# Characterization of Nicotine Replacement Therapy Use by Canadian Youths in Grades 9 – 12

by

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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

In Canada, nicotine replacement therapy (NRT) is a best practice for adult smoking cessation, but it is not recommended for use by youth smokers. Previous research has indicated that more than 20 percent of high school-aged smokers in Canada had used NRT, despite the cross-Canada requirement that youths under the age of 18 have a physician's prescription to purchase NRT. The goal of this study was to examine both student and school-level characteristics associated with use of NRT by youths.

Data from 29,296 grade 9 to 12 students who participated in the 2008-2009 National Youth Smoking Survey (YSS) were combined with Canadian census and built environment data in multilevel logistic regression models. The associations between lifetime and current NRT use with student characteristics (i.e., smoking status, social smoking connections) were examined alongside school environment factors such as urban/rural location and pharmacy density within a one kilometre radius of schools.

In 2008-2009, 21.1% of youth smokers in Canada had ever used NRT and 5.1% were currently using NRT. Odds of NRT use were highest among daily smokers, boys, youths who had made multiple quit attempts, and youths who self-identified as smokers. Attending a school located within an urban area increased youths' odds of NRT use, whereas higher density of pharmacies surrounding a school was inversely associated with NRT use. This study is the first to identify significant between school differences in NRT use. It also reveals that many youths are using NRT in the absence of a quit attempt. Further research is needed to identify school characteristics that impact NRT use, and understand how youths are accessing NRT.

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# Chapter 1: Introduction and Overview

Since cigarettes were first identified as carcinogenic in the 1964 Surgeon General's Report (U.S. Public Health Service, 1964), great advances have been made in understanding the science of tobacco dependence and smoking cessation. In recent decades, public health movements and government policies –such as anti-tobacco advertising campaigns and increased taxation of cigarettes – have decreased tobacco use in Western countries (Peto, Darby, Deo, Silcocks, Whitley & Doll, 2000). Paired with effective smoking cessation tools – such as behavioural counselling and nicotine replacement therapy (NRT) use – these public health measures have led to a significant decline in the prevalence of smoking in Canada and abroad (Health Canada, 2009; Peto et al., 2000).

Despite the success of tobacco control strategies over the years, established best practices and policies have fallen short in a key area: provision of youth-specific smoking cessation tools. Although numerous studies have indicated that the majority of adult smokers began smoking as adolescents (Chassin, Presson, Sherman & Edwards, 1990; Everett, Warren, Sharp, Kann, Husten, & Crossett, 1999; Gans & Blyth, 1990; Lenney & Enderby, 2008; Lessov-Schlaggar et al., 2008 ), most smoking cessation tools are developed for and tested in adult populations (Backinger, McDonald & Ossip-Klein, 2003). Considering the risk of negative health outcomes is significantly reduced among individuals who quit smoking early in life (Peto et al., 2000; Taylor, Hasselbalad, Henley, Thun & Sloan, 2002), the existence of such a significant lag between smoking initiation and use of effective treatment is unacceptable. Most youth smokers want to stop smoking and try to quit at least once (Bancej, O'Loughlin, Platt, Paradis & Gervais, 2007; Leatherdale & McDonaled, 2007), yet up to 78 percent of these cessation attempts among youth smokers are unsuccessful (CDC, 2001; Ershler, Leventhal, Fleming & Glynn, 1989). Research has shown that the majority of youth smokers do not want to use most of the existing evidence-based best practices for cessation (e.g., telephone quitlines, health professional guidance) (Balch, Tworek, Barker, Sasso, Mermelstein & Giovino, 2004; Fiore et al., 2008; Letherdale & McDonald, 2005), however, they would consider using nicotine replacement therapy (NRT), such as nicotine patches or gum

(Dalton et al., 2010; Lawrence, 2001; Leatherdale & McDonald, 2007). Although research with adults using NRT has demonstrated improved cessation outcomes (Fiore et al., 2008; Lancaster, Stead, Silagy & Sowden, 2000; Peters & Morgan, 2002), limited evidence for its efficacy in youth smokers (McDonald, Colwell, Backinger, Husten & Maule, 2003; Moolchan et al., 2007; Sporer, Mermelstein & Curry, 2009) has led to NRT's inconsistent inclusion in some best practice guidelines for youth smoking cessation, but not others (Fiore et al., 2000; Fiore et al., 2008; MHNZ, 2007). Based on this ambiguous evidence, the Canadian government has restricted the sale of NRT to youths (under 18 years old) so that only those who have a physician's prescription can purchase it (Physical Health Unit, 2004). In contrast, countries such as the United Kingdom and New Zealand have recently made NRT broadly available to youths who are 12 years of age and older (MHNZ, 2007; Raw, McNeil, West, Arnott & Armstrong 2005). To inform future discussions surrounding the provision of NRT to Canadian youth smokers who want to quit smoking, a better understanding of the prevalence of NRT use in this population and the characteristics associated with NRT use is needed.

# Chapter 2: Review of the Literature

## 2.1 Youth smoking patterns and prevalence in Canada

Cigarette smoking is one of the leading causes of death and disease in the world (Ezzati & Lopez, 2003), yet 11.6 percent of Canadian high school students were current smokers in 2008 (Elton-Marshall, Leatherdale, Ahmed, Manske, Burkhalter, submitted). Youths who left high school prior to graduation were excluded from Elton-Marshall et al.'s (submitted) analysis, therefore this is figure is likely an underestimate of the actual prevalence of youth smoking in Canada (Rojas, Killen, Haydel & Robinson, 1998). Although there have been sizeable drops in youth smoking prevalence over the past two decades, declines have become stagnant in recent years (Health Canada, 2010). In 2009, 58 percent of Canadian smokers aged 15-19 were daily smokers who smoked an average of 11.4 cigarettes per day (CPD) (Reid & Hammond, 2011). Within this age group, males were more likely to be current smokers (14.9%) than females (10.9%) and youths in the Prairies and Quebec were more likely to be current smokers than youths in Ontario (Reid & Hammond, 2011).

## 2.2 Detrimental effects of youth smoking

### 2.2.1 Short-term health effects of smoking

Adolescent smokers can experience harmful effects of smoking in the short-term. For instance, youths who smoke report poorer health and increased health services utilization than non-smokers (Johnson & Richter, 2002; Newcomb & Bentler, 1987). Teenagers who take up smoking also experience a decline in academic performance and are more likely to drop out of high school than non-smokers (Townsend, Flisher & King, 2007; Tucker, Martinez, Ellickson & Edelen, 2008), however the direction of this correlation is unclear. While these short term health effects of youth smoking are cause for concern on their own, it is the long-term health trajectory of youths who smoke that necessitates aggressive intervention.

### 2.2.2 Smoking youths become smoking adults

Unfortunately, many youth smokers do not grow out of their smoking habit as adults (Chassin, et al., 1990; Lenney & Enderby, 2008; Lessov-Schlaggar et al., 2008; Okuyemi, Harris, Scheibmeir, Choi, Powell & Ahluwalia, 2002). In fact, approximately one third to one half of youths who try cigarettes become regular (Kessler, 1995; White et al., 2002) or dependent smokers (Shiffman, 1991) as adults, with progression to regular smoking more likely among youths who initiated smoking at a younger age (Everett et al., 1999). In contrast with the tobacco industry's claim that the decision to smoke is a free choice made by adults, approximately 75% of adult smokers initiated cigarette use before they were 18 years old (Gans & Blyth, 1990; Kessler, 1995). These findings highlight the need to improve smoking cessation outcomes in adolescents before they progress to smoking as adults.

### 2.2.3 Long-term health and economic costs of smoking

It is estimated that approximately 5.4 million people in the world die every year from diseases caused by smoking (WHO, 2008). Even within Canada where smoking prevalence is relatively low, 17 percent of deaths in Canada can be attributed to tobacco use every year (Rehm et al., 2006) and smoking attributable hospital care costs Canadians over $2.5 billion annually, (Baliunas, Patra, Rehm, Popova & Taylor, 2007). Most of these health and economic costs could be averted if youth smokers were able to quit prior to adulthood. In fact, longitudinal data indicate that excess risk of smoking-related morbidity and mortality is virtually eliminated among individuals who quit early in life (Peto et al., 2000; Taylor et al., 2002). Despite the innumerable gains to be made by improving youth smoking cessation, the majority of smoking cessation tools are developed for and tested in adult populations (Backinger et al., 2003).

## 2.3 Youth smoking cessation tools and best practices

### 2.3.1 Youth smokers want to quit smoking

Using data from the 2008-2009 Canadian Youth Smoking Survey, Elton-Marshall and colleagues (submitted) determined that within a nationally representative sample of Canadian smokers in grades 9-

12, 73 percent (n = 132,475) had tried to quit smoking at least once. High proportions of youth smokers attempting to quit smoking have also been identified in American adolescent populations by Zhu and colleagues (1999). Despite the large number of youth smokers who try to quit smoking every year, more than three quarters of quit attempts are unsuccessful (Bancej et al., 2007; Ershler et al., 1989). To narrow the gap between the number of quit attempts and the proportion of youths who successfully quit smoking, it is critical to develop smoking cessation tools geared specifically toward youth.

### 2.3.2 Best practices and youth preferences for smoking cessation

A wide variety of effective smoking cessation tools exist for adult smokers who wish to quit (Fiore et al., 2008). Many of these tools have simply been passed down to youth smokers, without adequate investigation into how youths in particular *want* to quit smoking (Backinger, et al., 2003; Garrison, Gristakis, Ebel, Wiebe & Rivara, 2003). This disregard for youth preferences has led to the low participation, high attrition and low quit rates that characterise youth smoking cessation programs (Moolchan, Ernst & Henningfield, 2000). The following sections review current best practices and alternate practices in youth smoking cessation, highlighting youth attitudes towards cessation programs and tools that have been proven effective in adults. Due to the emphasis on youth preferences, regulatory strategies that are mandatory for youth (i.e., increased cigarette taxation, youth tobacco possession laws) will be excluded from this discussion.

#### 2.3.2.1 Behavioural counselling and motivational enhancement

Numerous meta-analytic reviews and best practice guideline panels have identified behavioural counselling and motivational enhancement as best practices for youth smoking cessation (Curry, Mermelstein & Sporer, 2009; Fiore et al., 2000; Fiore et al., 2008 Grimshaw & Stanton, 2006; McDonald et al., 2003; Sussman, Sun & Dent, 2006). Grimshaw and Stanton (2006) analysed the results of 24 trials involving over 5000 youth smokers and concluded that of all of the cessation tools available to youths, only motivational enhancement and behavioural therapy significantly increased youths' odds of quitting. Similar conclusions were drawn from a literature review conducted by Curry and colleagues (2009), and

an expert review panel led by McDonald in 2003. A more lukewarm sentiment was put forth by the 2008 Clinical Best Practice Guidelines for Treating Tobacco Use, formulated based on meta-analyses of existing literature and the expertise of a review panel (Fiore et al., 2008). This panel recommended behavioural counselling with a level B strength of evidence, which indicates that although some evidence from randomized clinical trials supports the recommendation, the scientific support was not optimal (Fiore et al., 2008).

Despite the high level of efficacy behavioural counselling and motivational enhancement programs show in controlled trials, very few youth are willing to participate in them. For example, in a focus group study of 48 American adolescent smokers and past smokers, Balch and colleagues (2004) found that there was "no interest" in seeking professional counselling to quit smoking. Equally negative attitudes towards counselling have been identified by Leatherdale and McDonald (2005) in a survey study of youth smokers in which 71.8 percent of daily smokers (n = 396) and 78.1 percent of non-daily smokers (n = 123) reported that they would "never" meet with a teacher, guidance counsellor, or school nurse to help them quit smoking. Similar findings were made in a later study by Leatherdale and McDonald (2007) in which 74.7 percent of high school-aged occasional smokers (n = 79) and 64.5 percent of daily smokers (n = 100) reported that they would "never" meet with a teacher, guidance counsellor, or school nurse as a cessation approach. These data suggest that although counselling-based interventions achieve results within the controlled setting of a study, their real-world effectiveness may be hampered by youths' unwillingness to use them.

#### 2.3.2.2 School-based interventions

Sussman and colleagues (2006) performed a meta-analysis of 48 teen smoking cessation studies and found that in addition to behavioural counselling and motivational enhancement, school-based clinic and classroom techniques were effective at helping youth quit. Although school-based cessation groups are the most widely used intervention for treating tobacco dependence in youths (Mermelstein et al., 2002), very few youth smokers express any desire to use them. For instance, in a focus group study of

twenty-five 13 to18 year-old current and former smokers MacDonald and colleagues reported negative attitudes towards school-based interventions, noting that many youths felt such programs were unsupportive or "toxic" for teens attempting to quit smoking (MacDonald, Rothwell & Moore, 2007). In Balch et al.'s (2004) focus group study with 48 youth smokers, similar perspectives were shared, with some youths claiming that school-based programs are unnecessary, ineffective, patronizing and insensitive to the lived experience of young people.

The sentiments expressed by youths in these focus groups are similar to findings from survey data in which most young smokers report that they would never attend group meetings at school to help them in a quit attempt (Leatherdale & McDonald, 2005; Leatherdale & McDonald, 2007). Only the most addicted smokers interviewed by MacDonald and colleagues (2007) were willing to participate in school based cessation programs because their desire to quit superseded their reservations about school-based programs. Molyneux and colleagues (2006) also identified that some youth were interested in using school-based cessation services on the provision that their identity as smokers was kept entirely confidential. Due to the seeming efficacy (Sussman, Sun & Dent, 2006) and widespread adoption of school-based smoking cessation programs (Mermelstein et al., 2002), they have the potential to help countless youth smokers quit. Similar to behavioural counselling and motivational enhancement however, youths' limited desire to participate in these programs may prevent them from impacting a significant proportion of the youth smoker population.

#### 2.3.2.3 Nicotine replacement therapy (NRT)

Several literature reviews and meta-analyses have reported that there is no evidence that NRT significantly aids youth smoking cessation (Curry et al., 2009; Fiore et al., 2008; Grimshaw & Stanton, 2006). Interestingly, the Clinical Best Practice Guidelines published by Fiore and colleagues in 2000 suggested use of NRT in youths when tobacco dependence was apparent and strong intention to quit was obvious (Fiore et al., 2000). Both the 2000 and 2008 guidelines highlight that NRT has been proven safe for use among youths and adolescents (Fiore et al., 2000; Fiore et al., 2008), however in the 2008

guidelines, the panel cites the results of three inconclusive studies published since 2000 as evidence to revoke their initial recommendation of NRT for youth smoking cessation (Hanson, Allen, Jensen & Hatsukami, 2003; Moolchan et al., 2005; Roddy, Romilly, Challenger, Lewis & Britton, 2006).

Despite incomplete research findings regarding its efficacy, NRT has been identified by youths in several studies as a smoking cessation tool they would be interested in using (Leatherdale & McDonald, 2007; Lawrance, 2001; MacDonald, Rothwell & Moore, 2007). In MacDonald and colleagues' (2007) focus group study of 13-18 year-old youth smokers, NRT was named as the main form of cessation support that youths felt could truly help them quit, however access issues limited their NRT use. In a school-based survey of youth smokers in Ontario, Leatherdale and McDonald (2007) found that NRT was the only formal cessation tool youth smokers were interested in using. Similarly, Lawrance's survey study of 585 high school-aged smokers' indicated that youths preferred the confidentiality and ease of use associated with NRT, compared with more common services such as group counselling (2001).

