 2008). Zoning regulations have been used in a few states in California to regulate the location of tobacco retailers near venues like schools or residential premises (Public Health Law & Policy, 2010). Unfortunately, this has not been implemented in Canada. In Canada, the government should consider dedicating some funds to conduct pilot studies that focus on zoning as one of the tobacco-control interventions. For example, researchers can compare the smoking rates of students who attend schools in neighbourhoods that have implemented zoning regulation, with the smoking rates of students who attend schools that are located in neighbourhoods that have not implemented zoning regulations.

Fourth, the finding of friends or family members who smoke was consistent across all the smoking stages and the risk increased as the number of closest friends who smoke cigarettes increased. This finding emphasizes the need to target (with prevention and cessation interventions) both the subpopulation of students at risk of being current smokers and also their smoking family members and friends that put them at greatest risk (Leatherdale et al., 2005a; Leatherdale et al., 2005b). Students need to be encouraged to forge friendships with non-smoking peers who will model the benefits of being tobacco free.

Fifth, low school connectedness scores, low self-esteem, and use of alcohol or marijuana increased the likelihood of a student being in a smoking stage. School health experts recommend that schools curricula should use a comprehensive school health approach (CSH) which consists of four pillars; teaching and learning; school policies; social and physical environment; and community partnerships and services (Joint Consortium for Schools Health, 2009; New Brunswick Student Wellness Strategy[NBWS]), 2009). Research has shown that this approach is effective in improving both the student's educational outcomes and targets his/her immediate social and physical environments (Joint Consortium for Schools Health, 2009) which are known to predispose adolescents to experimenting with cigarettes (Flay & Petraitis, 1994). Moreover, this approach encourages healthy social behaviours, for example, it helps students feel more connected to their school, and it also boosts their self-esteem, equips them with relevant anti-smoking

knowledge and skills to resist substance use. Additionally, CSH links them with community resources. Therefore, this approach helps to deter never smokers from initiating smoking or smokers from progressing to regular smoking. It is also consistent with current efforts in Canada (e.g., NBWS) to address “upstream” issues in school settings to create environments and provide skills to enable the youth to resist any form of substance use.

A notable observation is that although the CSH programs are recommended, this approach mainly addresses two out of three streams of the TTI, namely the intrapersonal (individual) and social context (peers and family) streams of the TTI. There is need to also address school-level influences. Furthermore, results from this study showed that the programs need to be school-specific i.e., tailored to the needs of the secondary schools especially those that were identified as predisposing the students to smoking. Specifically, the CSH needs to be responsive to schools in rural areas or those schools that are located in low SES neighbourhoods or schools that are surrounded by tobacco retailers within a 1-km radius. Finally, the odds of a student being current smoker increased as students’ grades increased from grade 9 to 11 as was the case in existing literature (SAMHSA, 2007). These findings suggest that school-based prevention strategies should be implemented early when students are in lower grades and sustained into high school years.

## **7.4 Strengths and Limitations**

### **7.4.1 Strengths of this study**

The present study has several strengths including the provision of nationally representative evidence of the importance of multi-level factors for Canadian adolescent smoking behaviours. It is guided by a relevant theory i.e., TTI which is a comprehensive theory that offers testable predictions and insights regarding the causes of health-related behaviours including tobacco use (Flay & Petraitis, 1994). This study also examines these factors among adolescents in different smoking stages i.e., being susceptible to smoking, experimental smoking and current smoking and uses an appropriate analysis method (i.e., 2-level multi-level logistic regression). A 2-level multi-level logistic regression is appropriate because it accounts for the clustering of students within schools by allowing the model intercept to vary across schools, thus, produces accurate standard errors and reduces the likelihood of Type 1 error (McMahon et al., 2006).

## 7.4.2 Limitations

The present study has several limitations as indicated below:

- 1) The YSS and Census data are cross-sectional thus limits results to associations only, causal relationships cannot be inferred.
- 2) The use of secondary data analysis limits the variables available for use. For example, some of the protective and risk factors for adolescent smoking behaviours that were mentioned in the literature review (refer to Table B3 in Appendix B) and the TTI are not available in the data set that was used for the present study. They include intrapersonal factors (e.g., nicotine dependence, single-parent families, academic performance, depression, stress, impulsivity, religiosity, motivation to comply, social bonding social skills, self-determination, self-efficacy behavioural control), and broader social cultural factors such as school-based programs and/or policies, tobacco advertising and price. The fact that these plausibly relevant variables were not included in the present study means that fundamental predictors or moderators may have been missed.
- 3) This study used one Census variable (median household income) as a proxy measure for school neighbourhood SES. Various authors have criticized prior studies for exclusive reliance on Census data to measure neighbourhood characteristics (Furstenberg and Hughes 1997; Leventhal and Brooks-Gunn 2000). The use of multiple neighbourhood measures (social, physical and demographic) is preferred (Chuang, Cubbin et al., 2005).
- 4) The classification of the urban/rural location maybe a limitation because suburban areas that are usually located outside large cities may be classified as rural and yet in reality may have characteristics that are more urban than rural. There is need to include the suburban classification in the future.
- 5) There is no information on the reliability and validity of the DMTI-EPOI data. However, other studies have used the same measure (Chan & Leatherdale, 2011; Leatherdale & Strath, 2007).
- 6) The data are generalizable to youth who attended secondary schools in the 10 Canadian provinces. It excluded the following groups; a) all youth who do not go to school, b) all elementary school going youth , c) all youth in the territories, d) all youth in the military bases, institutions and those attending special schools e.g., visually- or hearing-impaired youth.

## 7.5 Conclusions

As hypothesized in the present study, student- and school-level characteristics were associated with the three smoking stages that were examined. This study showed that the characteristics of the school a student attends can increase their likelihood of a student being in any of the examined smoking stages. The location of a school that is, being in an urban or a high SES neighbourhood was inversely associated with experimental smoking when adjusting for student characteristics. The number of tobacco retailers that were located within 1-km radius of each school was associated with the odds of a student being a current smoker. It was also associated with a never smoker being susceptible to smoking. Several student-level intrapersonal and social context factors were associated with all the examined smoking stages. These findings underscore the continued need to develop new tobacco prevention policies and/or programs that are responsive to the risk and protective factors of adolescents in different smoking stages.

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## APPENDICES

### Appendix A

Table A1: Smoking stages of adolescents

Authors	Smoking stages	Definition of the stages
Cameron et al., 1999	5 stages: 1.Never smoker 2.Tried smoking 3.Experimenters 4.Regular smokers 5.Quit	<p>“<i>Never smoker</i>” was defined as someone who had never smoked, not even a puff</p> <p>“<i>Tried smoking</i>” was defined as someone who tried smoking a cigarette only once in the last 30 days</p> <p>“<i>Experimenter</i>” was defined as someone who smoked more than once in the last 30 days but does not smoke every day or almost everyday</p> <p>“<i>Regular smoker</i>” was defined as someone who smokes every day or almost over the last 30 days.</p> <p>“<i>Quit</i>” was defined as someone who smoked more than 100 cigarettes in the past but has not smoked in the last 2 weeks and considers themselves as quit</p>
Mayhew et al., 2000	6 stages: 1.Non-smoking – preparation 2.Non-smoking-contemplation and preparation 3.Tried 4.Experimenter 5.Regular 6.Established/daily smoker	<p>“<i>Non-smoker-pre contemplation phase</i>” is defined as a non-smoker who did not intend to smoke i.e., not susceptible (Pierce et al., 1996)</p> <p>“<i>Non-smoker-contemplation and preparation</i>” is defined as a non-smoker who intends to smoke i.e., susceptible (Pierce et al., 1996)</p> <p>“<i>Tried</i>” was defined as one who answered yes to “ever smoke”, has not smoked more than one or two cigarettes. Has not smoked in last year. May state that they have tried but quit</p> <p>“<i>Experimenter</i>” was defined as one who smokes occasionally on an experimental basis and does not intend to be a permanent smoker</p> <p>“<i>Regular</i>” was defined as one who smokes at least monthly, not as frequently as daily</p> <p>“<i>Established/daily smoker</i>” was defined as one who smokes daily. May smoke on occasion.</p>

## Appendix B

Table B2: A summary of intrapersonal, social context and socio-cultural factors associated with adolescent smoking behaviour from 48 studies