Although the aforementioned studies indicate that NRT holds appeal to some youth smokers, lack of access to it and uncertainty regarding its safety and appropriateness has left many adolescent smokers reluctant to use NRT. For example, in a focus group study of ninety-nine 16 to 19 year old Scottish smokers, several youths cited concerns that NRT is potentially harmful and only intended for use among adults (Amos, Wiltshire, Haw & McNeill, 2006). Other youths in Amos et al.'s focus group study complained that the cost of NRT was prohibitive and kept them from using it regularly (2006). This sentiment was echoed in Balch et al.'s focus group study of American adolescent smokers, some of whom also perceived the nicotine patch and gum as embarrassing and bad tasting (2004). Clearly, there is a broad range of receptiveness to NRT as a cessation tool among smoking youth. Unlike behavioural counselling or school-based cessation programs, NRT is inconsistently recommended as a best practice for helping youths quit (Fiore et al., 2008; MHNZ, 2007; Raw, McNeil, West, Arnott & Armstrong 2005); however, youths do appear to be more interested in using NRT than other cessation tools.

#### 2.3.2.4 Quitting without assistance

In three separate survey studies of smoking youth, the majority of adolescent smokers expressed a desire to quit on their own, without using a formal cessation program (Lawrance, 2001; Leatherdale & McDonald, 2007; Stanton, Lowe, Fisher, Gillespie & Rose, 1999). This sentiment was replicated in a focus group study by Bernat and colleagues (2008), who found that many adolescents believe that willpower is all they need to quit smoking. Although quitting "cold-turkey" is the method of choice for most youth, very few adolescent smokers are actually able to quit smoking using willpower alone, meaning that the majority of youths who use this tactic will eventually relapse (Jannone & O'Connell, 2007). Improving the uptake of more effective smoking cessation tools would likely result in improved smoking cessation rates among youths.

## 2.4 Appropriateness of NRT for youth smoking cessation

Given its unique positioning as an adult best practice for smoking cessation that youths are interested in using, researchers have begun to investigate NRT as a quitting aid for youth smokers. The findings and methodologies of these studies are discussed in the proceeding section.

### 2.4.1 Effectiveness of NRT among adult smokers

A recent meta-analysis by Stead and colleagues examined the results of 111 randomized or quasi-randomized NRT trials with at least 6 months follow-up and found that people using NRT were 1.58 times more likely to successfully quit smoking than controls (95% CI: 1.50-1.66) (Stead, Perera, Bullen, Mant & Lancaster, 2008). These findings are consistent with the large body of research showing that adult smokers using NRT to quit smoking have significantly improved cessation rates and less relapse compared to quitting on their own (Fiore et al., 2000; Lancaster et al., 2000; Peters & Morgan, 2002).

Among adults that are considered "light smokers" (fewer than 10 CPD [Cunningham & Selby, 2007]), efficacy of NRT is less consistent. In a study of 755 adult light smokers, individuals using nicotine gum had no better quit rates than those using a placebo (Ahluwalia et al., 2006). It was noted in this study that participants used far less gum than would typically be required to reduce cigarette cravings

(Ahluwalia et al., 2006). This under-dosing of NRT has been observed previously (Fagerström, Schneider & Lunell, 1993) and could be a factor in youths for whom there would be social influences (parents, friends, and teachers) that may deter them from using appropriate doses of NRT. In contrast with the above null finding, a study of 460 adults who smoked less than 15 CPD showed significantly increased odds of quitting at six weeks and one year follow-up when using nicotine lozenge instead of a placebo lozenge to help them quit smoking (Shiffman, 2004). Some of the light smoking adult populations in which NRT efficacy has been studied consume fewer CPD (i.e., 7.5 CPD in study of 662 light smoking adults by Okuyemi, Zheg, Guo and Ahluwalia [2009]) than daily youth smokers (11.4 CPD [Ried & Hammond, 2011]); thus positive findings of NRT efficacy in this light smoking adult population suggest that NRT may have a place in a strategy to help some young smokers quit.

### 2.4.2 Effectiveness of NRT among youth smokers

There have been a limited number of studies that tested the efficacy of NRT in helping youth smokers quit (Hanson, Allen, Jensen & Hatsukami,2001; Moolchan et al., 2005; Hurt et al., 2000; Smith et al., 1998; Roddy, Romilly, Challenger, Lewis & Britton, 2006). Of these studies, all have noted the absence of serious adverse health effects from NRT use in youth populations, however none of them have reported significant effects of NRT on cessation success (Hanson, Allen, Jensen & Hatsukami, 2001; Moolchan et al., 2005; Hurt, Croghan, Beede, Wolter, Croghan, & Pattern, 2000; Smith et al., 1998; Roddy, Romilly, Challenger, Lewis & Britton, 2006). Given the positive impact NRT has had on cessation in light smokers in some studies (e.g., Shiffman, 2004), these null findings in youth smokers (some of whom smoke more CPD than light smokers [Moolchan et al., 2005; Smith et al., 1998]) are unexpected. A possible explanation lies in the many methodological issues (i.e., lack of control groups, unclear inclusion criteria, use of self-definition as a smoker as an outcome, problems with recruitment and retention, lack of follow-up data) that affected every trial of NRT efficacy in youths on record (Mermelstein et al., 2002). It is also possible that the lack of efficacy observed in the NRT trials with youth is due to the fact that youth smokers do not smoke enough CPD or have not been smoking long

enough to become addicted to nicotine, therefore NRT does not help them quit (Sanouri, Ursprung, DiFranza, Costa, & DiFranza, 2009). This concept will be explored in the next section.

#### 2.4.2.1 Are youth smokers addicted to nicotine?

A number of smoking cessation experts have hypothesized that youth smokers do not benefit significantly from NRT during cessation attempts because they are not physiologically dependent on nicotine (Sanouri et al., 2009). Understanding the extent of physiological dependence on nicotine in youth smokers is important for determining whether or not use of NRT is appropriate in this population. Although there is strong evidence of non-physiological factors – such as social cues – influencing cessation success in youth smokers (Urberg, Değirmencioğlu & Pilgrim, 1997), recent findings suggest that even occasional youth smokers may develop physical dependence on nicotine (DiFranza et al., 2000; DiFranza et al., 2007). In fact, DiFranza and colleagues found that initial symptoms of nicotine dependence in youths can appear within days to weeks of smoking initiation, often prior to the onset of daily use (2000; 2007). Paired with the finding that some non-daily youth smokers struggle with cigarette cravings and fail to quit smoking (DiFranza et al., 2007), these data challenge the paradigm of a minimum of 10 cigarettes per day (CPD) as the threshold for nicotine dependence, as suggested in some of the NRT literature (Robinson, Schroeder & Moolchan, 2006; Thompson & Hunter, 1998).

One of the main difficulties in identifying whether youth smokers are addicted to nicotine is the poor construct validity of adult scales of nicotine dependence used with youth smokers. For instance, one of the standard items on the commonly used Fragerström Test of Nicotine Dependence (FTND) is the question "How soon after waking do you smoke your first cigarette of the day?" (Balfour, Benowitz, Fragerström, Kunze & Keil, 2000). Although time to first cigarette is an important item in assessing the extent of adult nicotine addiction, it has poor construct validity among youths whose smoking behaviour is strongly affected by non-smoking rules enforced by parents and teachers (Balfour, Benowitz, Fragerström, Kunze & Keil, 2000; Cohen, Myers & Kelly, 2002). Attempts to modify the Fragerström test have shown some promising results, with one study reporting significant correlation between

modified FTND scores and saliva cotinine levels (Rojas, Killen, Haydel & Robinson, 1998). Identifying the extent of nicotine dependence in youth is an important component of determining which youth smokers, if any, should be provided with NRT. Continual development and testing of youth-specific nicotine dependence scales is therefore imperative.

#### 2.4.2.2 What types of NRT do youths prefer?

The effectiveness of NRT is, in part, dependent on whether youths are willing to use it, therefore understanding youth NRT preferences is important. Due to the paucity of data regarding youth NRT use, it is difficult to make clear conclusions regarding youth preferences for different types of NRT. In one study of 4403 grade 11 students in Memphis Tennessee, 5.3% had ever used NRT; of these NRT users, 41.6% reported exclusive use of gum, 29.2% reported exclusive use of patch, 29.2% reported use of both patch and gum (Dalton et al., 2010). Although no type of NRT has been shown to significantly aid youths in cessation attempts, a meta-analyses by Fiore et al (2008) indicated that using nicotine gum was less effective at helping adults quit than using a nicotine patch.

## 2.5 Why study characteristics associated with NRT use?

Although great advances have been made in reducing smoking prevalence in Canada and abroad, more than one in 10 youths in Canada is a current smoker and many of these youths will likely continue to smoke as adults (Chassin, Presson, Sherman & Edwards, 1990; Elton-Marshall, Leatherdale, Ahmed, Manske, Burkhalter, submitted). Evidence has surfaced that even non-daily smoking youths can develop nicotine dependence (DiFranza et al., 2000; DiFranza et al., 2007), however most adolescent smokers would rather attempt to quit on their own than use a formal cessation aid during a quit attempt (Leatherdale & McDonald, 2007). NRT is the exception to this rule as a substantial of young smokers are interested in using it. There is therefore an urgent need for large NRT efficacy trials with representative samples of youth smokers to guide best practices. Until there is stronger evidence of NRT's clinical

appropriateness, it is important to track its use in youth populations to identify which groups are more likely to use it. In the event that NRT is eventually included in a comprehensive cessation strategy for Canadian youth smokers, findings from this study will aid in targeting underserved subgroups of young smokers. Conversely, if NRT is eventually identified as inappropriate for youth smoking cessation, understanding the characteristics of youths who are most likely to use it will be critical to controlling its use.

## 2.6 Individual and Environmental characteristics Associated with NRT Use

For the present study, Albert Bandura's *social cognitive theory* (1999) was used as a framework to examine the individual characteristics associated with NRT use in youth smokers. Bandura's theory posits that human actions – such as NRT use – are guided by a triad of reciprocal factors: 1) personal determinants (cognitive and biological), 2) behavioural determinants, and 3) environmental determinants (Bandura, 1999). These three theorized categories of sociocognitive determinants can be applied to NRT use in youths, as represented in Figure 1.

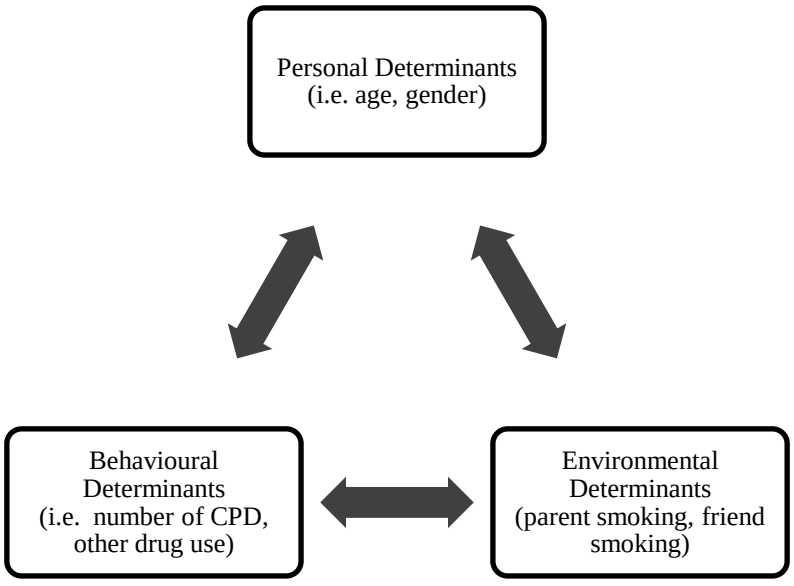


**Figure 1: Theoretical model of sociocognitive determinants of NRT use in youth smokers**

In addition to determining the individual-level factors associated with NRT use among smoking youth, examination of the broader contextual factors correlated with NRT use can inform future public

health interventions. Recent studies of youth smoking behaviour indicate that attendance at certain schools has an independent effect on the likelihood that students will smoke, even when individual factors are controlled for (Ellickson, Bird, Orlando, Klein & McCaffery, 2003; Murnaghan, Sihvonen, Leatherdale & Kekki, 2007; Sabiston et al., 2009). Further research is needed to understand whether similar contextual effects impact NRT use among youth smokers. Bronfenbrenners's (1977) *ecological theory* is a useful theoretical framework for representing how school-level contextual factors could affect NRT use among youth smokers. As depicted in Figure 2, a *microsystem* represents the immediate effects of personal factors (as identified in Figure 1) – as well as the effect of school and work environments – on a youth's likelihood of NRT use. For example, having a high proportion of friends who smoke may decrease a youth's likelihood of using NRT at the *microsystem* level, just as going to a school located near several pharmacies may increase their odds of using NRT. The *mesosystem* represents the level at which individual and proximal environmental factors such as these would interact to have a cumulative effect on probability of a youth using NRT. Understanding how school characteristics combine with specific individual-level factors to affect use of NRT in adolescents could aid in targeting high risk students and schools for future interventions. The influence of *exosystem* and *macrosystem* effects on youth NRT use is beyond the scope of the current investigation.

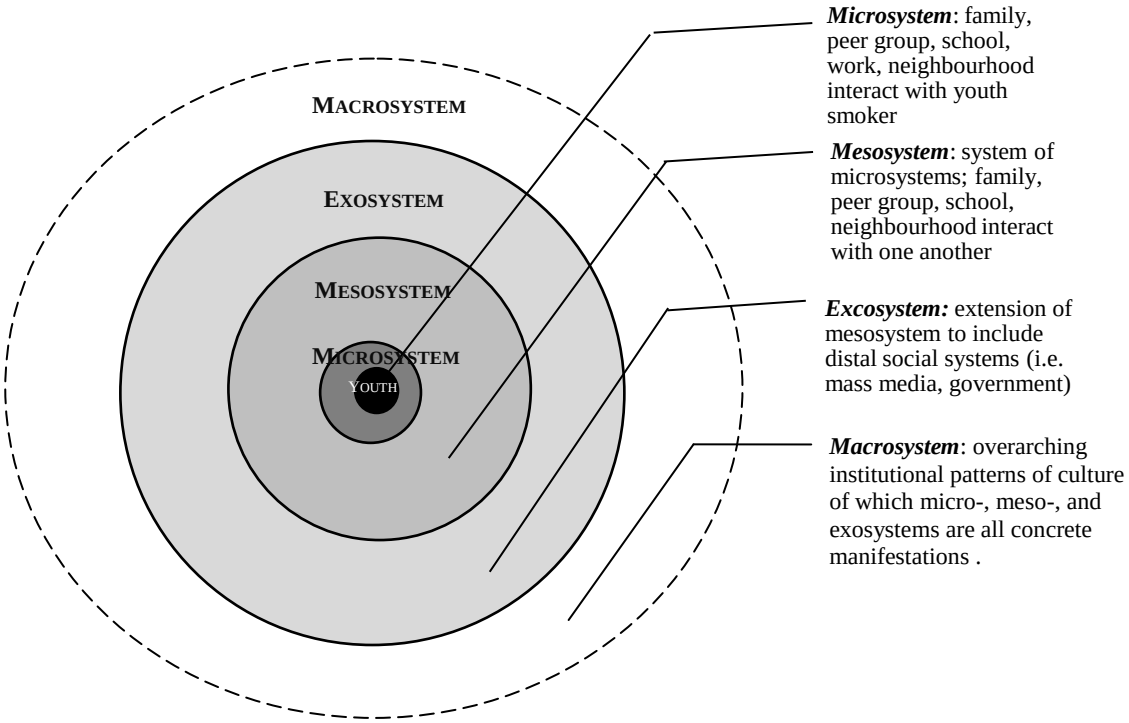


**Figure 2: Theoretical model of ecological determinants of NRT use in youth smokers**

The following sections will elaborate on specific examples of individual and school- environment determinants of NRT use among youth smokers. A third section will outline demographic characteristics of youths that could moderate individual or school-level factors' effect on youth NRT use. These demographic characteristics were controlled for in the present study.

### 2.6.1 Personal Determinants of NRT use in youth smokers

Certain individual characteristics – such as being male or older –have been associated with increased NRT use among youth (CDC, 2003; Dalton III et al., 2010; Harbaum-Botello, Schroeder, Collins, & Moolchan, 2010). Other individual factors, such as youths' disposable income level have also been associated with likelihood of NRT use (Lane, Leatherdale & Ahmed, 2011). Examining how these individual characteristics affect NRT use is important as it allows us to gauge which youths are most likely to take advantage of public health policies that make NRT available to teens. Conversely, determining traits associated with decreased likelihood of NRT use (i.e., low disposable income) (Lane et al., 2011) will help identify youths who may benefit from improved access to this cessation tool, in the

event that it is determined appropriate for use among youth populations. The following personal factors have been associated with NRT use among youth and will be examined in this study.

#### 2.6.1.1 Age

Older youths have been shown to be more likely to use NRT than younger youths (Curry, Sporer, Pugnach, Campbell & Emery, 2007). This finding has been consistent across previous studies (CDC, 2003; Lane et al., 2011), and is probably due to a combination of increased ability to access NRT and increased dependence on nicotine with age. For example, not only are older youths closer to the 18-year-old threshold for purchasing NRT without a doctor's prescription, they are also likely to smoke more cigarettes (and be more nicotine dependent) than younger youths (Faulker, Farrelly & Hersey, 2000). Also, the longer youths have been smokers, the more likely they are to have made a quit attempt (Burt & Peterson, 1998) and the more aware they are of the existence of NRT (Rainio et al., 2010), which may increase the odds of older youth smokers using NRT compared with younger youth smokers. In this study, grade in high school was used a proxy measure for age in years to reflect the units that are commonly used when planning health policies for youths.

#### 2.6.1.2 Gender

In a recent analysis of Canadian high school-aged youth, current use of NRT among current and former smokers was over four times more likely among males than females (Lane et al., 2011). This finding aligns with past research indicating that significantly more high school aged males than females smoke (Reid & Hammond, 2011), and young male smokers tend to have higher nicotine dependence scores than their female counterparts (Rojas et al., 1998). Based on these findings, it seems reasonable that males may benefit more from NRT use during a quit attempt and hence may be more apt to use it.

However, there is also a substantial body of evidence that suggests female youths would be more apt to use NRT in quit attempts. One study of 100 adolescents (aged 13 to 19) who smoked greater than 10 CPD found that females experienced significantly more cigarette cravings during quit attempts than

males (Dickman, Mooney, Allen, Hanson, & Hatsukami, 2009). This effect was amplified in young women who were using oral contraceptives, which are known to increase nicotine metabolism (Benowitz, Lessov-Schlaggar, Swan & Jacob, 2006; Dickman et al., 2009). Given that young girls metabolize nicotine faster than young boys (Benowitz et al., 2006) and tend to report more cigarette cravings during quit attempts (Wileyto, O'Loughlin, Lagerlung, Meshefedjian, Dugas & Gervais, 2009), it seems logical that they would be more inclined to use NRT than their male counterparts. Additional research examining gender differences in NRT use is required.

#### 2.6.1.3 Disposable income

Several studies have identified that youth smokers perceive the cost of NRT as a barrier to its use (Amos et al., 2006; Balch et al., 2004; Hines, 1996), therefore it follows that youth with more disposable income would be more likely to use NRT in a quit attempt than those with less disposable income. Indeed, among youths who had disposable income in a recent study of adolescent smokers, probability of NRT use increased with level of disposable income (Lane et al., 2011). However, NRT use was highest among youth smokers who had no disposable income, suggesting that youths with no disposable income may be accessing NRT from social sources or public health programs (Lane et al., 2011). Additional research is needed to clarify the association between NRT use and disposable income.

#### 2.6.1.4 Belief that smokers can quit any time they want

Youth smokers who believe that they can quit smoking successfully at any time are the least likely to use formal cessation tools (Balch et al., 2004). Although Weinstein et al. (2004) have identified that the majority of youth smokes believe it would be easy to quit at any time, the quantitative relationship such beliefs have with likelihood of using NRT, specifically, have not been examined to date.

#### 2.6.1.5 Self-identification as a smoker

Research has shown that up to half of the youths who are classified as smokers by the Youth Smoking Survey taxonomies do not consider themselves smokers (Leatherdale & McDonald, 2006). Self-

identification as smoker could influence likelihood of NRT use by youth, as some youth smokers consider NRT an appropriate cessation tool only for more established smokers (McNeill et al., 2005).

### 2.6.2 Behavioural Determinants of NRT use in youth smokers

The following sections will outline certain behavioural characteristics that have been associated with NRT use in past research. Other behavioural factors of interest will also be explored due to their relevance for guiding youth smoking cessation best practices.

#### 2.6.2.1 Smoking Status

Given NRT's formal status as a stop smoking medication, it would be expected that youths who are current smokers are more likely to use NRT than youths who are not. This expectation has been confirmed in recent research that showed current smokers were 3.59 times (95% CI: 1.78 -7.26) more likely to have used NRT in the past 30 days than former smokers (Lane et al., 2011). In terms of informing policies that facilitate youth access to NRT or subsidise NRT for youths, it is also important to identify whether non-smoking youths are using NRT inappropriately. In a 1998 study of NRT use in a sample of grade 11 students in Memphis, Tennessee (n = 4,078), it was found that of the 5% of ever NRT users identified, 18% reported never smoking (Klesges, Johnson, Somes, Zbikowski & Robinson, 2003). Elucidating how different classes of smokers and non-smokers use NRT in a nationally representative Canadian sample is important for future targeting of NRT interventions or restrictions to particular sub-populations.

#### 2.6.2.2 Number of past quit attempts

In a recent analysis of NRT use among Canadian youth smokers (Lane et al., 2011), the probability of ever or currently using NRT increased with the number of past quit attempts a youth smoker had made. A similar finding in light-smoking (fewer than 10 CPD) adults showed that an increased number of past quit attempts was associated with increased adherence to NRT use (Okuyemi et al., 2010). Elucidating whether this association between number of past quit attempts and NRT use is

retained in the context of numerous other sociocognitive factors is important to help medical practitioners target NRT use advice to youth smokers who will be most receptive to it.

#### 2.6.2.3 Cigarettes per day (CPD)

Ten CPD is typically considered the minimum threshold of smoking to warrant use of NRT in a quit attempt (Cunningham & Selby, 2007; Robinson et al., 2006; Thompson & Hunter, 1998), and is often used as an inclusion criterion for trials of NRT efficacy among youth (Hanson et al., 2003; Moolchan et al., 2005). Cohen and colleagues performed a study of 67 youths who smoked fewer than 10 CPD and found that 85 percent of them met DSM-IV criteria for nicotine dependence (2002). This finding suggests that the 10 CPD cut-off may be excluding youths who are addicted to nicotine from NRT trials. Assessment of the relationship between CPD and NRT use is necessary to reveal whether the subject populations in NRT efficacy trials are representative of the true NRT user population, or whether NRT use is actually prevalent in youths smoking fewer than 10 CPD.

#### 2.6.2.4 Attendance at classes where they discussed the health effects of smoking

Tobacco control curricula within schools have a limited impact on decreasing smoking prevalence (Tengs, Osgood & Chen, 2001; Bruvold, 2003), however few studies have investigated their impact on student uptake of cessation tools such as NRT. In a 2006-2007 study of youth NRT use in Canadian high school students, there was a significant, inverse relationship between number of classes attended where the effects of smoking were discussed and likelihood of using NRT (Lane et al., 2011). It is possible that tobacco control curricula provided adequate encouragement and information to prompt smoking youth to quit independent of pharmacological aid. Consistent with existing evidence, it may also be possible that such curricula propagate the common misconception that nicotine is responsible for the negative health effects of smoking (Amos et al., 2006; Shiffman, Ferguson, Rohay & Gitchell, 2008), hence youth smokers may avoid using NRT to try to quit.

#### 2.6.2.5 Participation in a quit smoking contest

NRT is commonly given out in conjunction with quit and win contests in adult populations (Gomez-Zamudio, Renaud, Labri, Massé, Pineau & Gagnon, 2004; Hawk, Higbee, Hyland, Alford, O'Connor & Cummings, 2006), however this practice has not been documented in youth smokers. A 2006-2007 analysis of Canadian youths (grades 9-12) who were current and former smokers, showed that participation in quit and win smoking contest was not statistically associated with increased odds of NRT use (Lane et al., 2011). However, these findings have not been replicated among youth who are current smokers.

#### 2.6.2.6 Participation in smoking cessation counselling

Although most youth smokers are reluctant to seek out smoking cessation counselling (Balch, et al., 2004), it may be a necessary step for youths wishing to access NRT in Canada. According to policy, individuals under the age of 18 are required to present a doctor's prescription in order to purchase NRT at pharmacies across Canada (Kaplan et al., 2008), therefore accessing NRT may necessitate seeing a physician first. Given that 76 percent of Canadian physicians provide smoking cessation counselling to patients identified as smokers (Kaplan et al., 2008), a correlation between youths accessing NRT and youths receiving smoking cessation counselling would be expected. This expectation was confirmed in a recent pan-Canadian study of youth smokers, in which participation in smoking cessation counselling was associated with a doubling of a youth's odds of using NRT (Lane et al., 2011).

#### 2.6.2.7 Alcohol and drug use

Youths who use alcohol and drugs tend to report higher rates of smoking than the general adolescent population (Leatherdale & Ahmed, 2010; Myers & Brown, 1997; Perkins, 1999 Tucker, Ellickson, Orlando & Klein, 2005; White et al., 2002). Alcohol and drug abusing youth may therefore represent a population that are more likely to require additional cessation tools (such as NRT) to quit smoking. Furthermore, youths who are able to access controlled or illicit substances such as alcohol and

drugs may be more apt to access a regulated substance such as NRT. Understanding whether a relationship exists between alcohol or drug use and NRT use would provide new insight to those attempting to target youth cessation programs at high-risk individuals.

### 2.6.3 Social Environment Determinants of NRT use in youth smokers

Evidence indicates that social influences in a youth's environment can not only influence their likelihood of smoking (White et al., 2002), but also their probability of quitting (Christakis & Fowler, 2008). The following social influences are of particular interest with regard to NRT use in youth smokers.

#### 2.6.3.1 Parent and sibling smoking

Although there is evidence for the relationship between parent smoking (Avenevoli & Merikangas, 2003; Chassin, Presson, Pitts & Sherman, 2000;PCPHI, 2010; White et al., 2002) and sibling smoking (Avenevoli & Merikangas, 2003; Christakis & Fowler, 2008) with youth smoking, there is a paucity of data on how these factors influence use of NRT. Given that youths have been known to take cigarettes from smoking family members (DiFranza & Coleman, 2001; Raino & Rimpela, 2009), it follows that they may also procure NRT from family sources. To date, no research has investigated the association between social influences and NRT use.

#### 2.6.3.2 Friend smoking

Overall, 95 percent of current youth smokers in Canada report having friends who smoke, compared with 28 percent of non-smoking youth (PCPHI, 2010), and many youth initiate smoking in response to peer pressure (Lenney & Enderby, 2008), suggesting that smoking is a highly social behaviour among adolescents. Due to the social nature of adolescent smoking, many youths find it very difficult to quit smoking if their friends smoke (Jannone & O'Connell, 2007; Tucker, Ellickson, & Klein, 2002). Conversely, smoking friends who are making quit attempts may act as a social source of NRT for youth smokers. No research to date has investigated the association between friends smoking and NRT use.

### 2.6.4 School-Environment Determinants of NRT Use

#### 2.6.4.1 Density of pharmacies surrounding a school

In a recent study of 24,875 high school students who completed the 2005-06 California student survey, the average prevalence of current smoking was 3.2 percentage points higher at schools in neighbourhoods with the highest tobacco retailer density (greater than five retailers) than in neighbourhoods without any tobacco retailers, even after adjusting for school demographics and neighbourhood characteristics (Henriksen, Feighery, Schleicher, Cowling & Kline, 2008). Past studies of how youths access NRT indicate that 22-31% of youths who use NRT purchase it directly from pharmacies (Klesges et al., 2003; Raino, Huhtala & Rimpelä, 2010). Given that density of tobacco retailers has been shown to be associated with youths' smoking behaviour (Henriksen et al., 2008, Leatherdale & Strath, 2007), it logically follows that density of NRT retailers may be associated with youth NRT use. The current study will be the first to investigate the association between NRT use and pharmacy density, where density will be measured in a one kilometre radius surrounding schools. Given that pharmacies are often located in plazas or retail centres that also contain tobacco retailers, tobacco retailer density was also included in initial models of NRT use to control for their potential confounding affect on the pharmacy – NRT use relationship.

### 2.6.5 Demographic Determinants of Youth NRT Use

#### 2.6.5.1 Urban/rural location of school

Research indicates that youths living outside of urban centres are more likely to smoke than those living in urban centres (Henriksen et al., 2008; Huang, Chen, Chen, Magnus, Rice, Yen, & Hsu, 2009; McCarthy, Mistry, Lu, Patel, Zheng & Dietsch, 2006). Although this link between location and probability of smoking is well-established, little is known about how location of a school within (or outside of) an urban centre impacts use of different cessation tools, including NRT. Increased rates of smoking at schools in rural areas may necessitate greater NRT use to aid youths in cessation attempts;

however, decreased access to pharmacies or reduced anonymity associated with purchasing NRT in rural areas may result in lower NRT use among youth. Regardless of the direction of association, it is suspected that urban/rural location of schools impacts youth NRT use, therefore this school characteristic was controlled for in the present study.

#### 2.6.5.2 Province of residence

In a 2006-2007 analysis of 41,886 Canadian youth (grades 9-12), it was found that significant regional differences existed in current and ever use of NRT, with NRT use highest in the Prairie regions and lowest in Quebec (Lane et al., 2011). These findings are contrary to expectations given that the government of Quebec has been subsidizing NRT purchases since 2000, even among youth (Tremblay, Payette & Montreuil, 2009). Given these significant between-region differences in NRT use, province of residence was controlled for in the current study of characteristics associated with NRT use.