Author and study design	Factors
<b>Smoking susceptibility</b>	
<p>Carvajal, et al., 2004            Design: Cross-sectional            Location: USA            Sample size: 2,004            Age/grade: Median age 12 years            Analysis: Logistic regression</p>	<p><b><u>Intrapersonal factors</u></b>            -depression, poor parenting, poor coping strategies, low academic aspiration predicted smoking susceptibility            -global expectancies (extent to which one has favorable beliefs toward themselves and their future outcomes i.e., constructs like optimism and hope) predicted susceptibility in low SES students.</p> <p><b>Definition:</b> susceptibility definition is consistent with study by Pierce et al., 1996</p>
<p>Chan &amp; Leatherdale, 2011            Design: Cross-sectional            Located: Canada            Sample size: 36,175            Age/grade: Grade 9-12            Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b>            -never smokers in grades 10, 11 or 12 were less likely to be susceptible to future smoking compared to never smokers in grade 9</p> <p><b><u>Social context</u></b>            -being surrounded by smoking social influences i.e., older sibling and having a close friend (s) who smoke(s) increased the likelihood that never smokers are at risk for future smoking</p> <p><b><u>Socio-cultural factors</u></b>            - Number of tobacco retailers surrounding a school (1-km radius) was found to be associated with the likelihood of a never smoker being susceptible to future smoking (OR 1.03, 95CI% 1.01, 1.05).            -Neighbourhood disadvantage (those receiving social assistance) was not significantly associated with the likelihood of a never smoker being susceptible to smoking</p> <p><b>Definition:</b> susceptibility definition is consistent with study by Pierce et al., 1996</p>
<p>Chen et al., 2008            Design: Cross-sectional            Located: Canada            Sample size: 1,870            Age/grade: Grade 10-11            Analysis: Multivariate logistic regression            Project: British Columbia Youth Survey on Smoking and Health in 2001/2002</p>	<p><b><u>Intrapersonal factors</u></b>            -11th graders were less susceptible than 10th graders (odds ratio [OR]=0.80, 95% CI 0.64–0.99),            -girls were more susceptible than boys (OR=1.32, 95% CI 1.05–1.65).            -Ethnicity was not significant</p> <p><b>Definition:</b> Two aspects of susceptibility were measured (estimating smoking in the future and self-efficacy). To estimate smoking in the future, participants were asked “How likely is it that you will be smoking five years from now?” (very likely, somewhat likely, rather unlikely, and very unlikely). The second question i.e., the aspect of self-efficacy was measured by the question “How difficult is it for you not to smoke?” (not at all difficult, not very difficult, fairly difficult, very difficult, and extremely difficult). Only the adolescents who responded “very unlikely” to the question about estimation of smoking and responded “not at all difficult” to the question about self-efficacy were categorized as not susceptible to smoking, while those who gave any other responses were categorized as susceptible to smoking.</p>
<p>Guidon et al., 2008            Design: Cross-sectional study            Located: Laos, Cambodia, Vietnam            Sample: 260 schools            Age/grade: 11-17            Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b>            -Students who have access to pocket income are found to be more susceptible. while greater knowledge of the harmful effects of secondhand smoke appears to diminish susceptibility to smoking</p> <p><b><u>Social context</u></b>            -Students who have parents or friends who smoke and are who are exposed to secondhand smoke at home. Restrictive home smoking policies were associated with lower likelihood of trying smoking</p> <p><b><u>Socio-cultural factors</u></b>            -4.5% and 4.2% of the variation in smoking susceptibility is associated with school and class differences. -For girls billboard tobacco ads increases the risk of susceptibility. Classroom prevention decreases risk, Attendance of schools with higher prevalence of tobacco use increases risk of susceptibility, Anti-smoking media decreases risk</p>

	<p><b>Definition:</b> Smoking susceptibility among South East Asian never-smokers (that is, never tried or experimented with cigarette smoking, even one or two puffs), was derived using the algorithm of Pierce et al, 1996</p>
<p>Leatherdale et al., 2005a Design: Cross-sectional study Located: Canada Sample: 6679 (29 secondary schools) Age/grade 9-12 Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> -The odds of a never smoker being susceptible to smoking also decreased as age increased (OR=0.75) or if the student was male (OR=0.54), if a student believed smoking was harmful to health (OR= 0.64). -The odds increased if the student believed smoking was a waste of money (OR= 1.96) -The odds of a never smoker being susceptible to smoking decreased if student was not interested in smoking (OR 0.50) , enjoyed doing other things (OR=0.75), believed public places should definitely be smoke-free (OR= 0.30), believed students got into trouble for breaking school smoking rules (OR=0.76) -Psychosocial characteristics, the odds of a never smoker being susceptible to smoking decreased if a student (e) had friends who would disapprove of smoking (OR=0.49)</p> <p><b><u>Social context</u></b> -The odds of a never smoker being susceptible to smoking increased as the number of close friends who smoke increased (OR= 1.26) , if the student was exposed to smoking at a job (OR= 1.43)</p> <p><b><u>Socio-cultural factors</u></b> -If a non-smoking student attended a school where there was student smoking on the school periphery, he or she was less likely to be susceptible to smoking (OR= 0.71). -A significant contextual interaction between the smoking on the school periphery and friends' disapproval of smoking was identified (<math>\beta = 0.68 [0.23], p &lt; .01</math>); students with friends who disapprove of smoking were more likely to be susceptible to smoking if they attended a school with student smoking on the school periphery. -Intraclass correlation coefficient (ICC) was significant i.e., ICC=0.05 [0.02], <math>p &lt; .05</math> between-school random variation was identified. This accounted for 4.8% of the variability in the odds of being a susceptible never smoker</p> <p><b>Definition:</b> : susceptibility (Pierce et al., 1996)</p>
<p>Okoli et al., 2009 Design: Cross-sectional Located: Canada Sample size: 278 (49.6% male) Age/grade: mean age 15 (SD 1.5) Analysis: Multivariate logistic regression Project: British Columbia Youth Survey of Smoking and Health II</p>	<p><b><u>Intrapersonal factors</u></b> <i>Adolescents that were most susceptible to smoking:</i></p> <ul style="list-style-type: none"> <li>• were female, younger and in lower grade, had ever puffed a cigarette, had used alcohol or marijuana, had higher depression scores, and higher perceived physical and mental addiction to tobacco</li> </ul> <p><b><u>Social context</u></b> -had family members or peers who smoked</p> <p><i>In multivariate logistic analysis:</i></p> <ul style="list-style-type: none"> <li>• perceived mental addiction but not perceived physical addiction to tobacco was significantly associated with smoking susceptibility</li> </ul> <p><b>Definition:</b> Susceptibility was an adaptation of the measure developed by Pierce et al. (1996)</p>
<p>Smith et al., 2007 Design: Cross-sectional Located: U.S. Sample size: n=785 (48% male) Race: 80% white,14% Age/grade: Grade 9-12 Analysis: Logistic regressions</p>	<p><b><u>Intrapersonal factors</u></b> -Having more favorable attitudes toward remaining tobacco free OR(CI) 0.53 (0.29-0.96) and perceiving that friends would not be supportive of smoking OR 0.73 (<math>P&lt;.05</math>) were both associated with decreased likelihood of intending to smoke. -Perceived difficulty to quit was associated with decreased smoking intentions-OR(CI) 0.74 (0.56-0.99)</p> <p><b><u>Social context</u></b> -Normative influence and peer use were significant i.e., having more friends who smoke OR(CI) 1.78 (1.25-2.54) was associated with increased odds of intent to smoke</p> <p><b>Definition:</b> Non-smokers did not smoke or did not smoke in the past 30 days. Current smoker-smoked at least 1 cigarette in the past 30 days was coded as a smoker.</p>

<p>Szabo et al., 2006 Design: Cross-sectional Located: Australia Sample: 4125 Age: 12-17 years Analysis: Polytomous logistic regression analysis</p>	<p><b><u>Social context</u></b> Residing in homes with a total ban on smoking were least likely to be susceptible to smoking</p> <p><b>Definitions:</b> Non-susceptible non-smoker are those who had never smoked and were certain not to smoke. Susceptible non-smokers are those who had never smoked but were certain about smoking in the future or had a puff of a cigarette and were certain not to smoke again.</p>
<p>Unger et al., 2001 Design: Cross sectional Located: USA Sample size: 2681 Age/grade: Grade 10 Analysis: Logistic regression analysis</p>	<p><b><u>Intrapersonal factors</u></b> -Attitudes about perceived social consequences of smoking-makes one look cool (never smokers=OR=1.69 and ever-smokers=OR=1.73) - subjective norms (do peers think it's ok to smoke once in a while? (OR=1.21 ever-smoker; Never smoker= Not significant (NS)).</p> <p><b>Definition:</b> Smoking susceptibility (Pierce et al., 1996). Never smokers were defined as those who had never tried smoking even a puff. The opposite is ever smokers</p>
<p>Yang et al., 2011 Design: Cross-sectional Located: Australia Sample: 4125 Age: 12-17 years Analysis: Multi-level logistic regression analysis</p>	<p><b><u>Intrapersonal factors</u></b> - Smoking susceptibility was associated with having ever used alcohol or marijuana, being female and being in grade 9.</p> <p><b><u>Social context</u></b> -Smoking susceptibility was also associated with having a sibling who smokes, having 1 or 2 close friends who smoke. - Parental smoking and exposure to smoking in a car or in the home were not significantly associated with smoking susceptibility.</p> <p><b>Definition:</b> Smoking susceptibility (Pierce et al.,1996)</p>
<b>Experimental smoking / Smoking initiation</b>	
<p>*Chassin et al., 2005 Design: Longitudinal study Located: USA Sample size: 382 Age: 10-17 years Analysis: Logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> -Adolescents from disengaged families (low acceptance i.e., nurturance, warmth, attachment) and low behavioral control (i.e., monitoring, consistent discipline)) were most likely to initiate smoking. Adolescents reports of parents' smoking-related discussion was related to lowered smoking risk for teens with non-smoking parents. Opposite findings for teens with smoking parents</p> <p><b><u>Social context</u></b> -Parents who smoke</p> <p><b>Definition:</b> Smoking initiation: Adolescents reported whether they had ever smoked and their current smoking frequency, from less than monthly to daily.</p>
<p>*Dalton et al., 2003 Design: Prospective study Located: USA Sample size: 3547 adolescents Age/grade: 10-14 years Analysis: General linear models</p>	<p><b><u>Socio-cultural factors</u></b> After controlling for baseline characteristics, adolescents in the highest quartile of exposure to <b>movie</b> smoking were about 2.7 times more likely to initiate smoking compared with those in the lowest quartile. In this cohort, 52% of smoking initiation can be attributed to exposure to smoking in movies</p> <p><b>Definition:</b> Never smokers were students who had never tried smoking, not even a puff</p>
<p>*Grenard et al., 2006 Design: Prospective Located: China Sample size: 11 583 Age: 12-17 or older Analysis: Multi-level logistic regression TTI conceptual framework</p>	<p><b><u>Intrapersonal factors</u></b> -Susceptibility to smoking, - low self-confidence to quit smoking</p> <p><b><u>Social context</u></b> parental monitoring, good friend smoking, and peer smoking</p> <p><b><u>Socio-cultural factors</u></b> school academic ranking, initial liking of smoking, meaning of smoking</p>