## 2.7 Summary and Implications

The preceding review highlights the paucity of information regarding NRT use among youth smokers, despite their expressed interest in using it as a cessation tool. Although questions still exist regarding the appropriateness of NRT for youth smokers, there is reason to believe that it holds potential as a future tool for adolescent smokers attempting to quit. Regardless of whether or not NRT is reintroduced as a best practice for youth smoking cessation, understanding the individual and environmental factors associated its use will be critical in guiding future policies intended to encourage or limit its use. The current study uses Bandura's *social cognitive theory* (1999) and Bronfenbrenner's *ecological theory* as frameworks to guide an examination of student and school characteristics' association with current and ever use of NRT.

# Chapter 3: Study Rationale, Research Questions and Hypotheses

## 3.1 Study Rationale

Despite NRT's potential as a cessation tool for youth smokers, it is not consistently recommended as a best practice for youth smoking cessation (Fiore et al., 2008; MHNZ, 2007), nor is it accessible in Canada to youths under the age of 18 without a doctor's prescription (Physical Health Unit, 2004). In a recent study of Canadian high school students, it was found that more than 20% of current smokers had ever used NRT (Lane et al., 2011), suggesting that regardless of regulations restricting its purchase, youth smokers are accessing and using NRT. The current study sought to expand upon these finding by examining and comparing NRT use prevalence in the 2008-09 and 2006-07 data and by incorporating new data sources to identify additional sociocognitive and environmental factors associated with NRT use. Past research has consistently shown that both individual and school-level factors affect youth behaviour (Henriksen, Feighery, Schleicher, Cowling & Kline, 2008; Leatherdale, 2010; Leatherdale, Brown, Cameron & McDonald, 2005; Sabiston et al., 2009). To reflect these different layers of influence on NRT use, multilevel logistic models were developed with individual-level factors nested within schools. The findings from this study elucidate how personal, social and behavioural factors affect likelihood of youth NRT use within different school contexts. These data can be used to guide future large-scale intervention trials and public health policies aimed at improving cessation among youth smokers.

## 3.2 Research Questions

The purpose of this study was to examine the prevalence of NRT use among a nationally representative sample of grade 9 to 12 students across Canada in 2008-09. The study also investigated the association between current and ever use of NRT with individual characteristics and school environment. The following research questions were used to guide this study towards meeting these objectives.

### Research Question 1:

What was the prevalence of ever and current NRT use among grade 9-12 students in Canada in 2008-09?

Hypothesis 1**:** Despite the restrictions on its accessibility to youth, it is expected that NRT will be ever and currently used by at least 21 and 8 percent of Canadian youth smokers, as reported by Lane et al (2011), however it is expected that use rates will be lower among the general population of youths, due to lower NRT use among non-smokers (Dalton et al., 2010).

### Research Question 2:

Has the prevalence of ever and current NRT use by grade 9-12 students in Canada changed from the 2006-07?

Hypothesis 2: It is hypothesized that similar to adult NRT use trends (Reid & Hammond, 2011), NRT use among youths in Canada will be stable from 2006-2007 to 2008-2009.

### Research Question 3:

Did significant between-school variation in ever and current use of NRT by grade 9-12 students in Canada exist in 2008-2009?

Hypothesis 3***:*** Similar to the between-school variability reported in student overweight levels and student smoking susceptibility (Leatherdale, 2010; Leatherdale et al., 2005), it is hypothesized that there will be statistically significant between-school variability in ever and current use of NRT.

### Research Question 4:

If there was between-school variation in ever or current use of NRT, which school and student-level factors were associated with NRT ever or current use?

Hypothesis 4: The school and student characteristics outlined in section ***2.6*** will be associated with ever and current NRT use by Canadian youths in grades 9-12.

# Chapter 4: Methods

## 4.1 Data sources

### 4.1.1 The 2008-2009 Canadian Youth Smoking Survey

Cross-sectional data from 29,296 students in grades 9-12 who completed the 2008-2009 Youth Smoking Survey (Health Canada, 2009) were used in this study. This school based survey of youth smoking behaviours in the 10 Canadian provinces was administered with support and funding from the Controlled Substances and Tobacco Directorate of Health Canada, in cooperation with the Propel Centre for Population Impact at the University of Waterloo. Detailed information on the sample design, methods and survey rates for the 2008-2009 YSS is available online (www.yss.uwaterloo.ca) and in print (Elton-Marshall et al., submitted).

The goal of the YSS is to provide benchmark data on national smoking prevalence rates for youth and to evaluate the impact of tobacco control interventions (University of Waterloo, 2009). Data collected in the 2008-2009 YSS also documented youth cessation behaviours and psychosocial correlates of smoking. The YSS consists of (a) a machine-readable questionnaire completed by all eligible students at randomly sampled schools, and (b) a school-specific computer generated feedback report and executive summary delivered to each participating school within 8 to 10 weeks of data collection (Elton-Marshall et al., submitted). Only data from the machine-readable student questionnaire were used for this study. All protocols and materials associated with the YSS survey were approved by the University of Waterloo Human Research Ethics Committee prior to their implementation and administration, as well as local institutional review boards of participating provinces and health regions.

#### 4.1.1.1 YSS Student Questionnaire.

The YSS questionnaire is a valid and reliable tool for measuring the prevalence of smoking-related behaviours and beliefs (Health Canada, 2002). Module B of the YSS was introduced in the 2008-2009 version of the survey to query youths in Grades 7-12 on their use of alcohol and other drugs, in

addition to the standard tobacco-related questions (University of Waterloo, 2009). Although YSS data is collected for youths in grades 6-12, only responses ascertained from youths in grades 9-12 using this 65 item module (Appendix A) will be used in this study. The reasons for the exclusion of data from youths in grades 6-8 are: 1) the rate of smoking among students in grades 6-8 is very low (PCPHI, 2010), therefore NRT use in this population is expected to be negligible and cannot be reported due to Health Canada guidelines for publishing YSS data, and 2) DMTI-Spatial built environment data is only available for secondary schools.

#### 4.1.1.2 School Sampling

The target population for the YSS consisted of all young Canadian residents attending public, private and Catholic schools. The data in this study are from a representative sample of schools in the ten Canadian provinces, for youths in grades 9 – 12. Youth residing in the Yukon, Nunavut and the Northwest Territories were excluded from the sample, as were youth living in institutions or on First Nation Reserves, and youth attending special schools (i.e. schools for the visually impaired) or schools on military bases.

The sample design for the YSS was based on a stratified multistage design, constructed to provide a representative sample of youth in all provinces in Canada. Sampling was stratified by health region smoking rate and type of school (elementary or secondary). In Stage 1, the smoking rate among 15-19 year olds in each health region of the Canadian provinces (n = 133) was calculated using data from the Canadian Community Health Survey (CCHS) (Statistics Canada, 2010). School lists obtained from the provincial Departments of Education for each of the 10 provinces included enrolment data by grade for each school. Using these data, the total eligible grade enrolment in a health region was used as a weight to compute the median smoking rate for each province. Each school's six-digit postal code was used to identify the health region in which it was located. Schools with smoking rates below the health region median were classified as having "low" smoking rates, whereas those schools with smoking rates above the health region median were classified as having "high" smoking rates.

In Stage 2, schools were stratified into elementary or secondary school strata (based on whether there was a high enrolment of students in grades 6 to 8 or 9 to 12). Elementary and secondary schools were sampled in a 2:1 ratio due to the smaller enrolment sizes of the elementary schools. Given that only data from youths in grades 9-12 were used in this analysis, the proceeding description of data collection methods will be restricted to those methods used in secondary schools. Schools were over-sampled in each province based on the provincial school recruitment rate from the 2004-2005 and 2006-2007 YSS cycles. Based on lessons from previous YSS cycles, the 2008-2009 cycle included a third health region stratum in Ontario: Greater Toronto Area (GTA). The GTA health region stratum acknowledged the size of the GTA and the importance of being able to capture schools from the GTA even if there were refusals from the larger school boards in Toronto city. The GTA stratum consisted of all schools in the GTA, comprising these five health units: Toronto Regional Health Unit, York Regional Health Unit, Peel Regional Health Unit, Halton Regional Health Unit and Durham Regional Health Unit.

Sampling of private schools was based on a simple random sample of private schools in each province. The number of schools originally selected was roughly proportional to the number of students enrolled in private schools in that province as compared to the total in public schools.

#### 4.1.1.3 School Recruitment and Participation

School board recruitment began in October 2008 and typically consisted of a formal application (if applicable) or a recruitment package and phone calls. Of the school boards approached, 84% agreed to participate in the YSS. Following approval from presiding school boards, individual schools were invited to participate in the YSS. The standard recruitment package for both boards and schools included an invitation letter, a project summary, sample questionnaires, sample permission letters, and a template feedback report. Private schools were approached directly because there is no governing board to review research requests for these schools. Of all the schools that were approached, 59% agreed to participate in the survey. YSS Survey data were collected from December 2008 through to June 2009.

#### 4.1.1.4 Student Recruitment and Participation

Within each participating school, all students in 9 to12 were requested to complete the survey. Most secondary schools allowed passive permission protocols; these schools mailed information letters to students' parents in which the study procedures were described. Parents who objected to their child participating in the study were asked to call a toll-free number or contact the school to have their child's name added to a list of individuals who would not receive YSS surveys. Some secondary schools required active permission for students to participate in the YSS. Children at these schools took home information letters describing the YSS survey and had to return signed parental and child permission forms prior to receiving and completing a survey. Regardless of whether parents provided permission, students were able to decline participation on the day of data collection.

On the day of data collection, teachers administered the survey during a designated class period using standardized protocols. All eligible students were asked to participate and were not provided compensation. The survey took 30 to 40 minutes to complete on average, and was filled out by 73.2% of eligible students.

As with any population-based study, the sample of students surveyed may not reflect the true characteristics of the target population; thus population weights were created by the survey designers to allow population estimates to be made from the survey sample. A detailed outline of how these survey weights were constructed for the 2008-2009 data set is provided by the University of Waterloo (2009). Population weights were used only for the descriptive analyses of the data, whereas unweighted data were used for all multilevel logistic models.

### 4.1.2 The 2006-2007 Canadian Youth Smoking Survey

To determine whether current and ever NRT use has increased in Canada since the last YSS survey in 2006-2007 (*Research Question 2*), data from the 2006-2007 YSS survey was used. This nationally representative data was collected from 41,886 students in grades 9 to 12 as part of the 2006-07 Canadian Youth Smoking Survey (Health Canada, 2008). The target population consisted of all young

Canadian residents in grades 9 to 12 attending public and private elementary and secondary schools in 10 Canadian provinces; youth residing in the Yukon, Nunavut and the Northwest Territories were excluded from the target population, as were youth living in institutions or on First Nation Reserves, and youth attending special schools or schools on military bases. The sample design consisted of a two-stage stratified clustered design with schools as primary sampling units and classes as secondary sampling units. All eligible students in the selected classes were surveyed during class time and participants were not provided compensation. Active information (i.e., a letter detailing the study) with passive consent for parents (passive assent for students) was used to reduce demands on schools and to increase student participation rates. The researcher informed the parents of the students via mail, and asked them to call a toll-free number (accessible 24 hours a day) if they refused their child's participation (passive consent). Detailed information on the sample design, methods, and survey rates for the 2006-07 YSS are available at http://www.yss.uwaterloo.ca.

### 4.1.3 The 2006 Canadian Census

The Canadian census is a pan-Canadian cross-sectional household survey designed to provide information about the demographic, social and economic characteristics of Canadians. A complete description of 2006 census questionnaires, data sources, methodology and data accuracy can be found on the Statistics Canada website (Statistics Canada, 2007). For the 2006 census, basic data (age, sex, marital status, mother tongue) were collected from nearly all Canadians living within households in Canada. More in depth measures that made up the majority of census data were collected from a representative sample of 20% of Canadian homes.

Responding to the 2006 census survey was mandatory, which led to a 96.5% response rate. Census data are intended to be representative of the entire Canadian population, therefore a regression estimation procedure was used by Statistics Canada to ensure that historically under-reached sub-groups (i.e., young adult males) were weighted appropriately to account for under-sampling of these populations.

### 4.1.4 Digital Mapping Technologies Inc. (DMTI) Spatial – Enhanced Points of Interest (EPOI)

The 2008 DMTI-EPOI data file is a database of the type and location of different opportunity structures within the built environment (e.g. grocery stores, mini-marts, fast-food restaurants, fitness centres). Additional details about the DMTI-EPOI resources are available online (www.dmtispatial.com). For this study in particular, school-level built environment data pertaining to the number of pharmacies and the number of tobacco retailers located within a 1km radius of schools participating in the YSS were obtained from the EPOI data resource from DMTI.

Consistent with previous research (Pouliou and Elliott, 2010), the process of identifying and linking the DMTI-EPOI data to the YSS student level data involved three steps: (1) geocoding the address for each YSS school; (2) creating 1-km circular buffers (i.e., bounded areas surrounding each school in which the different opportunity structures of the built environment were quantified); and (3) linking the quantified built environment data for each school to the student-level data from each school. Arcview 3.3 (ESRI, 2002) software was used to geocode the school addresses and to create the 1-km buffers. In addition to pharmacies and tobacco retailers, the 2008 DMTI-EPOI data set contained information on density of "Maybe Tobacco Retailers." This category included retail outlets such as grocery stores and bowling allies that potentially could sell cigarettes, however cigarette sale was not confirmed at these locations. Given the ambiguity associated with the "Maybe Tobacco Retailer" measure, it was not included in models of NRT use by Canadian youth.

## 4.2 Measures

### 4.2.1 Outcome (Dependent) Measure

#### 4.2.1.1 NRT Use

The outcome measure of interest in this study is NRT use among different populations of Canadian youth. Consistent with previous research (Lane et al., 2011) youths were classified as "Ever" (lifetime) users of NRT or "Current" users of NRT, based on the following criteria. *Ever use* of NRT was determined via a question that asked students "Have you ever tried any of the following? (Mark all that apply)" for which "Using nicotine patches, nicotine gum, or nicotine lozenges" was a possible response. *Current use* of NRT was measured by a question that asked students "In the last 30 days, did you use any of the following? (Mark all that apply)," for which "Nicotine patches, nicotine gum, or nicotine lozenges" was a possible answer.

### 4.2.2 Descriptive (Independent) Measures

#### 4.2.2.1 Student Characteristics

*Gender*

Gender was classified as either *male* or *female*, based on students' responses to the query "Are you...male? female?" Females were used as the referent group in predictive models, as done by Leatherdale and Ahmed (2010). Gender was controlled for in all final models of NRT use predictors, regardless of its significance during backwards elimination model formation.

*Basic smoking status.*

Consistent with previous research (Reid & Hammond, 2009), basic smoking status (current smoker, former smoker, non-smoker) of each student was determined based on their answers to the two questions "Have you ever smoked 100 or more whole cigarettes in your life?" (yes, no), and "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). *Current smokers* were defined as having smoked 100

or more whole cigarettes in their lifetime and having smoked in the 30 days preceding the survey. *Former smokers* had smoked 100 or more whole cigarettes in their lifetime, but had not smoked at all in the past 30 days. This classification system is consistent with the Health Canada definitions of smokers and other research done in this field (Health Canada, 2010; Leatherdale, Hammond, Kaiserman, & Ahmed, 2007). *Non-smokers* had not smoked 100 or more cigarettes in their lifetime, but may have smoked between one and 99 whole cigarettes. Although this final category is more typically labelled *never smokers*, it was relabelled for the purpose of clarity in this study, as some classically labelled *never smokers* have smoked enough cigarettes that they consider themselves smokers. Basic smoking status was used to divide the 2008-2009 YSS population into sub-populations for multilevel logistic modelling.

*Detailed smoking status*

Beyond the basic smoking status categories used to identify different sub-populations of youths in accordance with the youth smoking literature (*non-smoker, current smoker, former smoker*) more detailed categories were used as sub-classifications within the multilevel models of NRT ever and current use. The detailed smoking status variables were defined using combinations of answers to a series of YSS survey questions, as outlined in Table 4 of Appendix B. Due to the small number of youths classified as *former daily* and *former occasional smokers*, these two categories were collapsed in the descriptive analyses, as well as for models within the entire youth population and the current smoking youth population. Detailed smoking status was included in all multilevel models of youth NRT use, regardless of its significance during backwards elimination model formation.

*Grade*

School grade was included as a descriptive measure in this study in the place of a direct age measurement (in years). This is because while age and school grade are highly correlated (Pearson correlation coefficient = 0.87390), grade holds more meaning for school stakeholders. For example, school-based interventions are more likely to be based on grade than students' specific age in years. As

done by Leatherdale (2008), grade was classified as an ordinal variable in this study, with grade 9 as the referent group in the predictive models. Grade was controlled for in all final models of NRT use predictors, regardless of its significance during backwards elimination model formation.

*Weekly disposable income*

Weekly disposable income was determined from students' response to the question "About how much money do you usually get each week to spend on yourself or to save? Remember to include all money from allowances and jobs like babysitting, delivering papers." The eight possible responses (Zero, $1 to $5, $6 to $10, $11 to $20, $21 to $40, $41 to $100, more than $100, I do not know how much money I get each week) were retained to maximize the specificity of results and reduce information loss through collapsing variables into fewer categories. Weekly disposable income was entered into all of the initial models for current and ever NRT use, with no disposable income as the referent group, as done by Lane et al (2011).

*Cigarettes per day*

Three measures – one ordinal and two continuous – of cigarettes per day were considered for inclusion in the multilevel regression models of NRT use. Within the youth smoking literature, a variety of ordinal and continuous measures of CPD are used regularly (Curry et al., 2007; Franken, Pickworth, Epstein & Moolchan, 2006; Klesges et al., 2003; Leatherdale & Strath, 2007; ), therefore none of the three measures were clearly superior based on the literature. Pearson correlation coefficients were therefore used to identify which measure was the most correlated with NRT use. As shown in Table 5 of Appendix C, the ordinal measure of CPD was the most correlated with NRT use, and was therefore selected to enter into the backwards elimination modelling of NRT use within the current smoking youth population. Both the ordinal measure of CPD and the most correlated continuous measure of CPD were included in the descriptive analyses.

*Number of previous quit attempts*

Number of previous quit attempts was determined from youth answers to the question "Have you ever tried to quit smoking cigarettes?" (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 to 3 times, I have tried to quit 4 to 5 times, I have tried to quit 6 or more times). The response "I have only smoked a few times" was excluded from predictive models, as done by Lane et al (2011), due to the ambiguous interpretation of how this response relates to past quit attempts. Each of the other response categories were retained in the multilevel models of NRT use among current smokers to maximize the specificity of results and reduce information loss through collapsing variables into fewer categories. *I have never tried to quit* was used as the referent group in the multilevel logistic regression analyses of NRT use among current smokers.

*Belief that smokers can quit any time they want*

Students' beliefs that smokers can quit any time they want was assessed based on the question "Can smokers quit anytime they want?" (yes, no, I do not know). Each of these categories was retained in the descriptive and multilevel logistic regression analyses, with *no* as the referent group for predictive analyses. Belief that smokers can quit any time they want was entered into all initial models of NRT use.

*Parent Smoking*

Parent smoking was determined from the YSS survey question "Do any of your parents, step-parents, or guardians smoke cigarettes? (yes, no, I do not know). This question was included to assess whether youth could possibly be accessing NRT from smoking parents. Given that youths who do not know whether their parents smoke are unlikely to be accessing NRT from them, "I do not know" answers were collapsed into the *no* category along with youths who respond "no." *No* served as the referent category for the predictive analyses in this study. Parent smoking was entered into all initial models of NRT use.

*Sibling Smoking*

Sibling smoking was determined from the YSS survey question "Do any of your brothers or sisters smoke cigarettes?" (yes, no, I do not know, I have no brothers or sisters). This question was included to assess whether youth could possibly be accessing NRT from smoking siblings. Given that youths who do not know whether their siblings smoke and youths who do not have siblings are unlikely to access NRT from them, "I do not know" and "I have no brothers or sisters" answers were collapsed into the *no* category along with youths who respond "no." *No* served as the referent category for the predictive analyses in this study. Sibling smoking was entered into all initial models of NRT use.

*Number of friends who smoke*

For this measure, students were asked "Your closest friends are the friends you like to spend the most time with. How many of your closest friends smoke cigarettes?" (None, one friend, two friends, three friends, four friends, five or more friends). For descriptive analyses and multilevel models of NRT use among the entire population and non-smokers, each of the original categories was retained and *none* was used as the referent category. For descriptive analyses and multilevel models among current smokers, *none* and *one friend* were combined due to the low number of youth smokers without any friends who smoke. For this population, the *zero to one friend who smokes* category was the referent group.

*Participation in quit smoking contest in last 12 months*

Participation in a quit smoking contest was determined via student responses to the question "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)." Students who marked "quit smoking contest" were included in the *yes* category, and everyone else was included in the *no* category. *No* served the referent group in all predictive models. Participation in a quit and win contest was entered into all initial models of NRT use.

*Participation in quit smoking program or counselling in last 12 months*

Participation in a quit smoking program or counselling was determined via students' responses to the question "In the last12 months, have you taken part in any other anti-smoking activities or events, either at school or in the community? (Mark all that apply)." Students who marked "quit smoking program or counselling" were counted among the *yes* category, and everyone else was included in the *no* category. *No* served as the referent group in all predictive models. Participation in a quit smoking program or counselling was entered into all initial models of NRT use.

*Attendance at classes where they discussed the health effects of smoking*

Attendance at classes where the health effects of smoking were discussed was determined via students' answer to the question "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). Categories for number of classes attended were collapsed into *none, 1 to 2 classes, 3 to 4 classes, 5 or more classes* and *I don't know* for descriptive statistics and predictive analyses, with *none* serving as the referent group in all initial multilevel models. Number of classes where youths discussed the health effects of smoking was entered into all initial models of NRT use.

*Use of alcohol in the last 12 months*

Use of alcohol in the 12 months preceding the survey was determined by the question "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). For descriptive analyses and multilevel predictive models in the entire youth population and the non-smoking youth population, past 12 month alcohol use was clustered into the categories *never use/no use in last 12 months, only a sip, less than once a month, once a month, 2 or 3*

*times a month, once a week, 2 to 3 times a week, 4 to 6 times a week*, and *every day*, with *never use/no use in last 12 months* as the referent category in predictive models. For descriptive analyses and multilevel predictive models in the current smoking youth population past year alcohol use was clustered into the categories *never use/no use in last 12 months*/*only a sip, less than once a month, once a month, 2 or 3 times a month, once a week, 2 to 3 times a week, 4 to 6 times a week*, and *every day*, with *never use/no use in last 12 months*/*only a sip* as the referent category in predictive models. According to the YSS administrators (University of Waterloo, 2009), *I do not know* is not a valid response to this survey question, therefore this category was not included in any of the models.

*Use of cannabis in the last 12 months*

Use of cannabis in the 12 months preceding the survey was determined through student answers to the YSS survey question, "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). These categories were retained and entered into the initial models of NRT use among the entire population, non-smoking youths and current smoking youths, with *never use* as the referent category. According to the YSS administrators (University of Waterloo, 2009), *I do not know* is not a valid response to this survey question, therefore this category was not included in any of the models.

#### 4.2.2.1 School Level Measures

*Pharmacy Density within one kilometre radius of schools*

Pharmacy density (PD) within a one kilometre radius of each school was selected because this is estimated to be representative of the distance most youth would be able to walk to and from their school. This measure is similar to the measure used by Henrikson et al., in their study of the relationship between tobacco retailer density around schools and adolescent smoking rates (2008). Although PD was originally

entered into the multilevel regression models as a raw value, these models failed to converge due to collinearity between variables. PD was grand-mean centred to prevent this multicolinearity, as recommended by Bickel (2007).

*Tobacco retailer density within a one kilometre radius of school*

Tobacco retailer density within a one kilometre radius of each school was selected because this is estimated to be representative of the distance most youth would be able to walk to and from their school. This measure is identical to the measure used by Henrikson et al., in their study of the relationship between tobacco retailer density around schools and adolescent smoking rates (2008). Tobacco retailers included only outlets (i.e., gas stations, convenience stores) that are known to consistently sell cigarettes, regardless of their location in Canada. Although tobacco retailer density was originally entered into the multilevel regression models as a raw value, these models failed to converge due to collinearity between variables. Tobacco retailer density was grand-mean centred to prevent this multicolinearity, as recommended by Bickel (2007).

#### 4.2.2.2 Demographic Measures

*School Location (urban/rural)*

School location was classified as either *rural* or *urban* by linking school postal code data with 2006 Canadian Census data in the Postal Code Conversion File (PCCF) program. Statistics Canada classifies any census subdivision (municipality) as a Census Metropolitan Area (CMA) if it had a core population of at least 100 000 during the previous census (Statistics Canada, 2010). For this study, schools located in census CMAs were classified as *urban* and all others were classified as *rural*, similar to the classification system used by Curry et al. in their survey of youth smoking cessation programs (2007). Urban/rural school location was controlled for in all final models of NRT use predictors, regardless of its significance during backwards elimination model formation.

*Province of residence*

Providence of residence was determined from the YSS survey administration data and controlled for in all models of NRT use. Province of residence was entered into each model of NRT use as independent provinces (not regions), and was retained in all final models, regardless of its significance during backwards elimination. Newfoundland and Labrador was the comparison province in all analyses.

## 4.3 Analysis

Data were analyzed using the statistics software package SAS 9.2 for Windows. The analysis was broken down into four separate stages to answer the four distinct research questions posed in section ***3.2***. The three different populations in which current and ever NRT use were modeled were: 1) The entire YSS population (containing all current, former and non-smokers), 2) Current smokers and 3) Non-smokers. Former smokers represented only 447 of the 28,197 youths whose responses were included in the multilevel models, therefore they were represented only within the models of NRT use by the entire population of Canadian youths. The specific steps involved for these analyses will be outlined in the sections below. Additional analyses (i.e., sensitivity analyses, exploratory tests) were done throughout the analysis process to verify the appropriateness of different variable choices and modeling techniques. Details on these tests can be found in the Appendices.

### 4.3.1 Multilevel logistic model development

Models of NRT use within the Canadian youth population were developed using multilevel logistic modelling techniques. The rational and advantages of these techniques are discussed in the proceeding section to provide context for the analysis steps outlined later.

#### 4.3.1.1 Benefits of multilevel logistic modeling with school-level random effects

Given the hierarchical nature of the data under study (students nested within schools), multilevel logistic modelling was employed to identify student and school characteristics associated with NRT use.

The choice to use multilevel logistic regression models rather than fitting single-level logistic models with group-level predictors was based on several major advantages of multilevel modelling.

One of the key assumptions of single-level logistic regression modelling is that all observations are independent (Howell, 2008). The clustering of students within schools violates this assumption when student data are analyzed in a single-level logistic model without controlling for school-level clustering. The violation of this key assumption causes underestimation of standard errors and increased risk of Type 1 error (McMahon, Pouget & Tortu, 2006). Multilevel modelling with a random intercept accounts for the interdependence of students within schools by allowing the model intercept to vary across schools (Bickel, 2007; Merlo, Yang, Chaix, Lynch, Råstam, 2005). In addition to producing accurate standard errors and reducing the likelihood of Type 1 error, multilevel modelling with a school-level random intercept also allows for measurement of the portion of variation in NRT use accounted for by differences between schools (Merlo et al., 2006).

#### 4.3.1.2 Advantages of using PROC NLMIXED in SAS 9.2 for multilevel modeling

Within SAS 9.2, there are two different procedures – PROC GLIMMIX and PROC NLMIXED – that are capable of estimating multilevel models of binary outcomes such as those in the present study. A full review of the advantages and disadvantages of PROC GLIMMIX versus PROC NLMIXED for estimating multilevel models is provided by Flom, McMahon and Pouget (2006). To summarize, PROC NLMIXED was selected for development of multilevel models in this study because it tends to produce more accurate estimates (Flom et al., 2006), whereas PROC GLIMMIX is known for producing biased estimates with binary data (Schabenberger, 2005).

#### 4.3.1.3 Use of unweighted data in multilevel models

Although weighted data were analyzed in the descriptive analyses of the study sample, unweighted data were used in the multilevel models. This was due to a limitation in the SAS NLMIXED procedure that was used to estimate the multilevel models in this study. Unlike the GLIMMIX procedure, which has a WEIGHT function, the NLMIXED procedure does not. Although the REPLICATE function

in NLMIXED can be used to provide weighted estimates for multilevel models, it tends to produce greatly overestimated standard errors, due to lack of control for sample size. To avoid such overestimation of standard errors, the REPLICATE function was not used, and the multilevel models were developed using unweighted data.

### 4.3.2 Analysis Stage 1: Descriptive Statistics

Frequency procedures were used to characterize the sample of high school aged youth under study. Weighted and unweighted student-level descriptive statistics were calculated using the PROC FREQ command in SAS 9.2 for the *entire* youth population under study, by gender and by basic smoking status. Weighted and unweighted student-level descriptive statistics were calculated for the *current smoker* population and the *non-smoker* population by gender. Chi-square analyses were also conducted as part of the descriptive analyses to indicate whether there were significant differences in the distribution of independent variables by gender or smoking status. Due to the very large sample sizes in all of the populations under study, the results of the chi-square tests indicated high levels of statistical significance for every variable, oftentimes for differences in frequencies that were not conceptually significant. For this reason, the results of the chi-square testing are not reported in the proceeding results section.

Among the *entire* population, *current smokers* and *non-smokers*, weighted and unweighted descriptive statistics for demographic characteristics and school environment features were calculated by urban/rural area. Both weighted and unweighted estimates for student and school characteristics are reported together. This is because although the weighted estimates are the most accurate representation of characteristics of the Canadian population, the unweighted data were used in all of the multilevel logistic regression analyses.

Exploratory frequency analyses were done on NRT use status by number of past quit attempts among current smokers. By determining whether or not NRT-using current smokers had ever made past quit attempts, these statistics provide insight into the proportion of NRT users using NRT for reasons

other than quitting. Frequency of NRT current and ever use was also determined by province and detailed smoking status.