	<p><b>Definition:</b> lifetime (those who have tried a cigarette even a puff) and past 30-day smoking (those who smoked 1-20 cigarettes per day in the past 30 days)</p>
<p>Leatherdale et al., 2005b Cross-sectional study Located :Canada Age: 13-16 years (Grade 9-11) Sample:4850 Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> The odds of being an experimental smoker increased if a student, intended to accept a cigarette if offered from a friend, intended to smoke in the next year, thought that students at school got into trouble for breaking the school smoking rules (OR=1.30), was exposed to smoking at a job (OR 1.52). Age and sex were not significant Psychosocial characteristics of students were also important. The odds of being an experimental smoker increased if a student (a) intended to accept a cigarette if offered from a friend [OR= 6.49), intended to smoke in the next year (OR= 3.78)</p> <p><b><u>Social context</u></b> The odds of being an experimental smoker increased if a student, had close friends who smoked (OR= 2.59)</p> <p><b><u>Socio-cultural factors</u></b> Students were at increased risk for becoming an experimental smoker if they attended a school with a relatively high smoking rate among senior (grade 12 and 13) than a similar student attending a school with a lower prevalence of older students who smoke . Each 1% increase in smoking rate among high school seniors increased the odds that a junior student was an experimental smoker vs. a tried-once smoker (OR=1.07) ICC-significant between-school random variation was found = 0.11 (0.04), P&lt;0.001). The school a junior student attended was significantly related to his or her likelihood of being an experimental smoker versus a tried smoker</p> <p><b>Definition:</b> Experimental smokers were operationally defined (1 = smoked more than once in the 30 days prior to the survey but did not smoke every day or almost every day). Tried-once smokers were operationally defined (0 = tried smoking only once in their life)</p>
<p>Ma et al., 2003 Design: Cross-sectional study Located: China Sample size: 3412 in rural &amp; urban Age: 9<sup>th</sup> grade Analysis: Two-level multiple logistic regression models</p>	<p><b><u>Intrapersonal factors</u></b> <i>Lifetime experimental smoking:</i> -Strongly associated with low refusal self-efficacy across both urban (OR=14.79 boys; OR=7.24 girls) and rural (OR=9.56 boys; OR=4.69 girls) samples. <i>Lifetime whole cigarette smoking</i> -Strongly associated with low refusal self-efficacy across both urban (OR=16.87 boys; OR=15.06 girls) and rural (OR=11.99 boys; OR=10.92 girls).</p> <p><b><u>Social context</u></b> -Strongly associated with peer smoking: <i>Lifetime experimental smoking</i> (OR=2.34 boys; OR=2.25 girls) and rural (OR=4.13 boys; OR=2.30 girls). <i>Lifetime whole cigarette smoking</i> (OR=2.53 boys; OR=2.69 girls) and rural (OR=2.73 boys; OR=3.03 girls).</p> <p><b><u>Socio-cultural factors</u></b> Lifetime experimental and whole cigarette smoking prevalence was higher among urban girls than among rural girls (All P&lt;0.05)</p> <p><b>Definitions:</b> Lifetime (one who has experimental smoking (tried smoking even a puff) or if one has smoked a whole cigarette)</p>
<p>McCarthy et al., 2009 Cross-sectional population-based study Located: USA Age: 12-18 Analyses: Multi-level logistic regression</p>	<p><b><u>Socio-cultural factors</u></b> -Density of retailers (geocoded state-reported locations of tobacco retailers) was associated with experimental smoking (OR=1.11) but not established smokers (OR=1.06) .This was confined to high school students (OR=1.17) in urban areas (OR=1.11). No effects were observed among middle school students or in rural school. High school students were more likely to obtain cigarettes from retailers, while middle school relied on social sources.</p> <p><b>Definition:</b> Experimental smoking was defined as smoking cigarettes at least 1 day in the preceding 30 days and not having smoked at least 100. Established smoking was defined as smoking cigarettes at least 1 day in the preceding 30 days and having ever smoked 100 or more cigarettes. These smoking status measures have been validated and used in previous studies and adolescents' self-reports of tobacco use have been shown to be generally valid.</p>

<p>*O'Loughlin et al., 2009 Design: Prospective study (longitudinal study) Located: Canada Sample size: n=877 Age/grade: Grade 7-12 Analysis: multivariate logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> - Sample (48% of 877) initiated smoking during follow-up. Factors associated with higher rate of smoking initiation: -Single-parent family status, younger age, poor academic performance -Psychosocial- stress, impulsivity, feeling a need to smoke, and not being afraid of package warnings -Alcohol and the use of other tobacco products (lifestyle)</p> <p><b><u>Social context</u></b> -Social environment –parents, siblings, friends, or teachers/staff who smoke - temptation from tobacco advertising</p> <p><b><u>Socio-cultural factors</u></b> -School tolerance of smoking</p> <p><b>Definition:</b> Initiation of a smoking was defined to have occurred during the data collection cycle in which participants reported smoking 1 or more cigarettes for the first time in the 3-month recall of cigarette use. Initiating daily smoking was defined to have occurred during the survey in which participants reported smoking every day in at least 1 or the preceding 3 months.</p>
<p>Szabo et al., 2006 Cross-sectional study Located: Australia Sample: 4125 Age: 12-17 years Analysis: Polytomous logistic regression analysis</p>	<p><b><u>Social context</u></b> Residing in homes with a total ban on smoking were least likely to have experimented with smoking. Interaction: between parental smoking status (but not friends who smoke) and home bans i.e., effect of home bans was strongest when neither parent smoked (home bans reduce the likelihood of an adolescent trying tobacco regardless of their friends smoking behaviour)</p> <p><b>Definition:</b> Experimental smoker– had a puff of a cigarette and was uncertain of not smoking again or had smoked fewer than 100cigarettes and had not smoked in the preceding week. Current smokers had smoked during the previous 7 days or had smoked more than 100 cigarettes and smoked in the previous month</p>
<b>Current smoking/regular/daily/occasional</b>	
<p>Bjarnason et al., 2003 Design: Cross-sectional study Located: 11 European countries Sample size: 33 978 Age:15-16 year olds Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> -Those who live with biological parents smoke less than those living with single mothers, who in turn smoke less than those living with single fathers, or with neither biological parent</p> <p><b>Definition:</b> dependent variable is a frequency-quantity measure of cigarette smoking constructed from a measure of life-time cigarette use and a measure of cigarette smoking in past 30 days</p>
<p>*Bricker et al, 2006 Design: Longitudinal study Located: USA Sample size: 4,576 families 3<sup>rd</sup> grade- 12<sup>th</sup> grade Analysis: social transmission probability model</p>	<p><b><u>Social context</u></b> -Probability that each close friend's smoking influenced child to smoke daily was 9% , each parents smoking influenced child was 11%, influenced by older sibling 7%</p> <p><b>Definition:</b> daily smoking status was defined as using cigarettes occasionally or often</p>
<p>Carvajal, et al., 2004 Design: Cross-sectional Location: USA Sample size: 2,004 Age/grade: Median age 12 years Analysis: Logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> <i>Predictors of current / regular smoking</i> -older (OR= 1.27), positive (OR=1.19) and negative attitudes towards smoking (OR=0.89), impediments to smoking (OR=0.89), self- efficacy to resist smoking (OR=0.82), academic success (OR=0.73), and parental norms (OR=0.86)</p> <p><b>Definition:</b> Current smoker-one who had smoked one or more cigarettes in the past 30 days. Regular smoker-one who had tried cigarettes 100 or more times or smoked cigarettes on 10 or more of the past 30 days</p>

<p>Chan &amp; Leatherdale, 2011  Design: Cross-sectional  Located: Canada  Sample size: 36,175  Age/grade: Grade 9-12  Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b>  -students in grades 10, 11 or 12 were more likely to be occasional or daily smokers than students in grade 9</p> <p><b><u>Social context</u></b>  -being surrounded by smoking social influences i.e., older sibling, a parent and having a close friend(s) who smoke(s) increased the likelihood of being an occasional or daily smoker</p> <p><b><u>Socio-cultural factors</u></b>  - number of tobacco retailers surrounding a school (1-km radius) and the neighbourhood disadvantage (those receiving social assistance) was not significantly associated with being an occasional or daily smoker</p> <p><b>Definition:</b> reported smoking more than 100 cigarettes in their life, students who reported smoking tobacco every day or almost every day in the 30 days preceding the survey were considered daily smokers, whereas those who reported smoking some days or only 1 or 2 days in the 30 days preceding the survey were considered occasional smokers.</p>
<p>*Chassin et al., 2008  Design: Longitudinal, multi-generational natural history study (longitudinal study)  Located: U.S.  Sample size: n=8,487  Age/grade: Grade 6-12  Analysis: Logistic regression</p>	<p><b><u>Social context</u></b>  -Parents who had an early onset, steep acceleration, high levels of smoking, and persistence over time had the highest risk for intergenerational transmission of smoking to their adolescent children</p> <p><b>Definition:</b> Ever smoked a cigarette</p>
<p>Chuang, 2005  Design: Cross-sectional study  Located: USA  Sample size: 959  Age: 12-14  Analysis: Mplus statistical modeling process</p>	<p><b><u>Socio-cultural factors</u></b>  -Low socioeconomic (SES) neighbourhoods were associated with increased parental monitoring, which was further associated with decreased tobacco use.  Note: these are not high school students- smoking prevalence is expected to be lower in middle and elementary schools</p> <p><b>Definition:</b> Adolescents were asked “how much have you ever smoked cigarettes in your life?” responses ranged from none, not even a puff to more than 20 whole cigarettes along a five-point scale</p>
<p>Chuang et al., 2009  Design: Cross-sectional  Located: USA  Sample size: 924  Age: adolescents  Analysis: Cluster Analysis</p>	<p><b><u>Social context</u></b>  -Parental smoking, Peer smoking</p> <p><b><u>Socio-cultural factors</u></b>  SES and Rural vs. urban (interactions). Parental smoking was associated with increased adolescent smoking in suburban white middle SES neighborhoods. Peer smoking was associated with increased adolescent smoking in rural neighborhoods</p> <p><b>Definition:</b> Individuals who have puffed to “more than 20 whole cigarettes</p>
<p>Doku et al., 2010  Design: cross sectional biannual surveys from 1977-2007  Located: Finland  Sample size: 96,747  Age: 12-18  Analysis: Logistic regression</p>	<p><b><u>Socio-cultural factors</u></b>  -SES smoking measured by familial SES or individual social position persisted over 30 years with higher rates of smoking in lower SES groups  -Used different SES indicators i.e., fathers occupation, education level, mothers education, school performance, type of schools, and students’ performance</p> <p><b>Definition:</b> Different indicators of smoking because there were differences in the prevalence of smoking between 12–14-year olds and 16–18-year olds, the analyses were performed separately for these age groups. Among 12–14-year-olds, smokers were those who had smoked two or more cigarettes in their lifetime. For 16–18-year-olds, smokers were those who reported having smoked more than 50 cigarettes in their lifetime, had smoked during the past week, and smoked daily. Both outcomes are dichotomous</p>