### 4.3.3 Stage 2: Chi-square tests for differences in NRT use between consecutive cohorts

Chi-square tests were computed to examine changes in the prevalence of current and ever NRT use in the 2006-2007 YSS data compared to the 2008-2009 data. Of the 133 secondary schools surveyed for the 2008-09 YSS, only one school was also surveyed in 2006-07, therefore the data sets were treated as independent data sets in this analysis. Although prevalence of NRT use is a proportion (unsuitable for chi-square analysis), chi-square analysis was facilitated by converting the prevalence estimates into frequencies of NRT users and non-users and comparing them between the two YSS cohorts, as suggested by Howell (2008).

### 4.3.4 Stage 3: Unconditional (null) multilevel logistic models to identify between school differences in NRT use

Prior to developing multilevel logistic regression models of NRT use containing individual and school-level predictor variables factors, *unconditional models* with random intercepts for: 1) ever use of NRT and 2) current NRT use in each population (*all youth*, *current smokers*, *non-smokers*) were developed by entering estimates derived from PROC GLIMMIX into PROC NLMIXED. The goal of these unconditional models – which were devoid of any predictor variables – was to identify whether clustering within schools accounted for a significant portion of the variance in NRT use (McMahon et al., 2006). From the unconditional models, the intraclass correlation coefficients (ICCs) were calculated to determine what proportion of the variability in the odds of NRT use was accounted for by random variation between schools (Merlo et al., 2006). A complete outline of the multilevel model components and the calculation of the ICC can be found in Appendix D. Null models of ever and current NRT use in each of the three populations under study showed significant between-school variation in NRT use.

Therefore, the analysis proceeded to the final stage of multilevel modelling with student and school-level predictor variables.

### 4.3.5 Stage 4: Conditional multilevel logistic analyses of ever/current NRT use

Although the analysis plan originally proposed for this study involved running univariate analyses for each variable and entering all significant variables into a final model, this plan was not seen through to fruition for practical reasons. When only one variable and a random intercept were entered into the PROC NLMIXED program in SAS 9.2., the model would often not converge, despite repeated attempts at adjusting beta estimates. It was identified that many of the models would only converge if more than one explanatory were entered into the model at a time, making univariate analyses impossible. One possible explanation for this counterintuitive outcome is that in the absence of other moderating variables in the model, the between school variance in NRT use may have been too close to zero when controlling for only one characteristic (i.e., gender), therefore the models did not converge. Backwards elimination to select final models was used instead, in keeping with the approach used by Leatherdale, Brown, Cameron and McDonald (2005). A schematic outline of the specific steps taken during model formation is provided in Appendix E. Once complete conditional models were determined, the *explained variance* was calculated using the formula in Appendix F. This figure allowed for examination of the proportion of between school variance in NRT use in each unconditional model that has been explained by the variables added to the conditional model.

### 4.3.6 Influence of missing data on final models

Although five of the six final multilevel models developed in the study were missing a negligible number of respondents due to missing data, Model 3 (ever NRT use among current smokers) was estimated using data from only 3,147 of the 3,630 current smokers in the sample (Table 6, Appendix G). To determine whether these missing data had a significant impact on the estimates produced in Model 3, the missing values in the *number of previous quit attempts* variable and the *past year marijuana use* variable were coded as *missing* and included in Model 3. As shown in Table 7 (Appendix G), this led to

only minor changes in the estimates produced. In the model that included missing variables, having made one previous quit attempt was no longer a significant predictor of ever NRT use, nor was having used marijuana one to three times a month in the year leading up to the survey. Pharmacy density within a 1 km radius of the school became a significant predictor of ever NRT use, although only marginally. These minor changes with the inclusion of missing values indicate that it is reasonable to interpret and draw conclusions from the estimates presented in Model 3 of Table 2.

# Chapter 5: Results

## 5.1 Descriptive statistics

### 5.1.1 Student characteristics

Data collected from 29,296 high school-aged Canadian students in 2008 and 2009 were included in the analyzed sample. With population weighting applied, this sample represents 1,660,892 Canadian youths in grades 9 through 12. Complete student-level descriptive statistics for the entire youth population, as well as the current smoking and non-smoking sub-populations are provided in Appendix H. An overview of the weighted sample statistics is provided below.

Overall, 51.7% of the sample identified themselves as boys, compared with 48.3% self-identifying as girls. Grades 9 through 12 were fairly evenly represented in the weighted sample, however there was slight over-representation of grade 10 students (28.8%) and under-representation of grade 12 students (17.1%) in the unweighted sample used in the multilevel modelling. Of the youths surveyed, 11.7% were current smokers, 1.6% were former smokers and 86.7% were non-smokers, however 14.8% of the entire population responded "Yes" to the query, "Are you a smoker." 13.5% of non-smokers reported having no weekly disposable income, compared with only 7.5% of current smokers. Conversely, 28.2% of current smokers reported having in excess of $100 a week of disposable income, compared with 18.1% of non-smokers.

Current smokers had significantly more social smoking connections than non-smokers: 65.1% of current smokers had parents or guardians that smoked, compared with 39.1% of non-smokers. Similarly, 42.3% of current smokers reported having a sibling that smoked, compared with only 17.6% of non-smokers. The most striking difference between current smokers and non-smokers was in the number of friends they had that smoked. 64.0% of current smokers reported having five or more close friends that smoked, whereas 58.1% of non-smokers had no friends that smoked.

Among current smokers, 56.7% believed that smokers could quit any time they want, and only 2.2% and 2.5% had ever participated in a quit and win contest or smoking cessation counselling. Within the entire population, 3.6% had ever used NRT, and 0.8% were current NRT users at the time of the YSS survey. Among current smoking youths, prevalence of lifetime NRT use increased to 21.1%, with 5.1% of current smokers reporting current NRT use. Of former smokers, 16.1% reported ever using NRT, whereas 1.0% of non-smokers had ever used NRT.

Both current and ever NRT use varied significantly by province within the entire youth population (Figure 3) and the current smoking youth population (Figure 4). Within the entire youth population, NRT ever use was highest in British Columbia (6.2%) and lowest in Ontario (2.9%). NRT current use was highest in Saskatchewan (1.5%) and lowest in Alberta (0.5%).

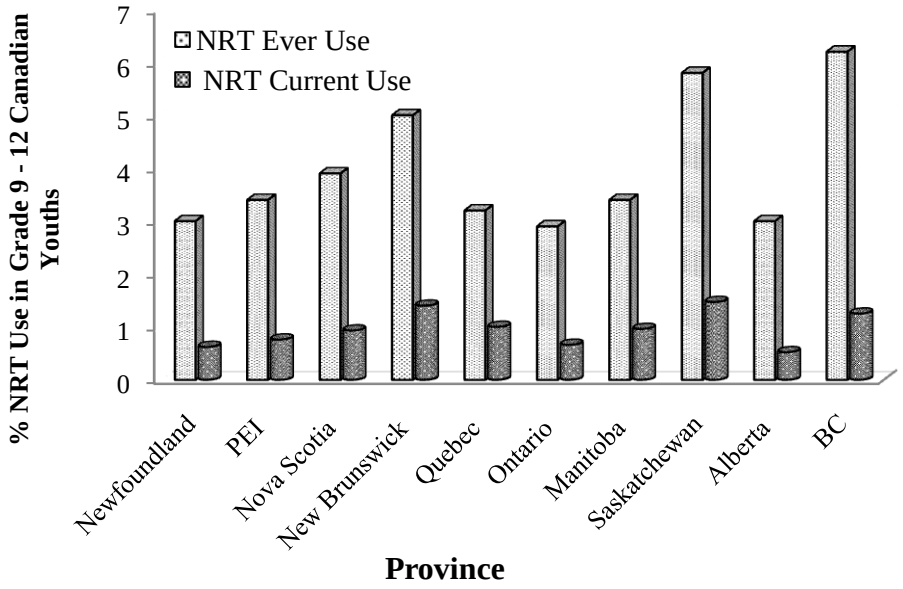


**Figure 3: Provincial prevalence of ever and current NRT use by Canadian youth**

Among Canadian youths who were current smokers (Figure 4), NRT ever use was highest in British Columbia (30.9%) and lowest in Newfoundland (15.8%). NRT current use peaked in Manitoba (6.6%) and was lowest in Newfoundland (3.3%). Ever and current NRT use by province was not calculated among non-smoking Canadian youth due to inadequate cell sizes in this sub-population.

### 5.1.2 Demographic and school environment characteristics

In the 2008-2009 school year, 66.2% of Canadian youths attended schools that were located in urban areas. On average, there were 1.6 (SD: 2.4, range: 0 – 26) pharmacies and 3.6 tobacco retailers (SD: 4.4, range: 0 – 95) within a one kilometre radius of each school. Complete demographic and school environment statistics for the entire youth population are available in Appendix I.

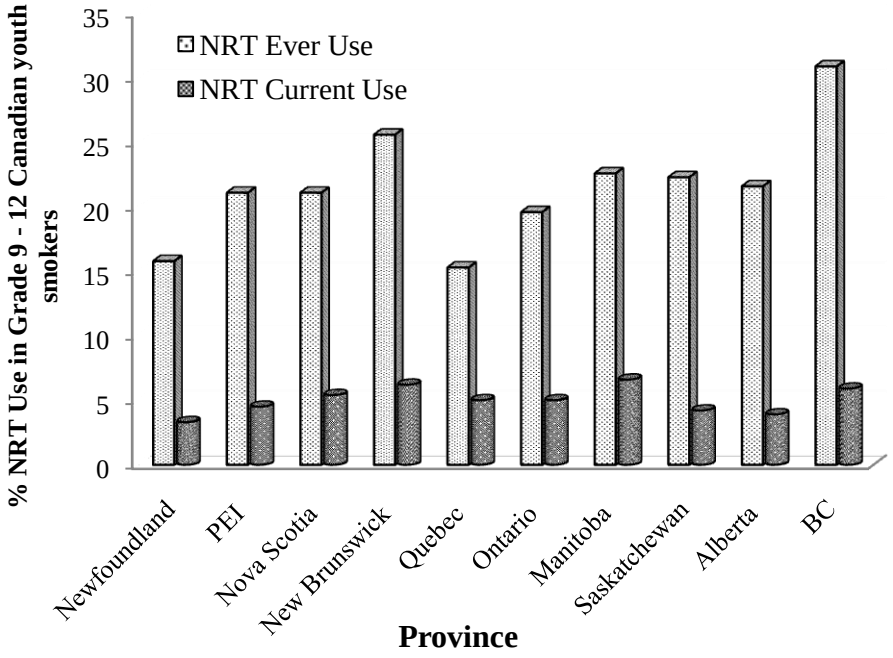


**Figure 4: Provincial prevalence of ever and current NRT use by Canadian youths who smoke**

### 5.1.3 Characteristics of ever and current NRT users

Of females in the general population, 3.1% were ever NRT users, compared with 4.1% of males. In an analysis of detailed smoking status among youths who reported ever using NRT, it was identified that 49.2% of lifetime NRT users were current daily smokers at the time of the survey, while 18.5% were current occasional smokers (Figure 5). Interestingly, 7.2% of the youths who reported lifetime NRT use had never even tried smoking, and 5% had never smoked a whole cigarette.

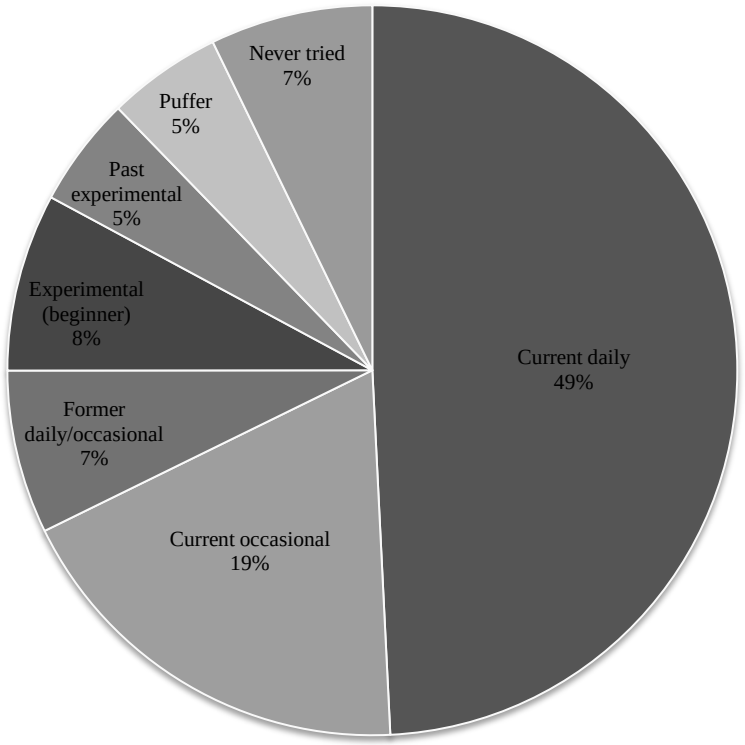


**Figure 5: Proportion of ever NRT users classified by detailed smoking status**

This pattern of NRT use among non-smokers was even stronger among current NRT users (Figure 6), 15.1% of whom had never tried smoking and 5.8% of whom had never smoked a whole cigarette. 50.7% of current NRT users were, however, current daily smokers, and 18.9% were current occasional smokers.

When NRT use is examined among the current smoking sub-population of youths, interesting patterns emerge regarding NRT use in the absence of a quit attempt. For instance, 16.1% of current smoking youth who have used NRT in their lifetime have never tried to quit smoking (Figure 7). Another 3.9% report that they have "only smoked a few times" when queried about past quit attempts. The majority of Canadian youth smokers who have ever used NRT have made between two and three quit attempts.

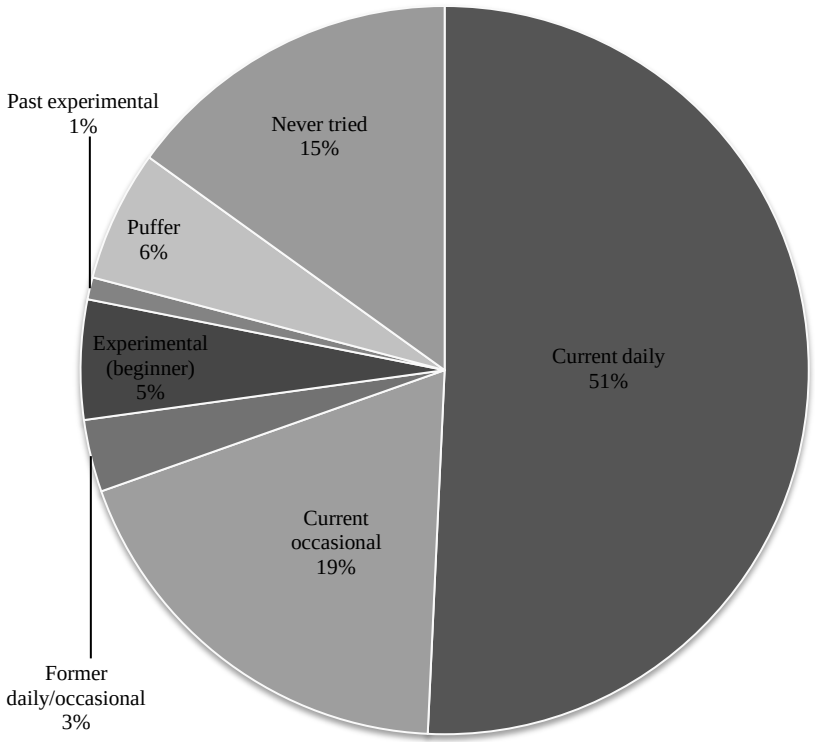


**Figure 6: Proportion of current NRT users classified by detailed smoking status**

A similar pattern of NRT use in the absence of a quit attempt is apparent when current NRT use among current smokers is examined (Figure 8). Among current smokers who used NRT in the 30 days leading up to the survey, 31.8% of them report never attempting to quit smoking, and 1.1% of them claim to have only smoked a few times. Similar to the pattern among ever NRT users, the majority of youth smokers currently using NRT had made between two and three quit attempts at the time of the survey.