<p>Duncan et al., 1999  Design: Cross-sectional study  Located: UK  Sample size: Age : all  Analysis: Multi-level logistic regression</p>	<p><b><u>Socio-cultural factors</u></b>  After taking account of the large range of individual characteristics, both as main effects and interaction , measures of the neighbourhood deprivation continue to have an independent effect on individual smoking status</p>
<p>Henriksen et al., 2008  Design: cross-sectional data  Location: USA  Sample size: 135 high schools  Age/grade: adolescents  Analysis: Multiple regressions and Ordinary Least squares (OLS) regressions</p>	<p><b><u>Socio-cultural factors</u></b>  -Current smoking prevalence was 3.2 percent points higher at school in neighbourhoods with the highest tobacco outlet density (&gt;5 outlets) than in neighbourhoods without any tobacco outlets.- Density of retail cigarette advertising in school neighbourhoods was similarly associated with high school smoking prevalence. Neither the presence of tobacco outlet within 1000 ft. of a high school nor the distance to the nearest tobacco outlet from school was associated with smoking prevalence  <b>Definition:</b> Individual-level data about smoking was aggregated (all at school level)  Smoker was one who reported any cigarette smoking in the past 30 days</p>
<p>Hutchinson et al., 2008  Design: Cross-sectional  Located: Canada  Sample size: n=1,337  Grade: Grade 8-12  Analysis: Logistic regression models</p>	<p><b><u>Intrapersonal factors</u></b>  <i>Significant predictors of current smoking</i>  - increasing grade OR (CI) 1.30 (1.19-1.43)  -Gender (female)- OR (CI) 1.46 (1.07-1.98)  -As depression scores increased, so did smoking (Highest depression quartile OR (CI) 2.45 (1.53-3.94). Being in the highest depression quartile, and having lower scores on the family dimension on life satisfaction scale was associated with increased odds of being a smoker  <b><u>Social context</u></b>  - Having a best friend who smokes is the best predictor for current smoking OR(CI) 5.86 (4.34-7.92) and also having other smokers in the house OR(CI) 1.79 (1.31-2.45)  <b>Definition:</b> Current smoking was defined as those who had smoked at least once in the previous month (British Columbia Youth Survey on Smoking and Health II [BCYSSH II])</p>
<p>Kalesan et al., 2006  Design: Cross-sectional study  Located: USA  Sample size: 55,967  Age/grade: 6-12  Analysis: Logistic regression model</p>	<p><b><u>Intrapersonal factors</u></b>  Non-smoking parents and strict concern about smoking had the lowest likelihood of being a current smoker. After adjusting for other social factors, the likelihood of being a current smoker was more than 5 times greater among boys than girls whose parents had smoked and were minimally concerned about smoking  <b><u>Social context</u></b>  Non-smoking parents and strict concern about smoking had the lowest likelihood of being a current smoker  <b>Definition:</b> A current smoker was defined by smoking cigarettes every day for at least 30 days, and a never smoker was defined as never having puffed on a cigarette and having no intention to smoke cigarettes in the future.</p>
<p>Khuder et al., 2008  Design: : Cross-sectional  Located: U.S.  Sample size: n= 5,392 (53.6% male)  Age/grade: aged 10-18  Analysis: Multiple logistic regression  Project: Northwest Ohio youth Survey (NOYTS)</p>	<p><b><u>Intrapersonal factors</u></b>  -Low academic achievement among adolescents in all grades  <b><u>Social context</u></b>  - Having a close friend that smoked  - Having a smoker at home  <b>Definition:</b> Smoker -ever smoked at least one cigarette every day for 30 days?"</p>
<p>Leatherdale et al., 2005c  Design: Cross-sectional study  Located :Canada  Age: 13-16 years (Grade 9-13)  Sample size: 22,091  Analysis: Multi-level logistic regression</p>	<p><b><u>Social context</u></b>  -Non-smokers were at a greater risk for transitioning to tobacco use if they had friends or parents who smoke. The odds of being an occasional smoker also increased if a student (a) had a father who smoked (OR= 1.36), had a mother who smoked (OR= 1.62), had an older brother who smoked (OR= 2.04), had an older sister who smoked (OR= 1.92), as the number of close friends who smoke increased (OR= 2.80).</p>

	<p>-The odds of being a regular smoker also increased if a student: had a father who smoked (OR= 1.25), had a mother who smoked (OR= 1.35), had an older brother who smoked (OR= 1.42), -had an older sister who smoked (OR= 1.5), and as the number of close friends who smoke increased (OR= 1.48).</p> <p><b>Socio-cultural factors</b></p> <p>-Students were at increased risk for smoking onset if they attended a school with a relatively <b>high smoking rate</b> among senior (grade 12 and 13)</p> <p>ICC-significant between-school random variation was found = 0.11 (0.04), P&lt;0.001). The school a junior student attended was significantly related to his or her likelihood of being a regular smoker versus an occasional smoker</p> <p><b>Definition:</b> Never smokers were defined as students who reported that they had never smoked a cigarette, not even a puff. Occasional smokers were defined as students who reported that they smoked more than once in the 30 days prior to the survey but did not smoke every day or almost every day. Regular smokers were defined as students who reported that they smoked every day or almost every day in the 30 days prior to the survey.</p>
<p>Leatherdale, 2005d Design: Cross-sectional population-based study Located: Canada Sample: 20,297 Age/grade 9-12 Analysis: Logistic regression</p>	<p><b>Socio-cultural factors</b></p> <p>-Occasional smokers were less likely to buy their own cigarettes (OR=0.85) and more likely to ask someone to else to buy their cigarettes (OR=1.24) (the more frequently they are asked their age on purchase attempts)</p> <p>-Regular smokers were less likely to buy their own cigarettes (OR=0.70) and more likely to ask someone OR=1.51) or a friend (OR=1.18) (the more frequently they are asked their age on purchase attempts)</p> <p><b>Definition:</b> Occasional smokers were defined as students who reported that they smoked more than once in the 30 days prior to the survey but did not smoke every day or almost every day. Regular smokers were defined as students who reported that they smoked every day or almost every day in the 30 days prior to the survey.</p>
<p>Leatherdale &amp; Strath, 2007 Cross-sectional population-based Located: Canada Sample size: 20,297 Age/grade 9-12 Analysis: Multi-level logistic regression</p>	<p><b>Socio-cultural factors</b></p> <p>The more tobacco retailers surrounding the school, the more likely smokers were to buy their own cigarettes and the less likely to get someone else to buy their cigarettes.</p> <p>-Student smoking habits were also related to their cigarette access behaviours</p> <p>Definition: Three definitions students i.e., those who buy their own cigarettes, someone else buys their cigarettes and friends supply their cigarettes</p>
<p>Lipperman-Kreda et al., 2009 Design: Cross-sectional Located: USA Sample size: 21,281 Age/grade: 12-18 Analysis: Multi-level logistic regression</p>	<p><b>Intrapersonal factors</b></p> <p>-low levels of perceived enforcement of anti-smoking policies</p> <p><b>Definition:</b> Participants were asked about their frequency of cigarette smoking in the past 30 days (Seven possible responses ranged from “0 days” to “All 30 days”), five dichotomous variables were created: any cigarette smoking in the past 30 days (yes/no), daily smoking in the past 30 days (yes/no), heavy episodic smoking (i.e., smoking of more than one cigarette per day on the days he or she smoked) in the past 30 days (yes/no), any cigarette smoking on school property in the past 30 days (yes/no), and the student’s likelihood of smoking a cigarette offered by a best friend (yes/no).</p>
<p>Lovato et al., 2010 Design: Cross-sectional Located: Canada Sample size: n= 22,681 Age/grade: Grade 10-11 Analysis: hierarchic logistic regression Project: SHAPES</p>	<p><b>Socio-cultural factors</b></p> <p>-Attending a school with a focus on tobacco prevention-OR(CI) 0.87 (0.81-0.94) and stronger policies prohibiting tobacco use – OR(CI) 0.92 (0.88-0.97) were less likely to smoke</p> <p>-Attended a school located within a community that had a higher proportion of immigrants-OR(CI) 0.99 (0.98-0.99) is inversely associated with smoking status</p> <p>-Students were more likely to smoke if they attended a school with students smoking in the periphery OR(CI) 1.25 (1.07-1.47), stronger enforcement of tobacco policy OR(CI) 1.20 (1.07-1.35), and when bylaw enforcement officer presence was higher OR(CI) 1.22 (1.04-1.43)</p>

	<p><b>Definition:</b> A smoker was defined as an adolescent who had smoked at least a few puffs of a cigarette on 2 or more days in the last month</p>
<p>Lovato et al., 2007 Design: Cross-sectional Located: Canada Sample size: n=22,318 Age/grade: Grade 10-11 Analysis: Multiple linear regressions Project: SHAPES</p>	<p><b>Intrapersonal factors</b> -Student's perceptions of policy enforcement significantly predicted school smoking prevalence (<math>R^2 = 0.36</math>) and location of tobacco use (<math>R^2 = 0.23-0.63</math>) -Students' perceived higher number of smokers at school – stronger predictor of school smoking rates on school property</p> <p><b>Socio-cultural factors</b> -Policy intention and implementation subscales did not significantly predict school smoking prevalence but resulted in moderate prediction of tobacco use in school property (<math>R^2 = 0.21-0.27</math>)</p> <p><b>Definition:</b> A smoker was defined as an adolescent who had smoked at least a few puffs of a cigarette on 2 or more days in the last month</p>
<p>Ma et al., 2003 Design: Cross-sectional study Located: China Sample size: 3412 in rural &amp; urban Age: 9<sup>th</sup> grade Analysis: Two-level multiple logistic regression models</p>	<p><b>Intrapersonal factors</b> <i>Past month smoking:</i> Strongly associated with low refusal self-efficacy across both urban (OR=9.38 boys; OR=4.68 girls) and rural (OR=5.27 boys OR=NS girls) - <i>Past month smoking:</i> (OR=1.85 boys; OR=1.35 girls) and rural (OR=3.42 boys; OR=NS girls)</p> <p><b>Socio-cultural factors</b> Current smoking prevalence were higher among rural boys than among urban boys (All <math>P &lt; 0.001</math>)</p> <p><b>Definition:</b> Current smoking (smoked 1-30 cigarettes in the past month)</p>
<p>Murnaghan et al., 2009 Design: Cross-sectional Located: Canada Sample size: Grade 10-12. <i>Sample (Wave 2)</i> n=1,538 (50% male) – Grade 10 (2000) <i>Sample (Wave 3)</i> n=1,484 (50.8% male) – Grade 11 (2001) Analysis: Multi-level logistic regression</p>	<p><b>Intrapersonal factors</b> -Increased likelihood of occasional smoking was associated with overestimating the percentage of youth their age who smoke</p> <p><b>Definition:</b> Non-smoker were students who reported that they had never smoked or had only tried once but quit; <i>occasional smoker</i>-smoked less than weekly; <i>regular smoker</i> –smoked every week</p>
<p>Murnaghan et al., 2008 Design: Cross-sectional Located: Canada Sample size: n=4,709 (49.2% male) Age/grade: Grade 10 <i>Data collection:</i> 1999-2001 (only used data from Grade 10 in the 3 waves) Analysis: Multi-level logistic regression</p>	<p><b>Socio-cultural factors</b></p> <ul style="list-style-type: none"> <li>• Attending a school with smoking prevention programs only was associated with a substantial risk of occasional smoking among students with two or more close friends who smoke</li> <li>• Attending a school with both smoking prevention programs and policies was associated with substantial risk of occasional smoking among students who did not believe there were clear smoking rules present</li> <li>• A student who attended a school with a smoking policy was more likely to be a regular smoker. A student who believed that students get into trouble for breaking the school smoking rules was as an increased risk for being a regular smoker</li> </ul> <p>Students attending schools where year of enrolment in high school starts in Grade 9 were more likely to be regular and occasional smokers</p> <p><b>Definition:</b> <i>Current non-smokers</i>-students who had never smoked or had only tried smoking once; <i>occasional smoker</i>-smoked less than weekly; <i>Regular smoker</i> –smoked every week or most days of the week</p>
<p>Murnaghan et al., 2007 Design: Cross-sectional, cohort study (natural experiment i.e., introduction of the SWITCH,</p>	<p><b>Socio-cultural factors</b></p> <ul style="list-style-type: none"> <li>• Attending a school with smoking prevention programming was associated with a decreased risk of being an occasional smoker: OR (CI) 0.42 ( 0.18-0.97)</li> <li>• School-based policies banning smoking on school property were associated with a small</li> </ul>

<p>Kick the Nic programs in all school in 2001)          Located: Canada          Sample size: n=3,965 (47.8% male)          Age/grade: Grade 12          Analysis: Multi-level logistic regression analysis</p>	<p>increased risk of occasional smoking, OR (CI) 1.06 (0.67-1.68)</p> <ul style="list-style-type: none"> <li>Combination of both policies and programs was not associated with either occasional or regular smoking</li> </ul> <p><b>Definition:</b> <i>Never smoker</i> were students who reported that they had never smoked or had only tried once; <i>occasional smoker</i>-smoked less than weekly; <i>regular smoker</i> –smoked every week</p>
<p>Park et al., 2010          Design: Cross-sectional          Located: U.S.          Sample size: n=16,833 (48.5% male)          Age/grade: Grade 9-12          Analysis: Hierarchical linear models  <i>Project:</i> Tobacco Use Prevention Education (TUPE)-spanning two school year surveys (2003-2004 and 2005-2006)</p>	<p><b><u>Intrapersonal factors</u></b>          -Student tobacco use, intention to smoke and perceived smoking prevalence by peers increased as students moved through grades 9 and 10 to grades 11 and 12</p> <p><b><u>Social context</u></b>          -number of friends smoking</p> <p>TUPE-related activities showed a suggestive association (p=0.06) with reduced rate in student tobacco use between the two surveys after adjusting for other contextual factors such as each school's socioeconomic characteristics</p> <p><b>Definition:</b> <i>Lifetime cigarette use</i> –was defined as ever smoked cigarettes; <i>Current smoker</i>-30-day cigarette use</p>
<p>*Patton et al., 2005          Design: 10 –year eight wave cohort          Located: Australia          Sample: 1943          Age: aged 14-15 years at baseline          Analysis: multivariate logistic regression analyses</p>	<p><b><u>Intrapersonal factors</u></b>          _At least one report of weekly cannabis use in the teens predicted a more than eightfold increase in the odds of later initiation of tobacco use</p> <p><b>Definition:</b> Smoking was categorized on the basis of frequency. Reported smoking on 6 or 7 days of the past week was classified as current daily smoking. Reported smoking of a cigarette in the past month was categorized as any current smoking. Self-defined ex-smokers who reported not having smoked in the month before the survey were classed as ex-smokers. Those who reported having ceased smoking in the 4 weeks before the survey were categorized as current smokers.</p>
<p>Pearce et al., 2009          Design: Cross-sectional study          Located: USA          Sample size:12,529          Age: all          Analysis: Two-level logistic regression models</p>	<p><b><u>Socio-cultural factors</u></b>          After controlling for individual-level demographic and SES, individuals living in the quartiles of neighborhoods with the best access to supermarkets (OR=1.23) and convenience stores (OR=1.19) had a higher odds of smoking compared with individuals in the worst access quartiles. However, once other neighbourhood-level (deprivation and rurality) variables are included- the association with neighbourhood accessibility was not apparent</p>
<p>Sabiston et al., 2009          Design: Cross-sectional          Located: Canada          Sample size: n=24,213 (49% male)          Age/grade: grade 10-11          Analysis: Multi-level logistic regression  <i>Project:</i> SHAPES</p>	<p><b><u>Intrapersonal factors</u></b></p> <ul style="list-style-type: none"> <li>lower school connectedness</li> <li>higher perceptions of student smoking prevalence</li> <li>lower perception of student smoking frequency</li> <li>stronger perceptions of the school tobacco context</li> </ul> <p><b><u>Social context</u></b></p> <ul style="list-style-type: none"> <li>greater number of family and friends who smoked</li> </ul> <p><b><u>Socio-cultural factors</u></b>          -weaker policy intention indicating prohibition and assistance to overcome tobacco addiction          -weaker policy implementation involving strategies for enforcement          -higher number of students smoking on school property</p> <p><b>Definition:</b> students who smoked a cigarette in the last 30 days (even a puff) and ever smoked a whole cigarette.</p>

<p>Thomson et al., 2005  Design: Cross-sectional study  Located: USA  Sample: 3831  Age: 12-17  Analysis: Multivariate analysis</p>	<p><b><u>Social context</u></b>  -Adolescence with a household smoking ban were more likely to perceive a lower adult smoking prevalence (OR 2.1), greater adult disapproval of adults smoking (OR 2.1), and teen smoking (OR 1.5)</p>
<p>Tyc et al., 2004  Design: Cross-sectional study  Located: USA  Sample: 237  Age: 12-18  Analysis: Logistic regression</p>	<p><b><u>Intrapersonal factors</u></b>  1) Being a smoker: Higher perceived instrumental value (OR=1.61), Higher risk-taking/rebelliousness (OR=1.18)  -Higher perceived vulnerability (OR=1.16), older age (OR=0.25), increased the odds of an adolescent being a smoker  -Smokers with lower intentions to quit perceived greater instrumental value of smoking (OR=1.47)  2)Smoking intentions: Greater intentions to smoke among non-smokers was best predicted by less knowledge (OR=0.69) and higher perceived instrumental value (OR=1.19)</p> <p><b><u>Social context</u></b>  Parental smoking increased the odds of an adolescent being a smoker (OR=3.46)</p> <p><b>Definition:</b> experimenter-tried smoking even a puff. Current smoker- smoked once a week or more times</p>
<p>Watts et al., 2010  Design: Cross-sectional  Located: Canada  Sample size: <i>n=11,881 (54% male)</i>  Age/grade: Grade 7-9 and 10-12  Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b></p> <ul style="list-style-type: none"> <li>• perceiving clear rules about smoking decreased the likelihood that a student would smoke on school grounds-OR (CI) 0.76 (0.62-0.93)</li> <li>• Perceiving that a high percentage of peers smoke: OR (CI) 1.15(1.12-1.18), that there are school rules about smoking: OR (CI) 1.55 (1.24-1.92) , that students obey the rules: OR (CI) 1.60 (1.40-1.82), and that students can be fined for smoking: OR (CI) 1.42 (1.23-1.64) or get in trouble OR (CI) 1.45 (1.24-1.70) increased the likelihood that students would smoke off school grounds</li> </ul> <p><b>Definition:</b> Ever smoked a cigarette</p>
<p>West et al., 2010  Design: Cross-sectional  Located: U.S.  Sample: 205  Age: mean age 13-19 years  Analysis: Ordinal regression</p>	<p><b><u>Intrapersonal factors</u></b>  1) Alcohol and Tobacco use was associated with acculturation (OR=2.10), skipping school (OR=2.01), parental consistency (OR=0.57)  1) Alcohol and Tobacco use was associated with peer use of Tobacco and alcohol (OR=2.36),</p> <p><b><u>Socio-cultural factors</u></b>  1) Alcohol and Tobacco use was associated with distance from respondents' home to the nearest tobacco retailer (OR=0.90)  - attending school in immediate proximity to the US/Mexico border (OR=2.41),  -the interaction between the distance to the nearest retailer and parents' consistent use of contingency management (OR=1.01)</p> <p><b>Definition:</b> Lifetime use of tobacco and alcohol. Asked students if they had ever used alcohol and tobacco</p>
<p>Wen et al., 2009  Design: Cross-sectional population-based data  Location: USA  Sample size: 13,552  Age/grade: 7<sup>th</sup>-12<sup>th</sup> grade  Main analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b>  -Being black (OR= 0.51), being US-born (OR= 1.20) , perceived physical maturity (OR= 1.13), Self-esteem (OR=0.92) , weekly allowance (OR=1.10) , Parent child closeness (OR=0.85) , parental control(OR= 0.78)  -Having a higher percentage of Hispanics were protective factors</p>