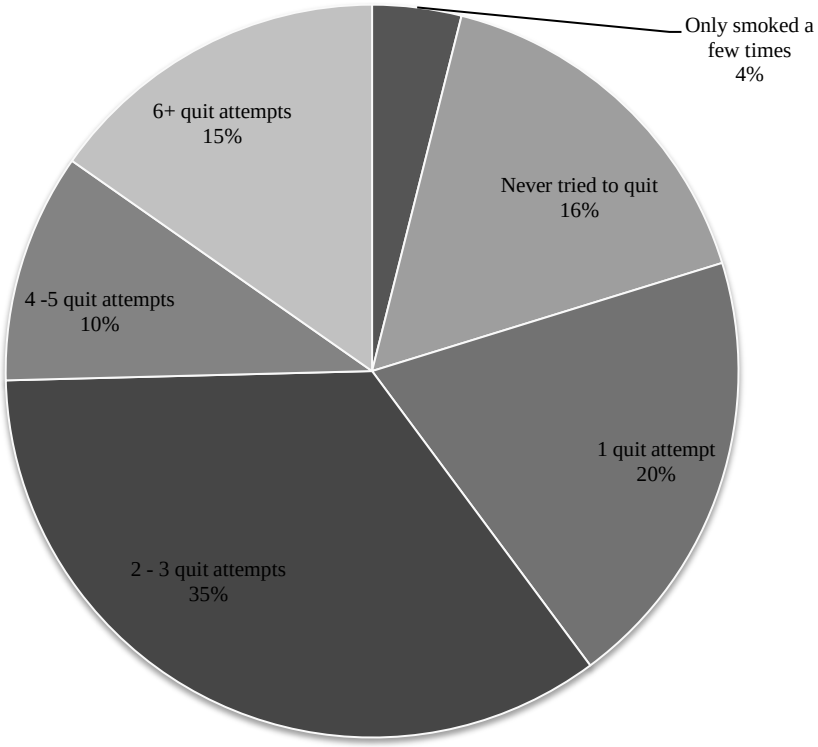


**Figure 7: Proportion of Ever NRT users among current smokers, classified by number of past quit attempts**

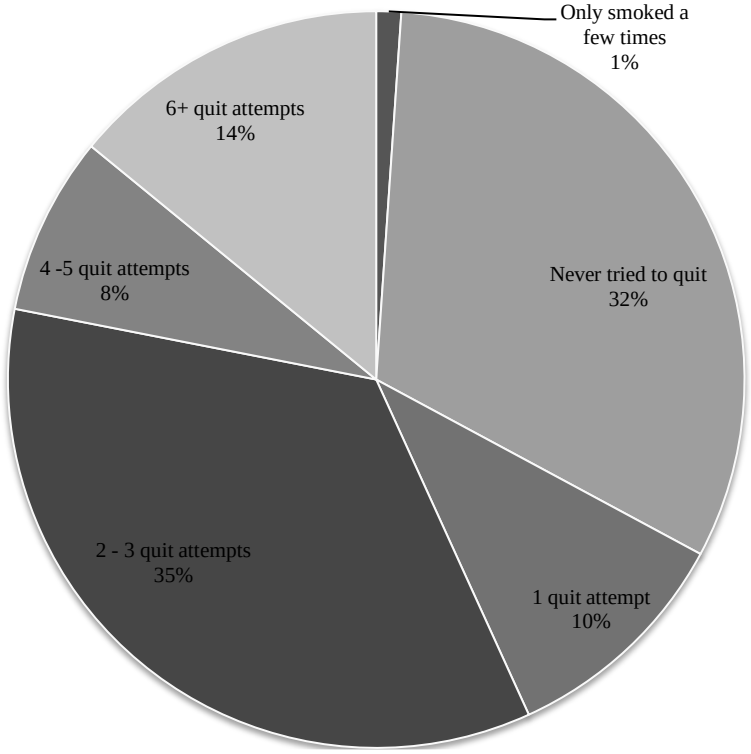


**Figure 8: Proportion of Current NRT users among current smokers, classified by number of past quit attempts**

### 5.1.4 Summary of descriptive statistics

Overall, 3.6% (n = 59,792) of high school-aged Canadian youth have ever used NRT and 0.8% (n = 13, 287) used NRT in the month prior to the YSS survey. NRT ever and current use were highest among current smokers (21.1% and 5.1%, respectively) and lowest among non-smokers (1.0% and 0.3%, respectively). Approximately half of current and ever NRT users were current daily smokers, however 7.2% of ever NRT users and 15.1% of current NRT users had never even tried smoking. Among current youth smokers, the majority (35%) of current and lifetime NRT users had made between two and three quit attempts, but 16-32% had never tried to quit.

## 5.2 Chi-square tests for differences in NRT use between YSS cohorts

Table 1 outlines the results of chi-square analyses for differences in NRT ever and current use between the 2006-2007 YSS cohort and the 2008-2009 YSS cohort. Details of these tests can be found in Appendix J. Within the entire youth population, there has been a statistically significant increase in prevalence of ever NRT use, from 3.3% to 3.6% ($X^2$ = 5.3350, $P$= 0.0209), which represents an additional 5,465 Canadian youths who were lifetime NRT users in 2008-2009 compared with 2006-2007. The proportion of NRT current users in the entire population has decreased from 1.14% to 0.85% ($X^2$ = 14.8979, $P$= 0.0001), indicating that 4,650 fewer Canadian youths had used NRT in the 30 days prior to the YSS in the 2008-2009 school year versus the 2006-2007 school year.

Prevalence of NRT current use among current smokers decreased significantly, from 8.3% in the 2006-2007 cohort to 5.1% in the 2008-2009 cohort ($X^2$ = 31.1003, $P$<0.0001). There were no significant between-cohort changes in prevalence of NRT ever us among current smokers, or prevalence of NRT use among non-smoking youth.

Table 1: Results of chi-square analyses for between-cohort differences in prevalence of ever and current NRT use by Canadian youths in 2006-2007 versus 2008-2009

| | **Prevalence of NRT use by YSS Data Collection Years** | | **Chi-square, *P-value*** |
|---|---|---|---|
| | ***2006-2007, %*** | ***2008-2009, %*** | |
| **Entire youth population** | (n = 1,646,262) | (n = 1,660,891) | |
| NRT Ever Users | 3.30 | 3.62 | $X^2$ = 5.3350, df=1, ***P*= 0.0209** |
| NRT Current Users | 1.14 | 0.85 | $X^2$ = 14.8979, df=1, ***P*= 0.0001** |
| **Current smoking youth** | (n = 167,921) | (n = 193,456) | |
| NRT Ever Users | 21.83 | 21.08 | $X^2$ =0.6461, df=1, *P*= 0.4215 |
| NRT Current Users | 8.31 | 5.07 | $X^2$ = 31.1003 , df=1, ***P*<0.001** |
| **Non-smoking youth** | (n = 1,452,042) | (n = 1,440,679) | |
| NRT Ever Users | 1.02 | 1.04 | $X^2$ =0.0888, df=1, *P*=0.7657 |
| NRT Current Users | 0.31 | 0.27 | $X^2$ =0.8895, df=1, *P*=0.3456 |

## 5.3 Unconditional multilevel logistic models to identify between school differences in NRT use

Six unconditional multilevel logistic regression models were developed to examine between school random variation in ever and current NRT use by: 1) all high school-aged youths in the 2008-2009 YSS sample, 2) current smokers, and 3) non-smokers. Complete equations, estimates and ICC calculations for each of these models can be found in Appendix K.

Within the entire high school-aged population sampled in the YSS, 5.8% ($\sigma_u^2$ = 0.1866) of the variability in the odds of students ever using NRT and 9.0% ($\sigma_u^2$ = 0.3243) of the variability in the odds of students currently using NRT can be accounted for by school-level differences. This means, for example, that for Canadian youths in grades 9-12, 5.8% of the variability in their odds of ever using NRT are due to characteristics of the schools they attend. Among high school-aged smokers in Canada, 2.7% ($\sigma_u^2$ = 0.09216) of the variability in the odds of ever using NRT and 8.6% ($\sigma_u^2$ = 0.3115) of the variability in the odds of currently using NRT can be explained by between-school differences. Finally, among non-smoking Canadian youth, 3.3% ($\sigma_u^2$ = 0.1123) of the variability in the likelihood of ever using NRT and

10.1% ($\sigma_u^2 = 0.3688$) of the variability in the likelihood of currently using NRT is accounted for by differences at the school level.

## 5.4 Conditional multilevel logistic analyses of ever/current NRT use

Six multilevel logistic regression models were developed as outlined in section ***4.3.5***. The complete models and beta estimates for these analyses can be found in Appendix L, however a summary is provided in Table 2 (pages 56-57). All of the associations discussed below existed while controlling for all of the other variables in Table 2. The unweighted proportions of current and ever NRT-using youths examined in Table 2 can be found in Table 31 of Appendix L.

### 5.4.1 Student characteristics associated with NRT use

Gender was significantly associated with ever NRT use across all models, with males' odds of ever using NRT being 1.33 (95% CI: 1.16-1.53) times greater than females' in the entire youth population. A similar pattern emerged for current use, with males being more likely to currently use NRT than females, especially among non-smoking youth, among whom boys were 2.69 times (95% CI: 1.61-4.49) more likely to be current NRT users than their female counterparts. Grade was not significantly associated with NRT use, except among the entire population and the current smoker population, in which students in grade 12 were significantly less likely (OR: 0.48, 95% CI: 0.32-0.73; OR: 0.46, 95% CI: 0.29-0.74) to be current NRT users than students in grade 9. When frequency of NRT current use is examined by grade in these populations (Table 31, Appendix L), a similar trend is observed, indicating that these findings are not the result of confounding by other variables in the multilevel models. Detailed smoking status was a significant predictor of ever NRT use across all models, but most significantly in the general population, where current daily smokers were 29.2 times (95% CI: 20.34-41.91) more likely to have ever used NRT than never smokers. Smoking status was also a significant predictor of current NRT use in the general population and the current smoking population, but not among non-smoking youths.

Odds of ever and current NRT use were significantly higher among youths who self-identified as smokers within the general population and the non-smoking population, however self-perceived smoking status was not significant enough to be included in the final models of NRT use among current smokers. Notably, self-perception as a smoker increased non-smokers' odds of ever NRT use 7.40 times (95% CI: 5.25-10.42) and odds of current NRT use 12.22 times (95% CI: 6.84-21.84) compared with non-smokers who did not consider themselves smokers. Among current smokers, odds of ever using NRT increased with the number of past quit attempts youths reported, however past quit attempts were not predictive of current NRT use. Another behavioural characteristic that was only predictive of ever NRT use among current smokers was past year marijuana use. Current smoking youths who had used marijuana were significantly more likely to have ever used NRT, although no dose-response relationship was apparent.

Among youths who were current smokers, attending smoking cessation counselling was associated with 2.83 times (95% CI: 1.40-5.70) greater odds of currently using NRT, whereas participation in a quit and win contest increased the likelihood of ever NRT use 1.87-fold (95% CI: 1.09-3.20). The only social characteristic that significantly impacted the odds of NRT use was having siblings who smoked. Having siblings that smoked increased the likelihood of lifetime NRT use by 21% (95% CI: 6% - 40%) in the general population and 49%
(95% CI: 13% - 95%) in the non-smoking population, but had no significant impact among current smokers.

Table 2: Multilevel logistic regression models examining student and school factors associated with NRT use among Canadian youths in grades 9 – 12 (2008-2009)

| Parameters | | Entire Youth Population | | Current smokers | | Non-smokers | |
|---|---|---|---|---|---|---|---|
| | | Model 1: **Ever NRT use** (n=28,994[a]) | Model 2: **Current NRT use** (n=28,994[a]) | Model 3: **Ever NRT use** (n=3,147[a]) | Model 4: **Current NRT use** (n=3,630[a]) | Model 5: **Ever NRT use** (24,977[a]) | Model 6: **Current NRT use** (n=25,110[a]) |
| **Gender**[b] | Female[c] | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Male | **1.33 (1.16, 1.53)** | **1.82 (1.41, 2.35)** | **1.22 (1.01, 1.47)** | **1.51 (1.11, 2.04)** | **1.70 (1.32, 2.20)** | **2.69 (1.61, 4,49)** |
| **Grade**[b] | 9[c] | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | 10 | 0.87 (0.72, 1.06) | 0.78 (0.56, 1.09) | 0.82 (0.62, 1.07) | 0.69 (0.46, 1.04) | 0.98 (0.71, 1.35) | 0.98 (0.56, 1.72) |
| | 11 | 0.95 (0.78, 1.15) | 0.82 (0.59, 1.14) | 0.92 (0.70, 1.20) | 0.73 (0.49, 1.08) | 0.88 (0.62, 1.25) | 1.04 (0.57, 1.88) |
| | 12 | 1.00 (0.81, 1.22) | **0.48 (0.32, 0.73)** | 0.97 (0.73, 1.29) | **0.46 (0.29, 0.74)** | 0.81 (0.55, 1.20) | 0.57 (0.26, 1.24) |
| **School location**[b] | Rural[c] | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Urban | **1.23 (1.05, 1.44)** | **1.74 (1.23, 2.46)** | **1.28 (1.03, 1.60)** | **1.93 (1.31, 2.82)** | 1.21 (0.88, 1.67) | 1.19 (0.70, 2.04) |
| **Smoking Status**[b] | Never tried | 1.00[c] | 1.00[c] | N/A | N/A | 1.00[c] | 1.00[c] |
| | Current daily smoker | **29.20 (20.34, 41.91)** | **7.36 (3.91, 13.86)** | **2.44 (2.00, 2.97)** | **2.74 (1.98, 3.80)** | N/A | N/A |
| | Current occasional smoker | **12.73 (8.92, 18.17)** | **3.26 (1.71, 6.23)** | 1.00[c] | 1.00[c] | N/A | N/A |
| | Former daily/occasional smoker | **32.09 (22.67, 45.44)** | **9.09 (4.48, 18.43)** | N/A | N/A | N/A | N/A |
| | Experimental smoker | **4.28 (2.98, 6.14)** | 1.43 (0.71, 2.89) | N/A | N/A | **2.16 (1.44, 3.24)** | 0.79 (0.38, 1.64) |
| | Past experimental smoker | **3.73 (2.64, 5.26)** | 1.12 (0.52, 2.44) | N/A | N/A | **3.16 (2.23, 4.49)** | 0.87 (0.40, 1.92) |
| | Puffer | **2.27 (1.60, 3.23)** | 1.52 (0.83, 2.75) | N/A | N/A | **1.98 (1.39, 2.82)** | 1.41 (0.79, 2.52) |
| **Are you a smoker?** | No[c] | 1.00 | 1.00 | - | - | 1.00 | 1.00 |
| | Yes | **2.58 (1.97, 3.37)** | **5.72 (3.36, 9.74)** | - | - | **7.40 (5.25, 10.42)** | **12.22 (6.84, 21.84)** |
| **Do any of your siblings smoke?** | No[c] | 1.00 | 1.00 | - | - | 1.00 | - |
| | Yes | **1.21 (1.06, 1.40)** | 1.24 (0.96, 1.60) | - | - | **1.49 (1.13, 1.95)** | - |
| **Number of previous quit attempts** | None[c] | N/A | N/A | 1.00 | - | N/A | N/A |
| | One | N/A | N/A | **1.39 (1.05, 1.82)** | - | N/A | N/A |
| | Two to three times | N/A | N/A | **2.41 (1.86, 3.11)** | - | N/A | N/A |
| | Four to five times | N/A | N/A | **3.22 (2.24, 4.64)** | - | N/A | N/A |
| | Six or more times | N/A | N/A | **4.18 (2.99, 5.84)** | - | N/A | N/A |
| Have you ever participated in smoking cessation counselling? | No[c] | - | - | - | 1.00 | - | - |
| | Yes | - | - - | - | **2.83 (1.40, 5.70)** | - | - |