	<p><b><u>Social context</u></b> Time spent with peers (OR= 1.20), best friend smoking (OR=1.74 ), household member smoking (OR=1.63 )</p> <p><b><u>Socio-cultural factors</u></b> -Attending a private school (OR=0.67 ) was a protective factor, Rural vs. Urban = NS, Higher percent of Hispanic students (OR=0.74 ), Neighbourhood- Not significant, State-level n-not significant</p> <p><b>Definition:</b> Ever smoked at least one cigarette every day for 30 days</p>
<p>Wiiium et al., 2006 Design: Cross-sectional Located: Norway Sample size: 1670 Age: 15 years (Grade 10) Analysis: Multi-level logistic regression</p>	<p><b><u>Intrapersonal factors</u></b> An individuals' opinion of societal norms and the expectations of significant others as well as their behaviour were significantly related to adolescent smoking behaviour</p> <p><b>Definition:</b> Smoking was measured by one item: How often do you smoke tobacco at present? (1) I do not smoke, (2) Less than once a week, (3) At least once a week but not every day and, (4) Every day. Option (1) and (2) means non-smokers, whilst (3) and (4) meant regular smokers.</p>

SHAPES-School Health Action, Planning and Evaluation System, PEI- Prince Edward Island, NA- Not Applicable, YSS- Youth Smoking Survey, SD- Standard Deviation  
\*These are longitudinal studies

Table B3: A Summary of the association of factors by smoking status from literature review

	Susceptibility or intention	Experimental smoking	Current smoking	Data available
<b>Intrapersonal (individual)</b>				
Age (increasing age or grade)*	↓	↓	↑	Yes
Single-parent family*		↑		No
Gender (male)	↓		↑	Yes
Education (lower education)*	↑	↑		Yes
Race (Hispanic or aboriginal or Caucasian)		↑		No
Access to pocket money	↑	↑	↑	Yes
Risky behaviour-Alcohol, drugs, sex, fights, puffed*	↑	↑	↑	Yes
Low self-esteem*		↑	↑	Yes
Depression (higher)*	↑	↑	↑	No
Stress*		↑		No
Intention to smoke/susceptible to smoking*	↑	↑		Yes
Low refusal self-efficacy	↑	↑	↑	Yes
Having positive attitudes toward smoking	↑	↑		Yes
Less knowledge about secondhand smoke	↑	↑		Yes
Perceptions that there are clear rules; high enforcement; that students obey them; or fined/get in trouble if caught smoking	↓	↑	↑↓	Yes
Perceived attitude towards remaining tobacco free	↓			No
Perceived difficulty associated with quitting*		↑	↑	Yes
Higher confidence to quit smoking				No
Low school connectedness		↑	↑	Yes
Higher perceived mental addiction*	↑	↑		No
Impulsivity*		↑		No
<b>Social context/situation (Family and peers, teachers)</b>				Yes
Overestimating students' smoking prevalence			↑	
Perceived disapproval of smoking by friends/parents	↓		↓	No
Having close friend(s) who smoke*	↑	↑	↑	Yes
Having family members who smoke*	↑	↑	↑	Yes
No total ban on smoking at home/secondhand smoke	↑	↑		Yes
<b>Socio-cultural environment (School)</b>				
School SES (low SES)	NS		↑↓	Yes
School location (Urban settings )		↑	↑↓	Yes
Tobacco retailer density (high density)	↑	↑	↑	Yes
Media, movie smoking, advertisements and low price*		↑	↑	No
School –focus on tobacco prevention program only			↑↓	No
School with both prevention program and policies			↑↓	No
School with stronger policies prohibiting tobacco use			↓	No
Prohibiting smoking on school property and bans			↑↓	No
Smoking on school periphery/property	↑		↑	No
Policy intention and implementation/stronger policy enforcement			↑	No
Schools/seniors students with higher smoking prevalence*	↑	↑	↑	Yes

❖ The factors that are bolded and have an asterisk were identified by the eight longitudinal studies (Chassin 2008; Bricker, 2007; Dalton 2003; Grenard, 2006; Patton et al, 2005 and O'Loughlin, 2009) the rest were from cross-sectional studies. The arrows that are shaded correspond to findings from the longitudinal studies

↑↓ The arrows show that there was a statistically significant relationship (↑=positive and ↓=negative relationship)

NS means that the result was not statistically significant

## Appendix C

Table C4: Number of participating and non-participating schools by health stratum and province, 2008-09 YSS\*

Province	Target # Schools	Health Stratum	# of Participating Schools	# of Schools Not Participating
NL	24	Low	13	0
		High	12	3
PE	22	Low	33	5
		High	25	5
NS	24	Low	7	8
		High	17	1
NB	24	Low	20	1
		High	8	8
QC	36	Low	15	34
		High	20	17
ON	54	Low	14	18
		High	19	11
		GTA	13	19
MB	28	Low	12	4
		High	18	0
SK	28	Low	12	9
		High	13	11
AB	32	Low	11	21
		High	14	13
BC	32	Low	11	22
		High	22	20
<b>Canada</b>	<b>304</b>		<b>329</b>	<b>230</b>

\*Source is YSS Microdata User Guide ([www.yss.uwaterloo.ca](http://www.yss.uwaterloo.ca))

Table C5: Number of participating and non-participating schools by school stratum and province, 2008-09 YSS\*

Province	Target # Schools	School Stratum	# of Participating Schools	# of Schools Not Participating
NL	24	Elementary	17	2
		Secondary	8	1
PE	22	Elementary	49	7
		Secondary	9	3
NS	24	Elementary	14	5
		Secondary	10	4
NB	24	Elementary	18	5
		Secondary	10	4
QC	36	Elementary	25	18
		Secondary	10	33
ON	54	Elementary	32	31
		Secondary	14	17
MB	28	Elementary	19	2
		Secondary	11	2
SK	28	Elementary	14	14
		Secondary	11	6
AB	32	Elementary	15	16
		Secondary	10	18
BC	32	Elementary	27	19
		Secondary	6	23
<b>Canada</b>	<b>304</b>		<b>329</b>	<b>230</b>

\*Source is YSS Microdata User Guide ([www.yss.uwaterloo.ca](http://www.yss.uwaterloo.ca))

Table C6: Total number of schools sampled, by province, 2008-09 YSS\*

Province	Target # schools 08/09	School recruitment rate 06/07 (%)	# Over-sampled 08/09	# of Schools added by request	Sample # at project outset
NL	24	93	6	0	30
PE	22	86	8	39 <sup>1</sup>	69
NS	24	64	6	0	30
NB	24	90	6	0	30
QC	36	73	36	0	72
ON	54	56	36	0	90
MB	28	90	8	0	36
SK	28	83	8	0	36
AB	32	71	22	0	54
BC	32	41	44	0	76
<b>Canada</b>	<b>304</b>	<b>74</b>	<b>180</b>	<b>39</b>	<b>523</b>

\*Source is YSS Microdata User Guide ([www.yss.uwaterloo.ca](http://www.yss.uwaterloo.ca))

## Appendix D

Table D7: Weighted frequencies by smoking stages

Smoking status	Weighted frequency for grade 6-8	Weighted frequency for grade 9-12
Current smoker (daily and occasional)	2.22%	11.65%
Experimental smoker	2.65%	6.92%
Trier	8.40%	15.34%
Never tried smoking	83.48%	54.77%

Table D8: SAS commands for calculating a weight for the grade 9 to 12 dataset

<p>Step 1.</p> <p>*Calculating a weight for grade 9-12...</p> <pre>proc means sum data=hspy2; where grade in (9,10,11,12); var wtp; run;</pre>
<p>Step 2.</p> <pre>data wdata912; set hspy2; grade912_wt= (wtp/ 1660891.72)*29296; run;</pre>
<p>An example of SAS syntax (Glimmix and Proc NLMixed) used in one of the multi-level analysis</p> <pre>proc GLIMMIX data=nlm912data abspconv=0.0001; CLASS schoolid_fk; MODEL EXPVNEVER (event="1. Yes") = gender grade10_dumy grade11_dumy grade12_dumy alcohol marijuana recmon20_dumy recmon100_dumy recmon101_dumy scoscore hurt DANGER relax schrulle parents sibling frend1_dumy frend2_dumy frend3_dumy frend4_dumy frend5_dumy location/solution dist=binary link=logit; random intercept /subject=schoolid_fk;</pre>

```

weight EXPVNEVER_WT;
title "Initial estimates of student level and location variables";
run;

```

- Estimates were then plugged into the Proc NLMixed analysis

```

proc nlmixed data=nlm912data qpoints=20 tech=newwrap;
title "Experimental VERSUS NEVER- ICC";
parms beta0=-6.1029 beta1=-0.2725 beta2=-0.1080 beta3=-0.2839
beta4=0.04886 beta5=1.5397 beta6=2.6691 beta7=0.6952 beta8=0.7715
beta9=0.9624 beta10=-0.2249 beta11=-0.5113 beta12=-0.3769 beta13=1.1830
beta14=0.4612 beta15=0.2775 beta16=0.4714 beta17=1.6738 beta18=2.0194
beta19=2.1884 beta20=2.0976 beta21=2.3854 beta22=-0.2743 s2u=0.4406;
eta = beta0 + beta1*gender + beta2*grade10_dumy + beta3*grade11_dumy +
beta4*grade12_dumy + beta5*alcohol + beta6*marijua + beta7*recmon20_dumy +
beta8*recmon100_dumy + beta9*recmon101_dumy + beta10*scoscore +
beta11*hurt + beta12*danger + beta13*relax + beta14*schrule +
beta15*Parents + beta16*sibling + beta17*frend1_dumy + beta18*frend2_dumy
+ beta19*frend3_dumy + beta20*frend4_dumy + beta21*frend5_dumy +
beta22*location + u;
mu = exp(eta)/(1+exp(eta));
model EXPVNEVER ~ binary (mu);
random u ~ normal(0,s2u) subject=schoolid_fk;
run;

```

## Appendix E

Table E9: Intrapersonal indicators

TTI domain	Specific question asked or how variable was derived	Coding for analysis
<b>Intrapersonal factors</b>		
Gender	Are you female or male?	0=female and 1=Male
Grade	What grade are you in?	0=Grade 9, 1= Grade 10, 2= Grade 11, 3= Grade 12
Pocket money	About how much money do you usually get each week to spend on yourself or save? Options included 1=0, 2=\$1 to \$5, 3=\$6 to \$10, 4=\$11 to \$20, 5=\$21 to \$40, 6=\$41 to \$100, 7=more than \$100, 8=I do not know how much money I get each week	0 = \$0 1= \$1 to \$20 2= \$21 to \$100 3= >\$100
Alcohol use	In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? Options included: 1 = I have never drank alcohol, 2 = I did not drink alcohol in the last 12 months, 3 = I have only had a sip of alcohol, 4 = Every day, 5 = 4 to 6 times a week, 6 = 2 or 3 times a week, 7 = Once a week, 8 = 2 or 3 times a month, 9 = Once a month, 10 = Less than once a month, 11 = I do not know-was not a valid response, so these students were not included in the analyses)	0 = I have never drank alcohol 1= Any use (option 2 to 10)
Marijuana use	In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...). Options included: 1 = I have never used marijuana, 2 = I have used marijuana but not in the last 12 months, 3 = Every day, 4 = 4 to 6 times a week, 5 = 2 or 3 times a week 6 = Once a week, 7 = 2 or 3 times a month, 8 = Once a month, 9 = Less than once a month, 10 = I do not know -not a valid response)	0 = I have never used marijuana 1= Any use (option 2 to 9)
Self-esteem	This a derived value from the Rosenberg Self-Esteem scale (Rosenberg, 1965) to measure overall self-esteem using 3 questions. Students were asked to respond to these questions: 1) In general, I like the way I am, 2) When I do something, I do it well, 3) I like the way I look. The responses were given on a 5-point Likert Scale i.e., 1=true, 2=mostly true, 3=sometimes true/sometimes false, 4=mostly false and 5=false and recoded into numeric values as shown in column three. The numeric values were summed to give a final score that ranged from 0 to 12. Higher scores represented higher self-esteem.	0 = False 1 = Mostly false 2 = Sometimes false / sometimes true 3 = Mostly true 4 = True

School connectedness	Five items assessed this factor. Students were asked whether they: 1) felt close to people at school, 2) felt part of their school, 3) were happy at school, 4) felt that the teachers at school treated them fairly, and 5) felt safe at school. The responses were given on a 4-point Likert Scale i.e., strongly agree, agree, disagree, strongly disagree and recoded as shown in second column. Consistent with previous literature (Sabiston et al, 2009), the five items of the school connectedness score were summed to give a final score that ranged from 0 to 5. Higher scores represented greater perception of school connectedness. This summation was consistent to previous literature (Sabiston et al., 2009) and the internal consistency of this scale was adequate ( $\alpha = 0.86$ ).	0= strongly disagree/disagree 1= strongly agree/agree
<b>Knowledge and attitudes</b>		
Do people have to smoke many years before it will hurt them?		0=No or I don't know 1=yes
Is there danger to your health from an occasional cigarette?		0=No or I don't know 1=yes
Does quitting smoking reduce health damage even after many years of smoking?		0=No or I don't know 1=yes
Can people become addicted to tobacco?		0=No or I don't know 1=yes
Can tobacco smoke be harmful to the health of the non-smoker?		0=No or I don't know 1=yes
Can smokers quit any time they want?		0=No or I don't know 1=yes
<b>Beliefs</b>		
Do people who smoke become more popular?		0=No or I don't know 1=yes
Do you think smoking is cool?		0=No or I don't know 1=yes
Can smoking help people when they are bored?		0=No or I don't know 1=yes
Does smoking help people relax?		0= no or I do not know, 1= yes
Does smoking help people stay slim?		0= no or I do not know, 1= yes
<b>Perception (rules, and smoking rate)</b>		
School rules	This school has a clear set of rules about smoking for students to follow. The responses were given on a 4-point Likert Scale i.e., 1=True, 2=usually true, 3=usually false, 4=false, 5=I do not know and recoded as shown in second column.	0= usually false/false /I do not know  1= true/ usually true
Number who smoke in grade	How many people in your grade, from your school, do you think smoke cigarettes? The options were 1=91 to 100%, 2=81-90%, 3=71-80%, 4=61-70%, 5=51-60%, 6=41-50%, 7=31-40%, 8=21-30%, 9=11-20%, 10=0-10%.	Same as responses that were given
<b>Anti-smoking Curriculum</b>		
Number of anti-smoking classes attended	How many classes did you have that talked about the effects of smoking? Options included 1=0 classes, 2=1 or 2 classes, 3=3 or 4 classes, 4=5 or 6 classes, 5=7 or more classes	0=no classes 1=1 or 2 classes 2=3 or more classes

Table E10: Social context indicators

TTI domain	Specific question asked or how variable was derived	Coding for analysis
Parents smoke	Do any of your parents, step-parents, or guardians smoke cigarettes? Options included 1=yes, 2=no, 3= I do not know	0= no or I do not know 1= yes
Sibling(s) smokes	Do any of your brothers or sisters smoke cigarettes? Options included Options included 1=yes, 2=no, 3= I do not know, 4= do not have brothers or sisters	0= no or I do not know or no brothers or sisters 1=Yes
Friends smoke	How many of your closest friends smoke cigarettes? Options included 0=none, 1=1 friend, 2=2 friends, 3=3 friends, 4=4 friends, 5 or more friends	0=0, 1=1 friend, 2=2 friends, 3=3 friends, 4=4 friends, 5=5friends or more
Smoking rules in the home	What are the rules about smoking in your home? Options included 1=No one is allowed to smoke in my home, 2= special guests, 3=people are allowed to smoke only in certain areas, 4=people are allowed to smoke anywhere in home	0=No one is allowed to smoke in my home 1= People are allowed (option 2 to 4)
Number of people who smoke at home	Excluding yourself, how many people smoke inside your home every day or almost every day? Options included 1=None, 2=1 person, 3==2 people, 4==3 people, 5=4 people, 6=5 or more people	0= None smokes 1=One or more than one

Table E11: Socio-cultural indicators

TTI domain	Specific question asked or how variable was derived	Coding for analysis
<b>Socio-cultural factors</b>		
Location of school (rural versus urban)	School location was derived from the school postal codes using the Postal Code Conversion File which provided a link between the postal code and Statistics Canada's standard Census geographical areas (Statistics Canada, 2010). Areas that consist of populations of 50,000 and above are considered to be urban, the rest are rural. Typically, a zero (0) in the second position of the postal code identifies a rural postal code (Statistics Canada, 2010).	0=rural 1=urban
SES of neighbourhood where schools are located	Median household income: The 2006 Census median household income data was used as a proxy measure for school neighbourhood socioeconomic status (SES) as has been done in previous studies (Chuang et al., 2005). This variable was a continuous variable and the unit change was in intervals of \$10,000 CAD for ease of interpretation.	Numeric data by units of \$10,000

Tobacco retailer density	<p>The 2008/09 Desktop Mapping Technologies Inc. [DMTI] and the Enhanced Points of Interest [EPOI] data provided numeric data regarding the number of tobacco retailers that were located within a 1-km radius of each school. The EPOI data file consists of a national database of more than 1.6 million Canadian business and recreational points of interest <a href="http://www.dmtispatial.com">http://www.dmtispatial.com</a>.</p> <p>The DMTI-EPOI data was obtained through geocoding the address for each school that participated in the YSS using Arcview 3.3 software (ESRI, 2002). This was followed by creating a 1-Km buffer to assess how many tobacco retailers were located within these buffers (i.e., radius surrounding each school in which the different structures of the built environment were quantified). A 1-Km radius was selected because it is estimated that it is representative of the distance most high school students would walk to and from their school (Chuang et al., 2005)</p>	Numeric (each 1 unit change)
--------------------------	---	------------------------------

## Appendix F

Table F12: A summary of 14 reviewed theories as applied to experimental substance use\*

Theories	Authors	Main focus of the theories
<i>Cognitive-affective theories of experimental substance use (ESU)</i>		Decision-making processes contribute to ESU
1. Theory of reasoned action	Ajzen & Fishbein, 1980; Fishbein and Ajzen, 1975	
2. Theory of planned behaviour	Ajzen, 1985	
<i>Social learning theories of ESU</i>		The effects of models who use substances
3. Social learning theory	Akers, 1977	
4. Social cognitive theory	Bandura, 1986	
<i>Conventional commitment and social attachment theories of ESU</i>		How various factors promote withdrawal from conventional society, detachment from parents, and attachment to peer who use substances
5. Social control theory	Elliot et al., 1985	
6. Social development model	Hawkins and Weis, 1985	
<i>Theories in which intrapersonal characteristics play key role</i>		Identifying the root causes of ESU in adolescents' personality and affective states
7. Social ecology model	Kumpfer and Turner, 1990-1991	
8. Self-derogation theory	Kaplan et al., 1975	
9. Multistage social learning model	Simons et al., 1988	
10. Family interaction theory	Brook et al. 1990	
<i>Theories that integrate cognitive-affective, learning, commitment, and intrapersonal constructs</i>		Theories that attempt to integrate cognitive-affective, social learning, commitment, , and intrapersonal constructs
11. Problem-behaviour theory	Jessor's et al., 1991	
12. Peer cluster theory	Oetting and Beauvais, 1986	
13. Sher's model of vulnerability	Sher, 1991	
14. Domain model	Huba and Bentler's, 1982	

\*Source (Petraitis et al., 1995)

## **Appendix G**

### **Youth Smoking Survey questionnaire-Module B (Student-level questionnaire)**



# About You

● ○ ○ ○ ○  
Proper Mark

⊗ ✓ ● ●  
Improper Marks

1. What grade are you in?

- Grade 6
- Grade 7
- Grade 8
- Grade 9
- Grade 10
- Grade 11
- Grade 12

**Quebec students only**

- Grade 6
- Secondary I
- Secondary II
- Secondary III
- Secondary IV
- Secondary V

2. How old are you today?

- 11 years or younger
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

3. Are you...

- Female?
- Male?

4. Are you an aboriginal person?

- Yes, First Nations
- Yes, Métis
- Yes, Inuit
- No, I am not an aboriginal person

5. What language do you speak most often at home?

- English
- French
- Other

6. How many years have you lived in Canada?

- 0 to 2 years
- 3 to 5 years
- 6 to 10 years
- 11 to 15 years
- 16 or more years

Do Not Forget This Column



## Your Experience with Smoking

12. Are you a smoker?

- Yes
- No

13. Have you ever tried cigarette smoking, even just a few puffs?

- Yes
- No

14. How old were you when you first tried smoking cigarettes, even just a few puffs?

- I have never done this
- I do not know
  
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

15. Do you think in the future you might try smoking cigarettes?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

16. If one of your best friends was to offer you a cigarette would you smoke it?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

17. At any time during the next year do you think you will smoke a cigarette?

- Definitely yes
- Probably yes
- Probably not
- Definitely not

18. Do you think it would be difficult or easy for you to get cigarettes if you wanted to smoke?

- Difficult
- Easy
- I do not know

19. Have you ever smoked a whole cigarette?

- Yes
- No

20. How old were you when you smoked your first whole cigarette?

- I have never smoked a whole cigarette
- I do not know
  
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

Do Not Forget This Column

21. Have you ever smoked 100 or more whole cigarettes in your life?

- Yes
- No

22. Have you ever smoked every day for at least 7 days in a row?

- Yes
- No

23. On how many of the last 30 days did you smoke one or more cigarettes?

- None
- 1 day
- 2 to 3 days
- 4 to 5 days
- 6 to 10 days
- 11 to 20 days
- 21 to 29 days
- 30 days (*every day*)

24. Thinking back over the last 30 days, on the days that you smoked, how many cigarettes did you usually smoke each day?

- None
- A few puffs to one whole cigarette
- 2 to 3 cigarettes
- 4 to 5 cigarettes
- 6 to 10 cigarettes
- 11 to 20 cigarettes
- 21 to 29 cigarettes
- 30 or more cigarettes

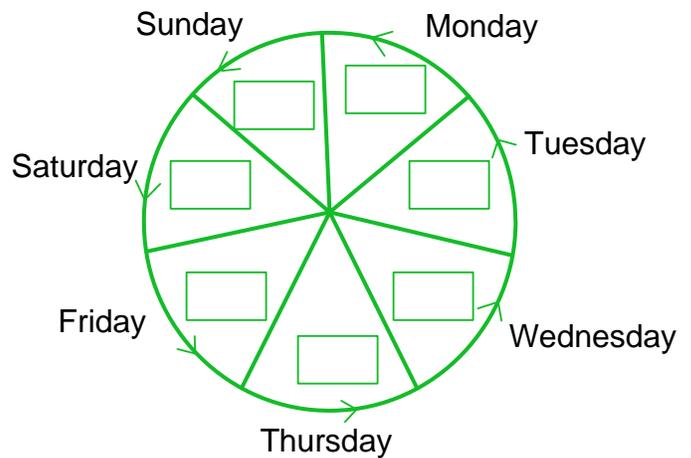
25. Think back over the last 7 days.

Find yesterday on the wheel and fill in the number of whole cigarettes you smoked.

Then follow the wheel backwards and fill in the number of whole cigarettes you smoked on each of the last 7 days.

If you have not smoked mark one of the circles below.

- I have never smoked
- I did not smoke over the last 7 days



26. When you smoke, how often do you share a cigarette with others?

- I do not smoke
- Never
- Sometimes
- Usually
- Always

	Sun	Mon	Tue	Wed	Thur	Fri	Sat
For office use only	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	6	6	6	6	6	6	6
	7	7	7	7	7	7	7
	8	8	8	8	8	8	8
	9	9	9	9	9	9	9



[ SERIAL ]

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 Original Select
- 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

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

Do Not Forget This Column



## 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

# Your School and You

50. How strongly do you agree or disagree with each of the following?

	Strongly Agree	Agree	Disagree	Strongly Disagree
a. I feel close to people at my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. I feel I am part of my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. I am happy to be at my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
d. I feel the teachers at my school treat me fairly.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
e. I feel safe in my school.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

51. In the last 4 weeks, how many days of school did you miss because of your health?

- 0 days
- 1 or 2 days
- 3 to 5 days
- 6 to 10 days
- 11 or more days

52. In the last 4 weeks, how many classes did you skip when you were not supposed to?

- 0 classes
- 1 or 2 classes
- 3 to 5 classes
- 6 to 10 classes
- 11 to 20 classes
- More than 20 classes

53. In the last 12 months, how many classes did you have that talked about the effects of smoking?

- No classes
- 1 or 2 classes
- 3 or 4 classes
- 5 or 6 classes
- 7 or more classes
- I do not know

**Do Not Forget This Column**

54. In the last 12 months, have you taken part in any other anti-smoking activities or events, either at school or in the community? (Mark all that apply)

- School assembly or class with guest speaker
- School health fair
- Media production (poster, commercial, etc.)
- Community event outside of school
- Quit smoking contest
- Quit smoking program or counselling
- I have not taken part in any of these activities or events in the last 12 months

55. How many people in your grade, from your school, do you think smoke cigarettes?

- |                                  |                                 |
|----------------------------------|---------------------------------|
| <input type="radio"/> 91 to 100% | <input type="radio"/> 41 to 50% |
| <input type="radio"/> 81 to 90%  | <input type="radio"/> 31 to 40% |
| <input type="radio"/> 71 to 80%  | <input type="radio"/> 21 to 30% |
| <input type="radio"/> 61 to 70%  | <input type="radio"/> 11 to 20% |
| <input type="radio"/> 51 to 60%  | <input type="radio"/> 0 to 10%  |

56. This school has a clear set of rules about smoking for students to follow.

- True
- Usually true
- Usually false
- False
- I do not know

57. How many students at this school smoke on school property?

- A lot
- Some
- A few
- None



[ SERIAL ]

## **Alcohol & Marijuana Use**

Please remember that we will keep your answers **completely confidential**. Your teachers and parents will not know how you answer these questions. Please take your time and be honest as you answer.

When we use the word **drink** it means one regular-sized bottle or can of beer or glass of draft; one glass of wine or a bottle of cooler; one straight or mixed drink with one shot of liquor or spirit (rum, whiskey, etc.).

58. In the last 12 months, how often did you have a drink of alcohol that was more than just a sip?

- I have never drank alcohol
- I did not drink alcohol in the last 12 months
- I have only had a sip of alcohol
  
- Every day
- 4 to 6 times a week
- 2 or 3 times a week
- Once a week
- 2 or 3 times a month
- Once a month
- Less than once a month
- I do not know

59. How old were you when you first had a drink of alcohol that was more than a sip?

- I have never drank alcohol
- I have only had a sip of alcohol
- I do not know
  
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

60. 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
- Once a month
- Less than once a month
- I do not know

61. How old were you when you first had 5 drinks or more of alcohol on one occasion?

- I have never done this
- I do not know
  
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

62. In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...)

- 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 week
- 2 or 3 times a month
- Once a month
- Less than once a month
- I do not know

63. How old were you when you first used marijuana or cannabis?

- I have never used marijuana
- I do not know
  
- 8 years or younger
- 9 years
- 10 years
- 11 years
- 12 years
- 13 years
- 14 years
- 15 years
- 16 years
- 17 years
- 18 years or older