| Parameters | | Entire Youth Population (Gr. 9-12) | | Current smokers | | Non-smokers | |
|---|---|---|---|---|---|---|---|
| | | Model 1: **Ever NRT use** (n = 28,994[a]) | Model 2: **Current NRT use** (n = 28,994[a]) | Model 3: **Ever NRT use** (n = 3,471[a]) | Model 4: **Current NRT use** (n = 3,630[a]) | Model 5: **Ever NRT use** (n = 24,977[a]) | Model 6: **Current NRT use** (n = 25,110[a]) |
| Have you ever participated in a quit and win contest? | No[c] | - | - | 1.00 | - | - | - |
| | Yes | - | - | **1.87 (1.09, 3.20)** | - | - | - |
| Past year marijuana use. | Never use of marijuana[c] | - | - | 1.00 | - | - | - |
| | Lifetime use, but not in last 12 months | - | - | **2.68 (1.64, 4.39)** | - | - | - |
| | Less than once a month | - | - | **1.98 (1.21, 3.23)** | - | - | - |
| | One to three times a month | - | - | **1.69 (1.02, 2.78)** | - | - | - |
| | One to three times a week | - | - | **1.78 (1.10, 2.89)** | - | - | - |
| | Four to six times a week | - | - | **1.83 (1.13, 2.96)** | - | - | - |
| | Every day | - | - | **2.17 (1.39, 3.38)** | - | - | - |
| Pharmacy density within 1km radius of school | | 0.97 (0.94, 1.005) | **0.86 (0.78, 0.95)** | 0.96 (0.91, 1.004) | **0.85 (0.76, 0.95)** | - | - |
| School level random variance | | 0.00640 | 0.1387 | 0.02103 | 0.09235 | <0.0001 | 0.09914 |
| ICC[d] | | 0.00194 | 0.0404 | 0.00635 | 0.0273 | NC | 0.0295 |

Notes:
Odds ratios adjusted for all other variables in the table and controlling for province of residence.
[a] Sum of individuals in same population may vary between different models due to missing values
[b]Variables retained in model regardless of significance during backwards elimination.
[c] Reference group
[d] Measure of the proportion of the total variance that is between-schools
**Bold**: p<0.05
N/A – not included in original backwards elimination model
NC – not computed
- Variable did not meet p>0.1 significance level for inclusion in model
Model 1 (For entire youth population): 1 = Ever use of NRT (n=1,071), 0 = Has never used NRT (n = 27,923)
Model 2 (For entire youth population): 1 = Current use of NRT (n= 287), 0 = Does not currently use NRT (n = 28,707)
Model 3 (For current smokers in youth population): 1 = Ever use of NRT (n= 679), 0 = Has never used NRT (n =2,468)
Model 4 (For current smokers in youth population): 1 = Current use of NRT (n= 204), 0 = Does not currently use NRT (n =3,426)
Model 5 (For non-smokers in youth population): 1 = Ever use of NRT (n=250), 0 = Has never used NRT (n =24,727)
Model 6 (For non-smokers in youth population): 1 = Current use of NRT (n=75), 0 = Does not currently use NRT (n =25,035)

### 5.4.2 School characteristics associated with NRT use

Even when controlling for student characteristics such as gender and smoking status, attending a school located in an urban area significantly increased youths' odds of ever or currently using NRT within the general population (OR: 1.23, 95% CI: 1.05-1.44) and the current smoking sub-population (OR: 1.28, 95% CI: 1.03-1.60), but not among non-smokers (OR: 1.21, 95% CI: 0.88-1.67). Pharmacy density within a one kilometre radius of schools was inversely associated with the odds of current NRT use among the general youth population (OR: 0.86, 95% CI: 0.78-0.95), as well as current smokers (OR: 0.85, 95% CI: 0.76-0.95). The unweighted grand-mean of pharmacies surrounding the schools surveyed in the YSS was 1.56 (SD: 2.4, range: 0-26), which will be rounded to two for the purposes of the proceeding discussion. Even when grade, gender, school location (urban/rural), smoking status and self-perceived smoking status are controlled for, students attending schools with three pharmacies within a one kilometre radius of the school were 14% less likely ($p<0.05$) to be current NRT users than students attending schools with two pharmacies located within a one kilometre radius. This inverse relationship between density of pharmacies surrounding schools and the odds of current NRT use is illustrated by Figure 9 on the following page. A similar pattern exists among youths who are current smokers: even when grade, gender, school location (urban/rural), daily versus occasional smoking status and participation in smoking cessation counselling are held constant, students attending schools with three pharmacies within a one kilometre radius are 15% less likely ($p<0.05$) to be current NRT users than students attending schools with two pharmacies located within a one kilometre radius. This pattern is illustrated in Figure 10, on the following page. Although it is possible that this represents a true association, a series of exploratory analyses were performed to examine potential causes of the unexpected direction of this effect. These analyses are outlined in Appendix M. Tobacco retailer density surrounding a school was not significantly associated with NRT use in any of the samples examined.

**Figure Caption**: Holding constant the variables outlined in Model 2 of Table 2, students attending a school with three pharmacies in a one kilometre radius are 0.86 times as likely to be current NRT users as youths attending schools with two pharmacies in a one kilometre radius.

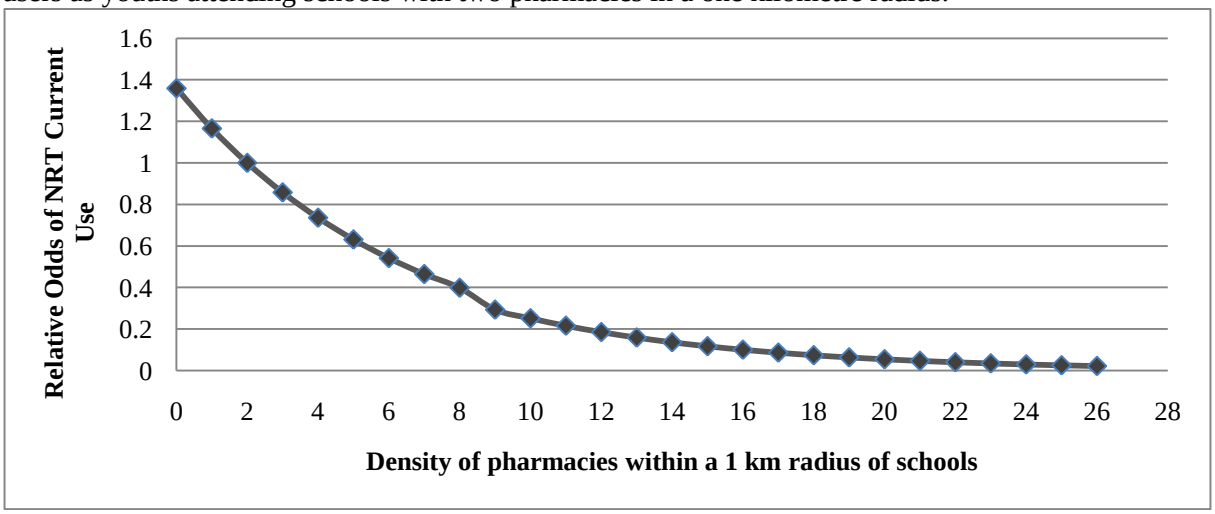


**Figure 9: Relative odds of Canadian students in grade 9-12 current NRT users, by pharmacy density within a 1km radius of their schools**

**Figure Caption**: Holding constant the variables outlined in Model 4 of Table 2, youths attending a school with three pharmacies in a one kilometre radius are 0.85 times as likely to be current NRT users as youths attending schools with two pharmacies in a one kilometre radius.

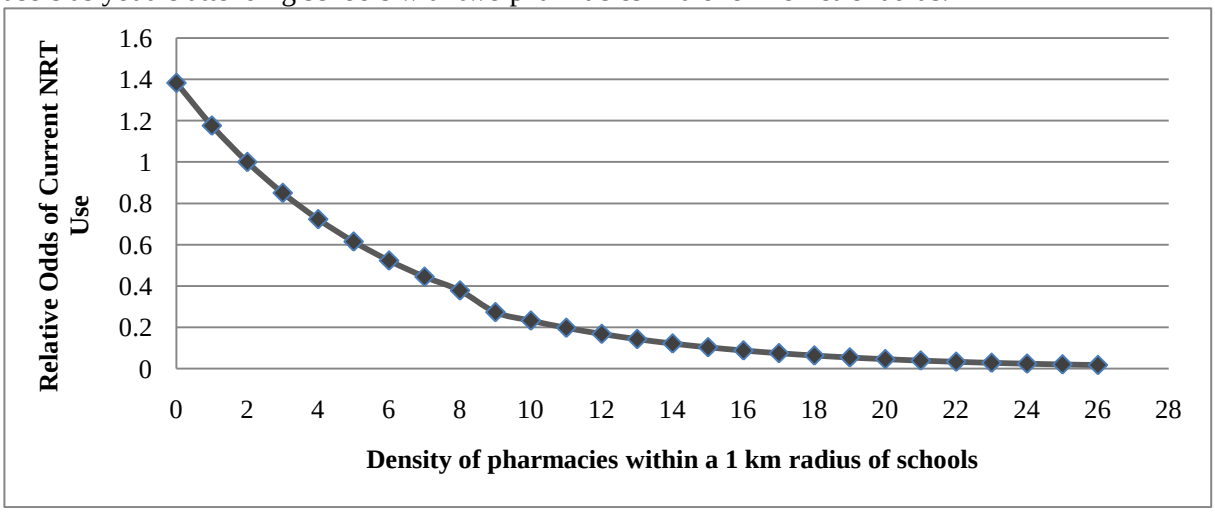


**Figure 10**: **Relative odds of Canadian youth smokers being current NRT users, by pharmacy density within a 1km radius of their schools**

In interpreting the impact of pharmacy density around a school on current NRT use, it is important to note that 68.5% of the students surveyed in the YSS attended schools with fewer than two pharmacies in a 1 km radius of the school (Figure 11). Among the general student population

and the current smoker population at these schools, youths had increased odds of using NRT compared to youths attending schools with two pharmacies. For instance, the 35.3% of youths in the general population attending schools with no pharmacies in a 1 km radius of their school were 1.28 times (95% CI: 1.15, 1.40) more likely to be current NRT users than youths attending schools with two pharmacies in a 1 km radius of their school.

**Figure Caption**: Of the students surveyed in the 2008-2009 YSS (n = 29,296), 10,327 (35.3%) attended schools with no pharmacies in a 1 km radius, 9,716 (33.2%) attended schools with one pharmacy in a 1 km radius, 4,509 (15.4%) attended schools with two pharmacies in a 1 km radius, and 4,744 (16.1%) attended schools with more than two pharmacies in a 1 km radius.

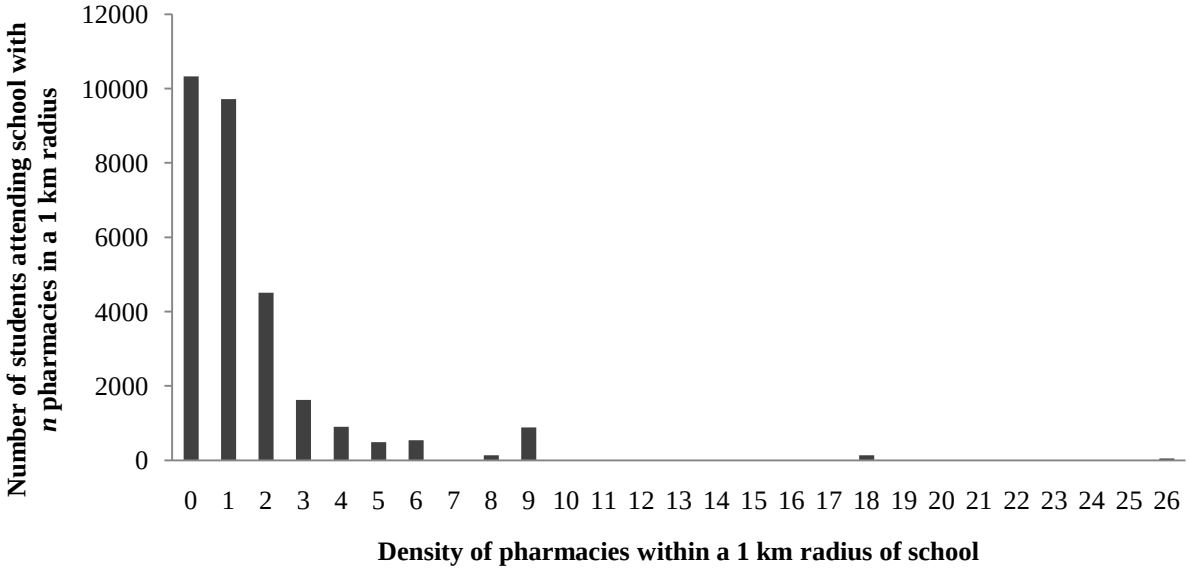


**Figure 11: Number of students in 2008-2009 YSS sample attending schools with *n* pharmacies in a 1 km radius of school**

### 5.4.3 Between-school random variance in unconditional models explained by variables in conditional models

To determine what portion of the school level random variance in the likelihood of NRT use was explained by the addition of school and student characteristics to the unconditional model, explained variance was calculated as shown in Table 3, on the following page. Across all three populations under study, addition of student and school level variables explained a greater portion of

the random variance in ever NRT use than in current NRT use. Among non-smokers, and the entire youth population, a negligible amount of unexplained between school variance in likelihood of ever NRT use remained following the addition of predictor variables to the models. A significant portion of unexplained between-school variance remained in all models of current NRT use following the addition of explanatory variables, especially among the entire youth population, in which 42.8% of the between school variance was unaccounted for by variables in the model.

Table 3: Explained variance in school level random variance between unconditional and conditional multilevel models of NRT use

| **Models** | | **School level random variance** | | **School-level explained variance** |
|---|---|---|---|---|
| | | ***Unconditional model*** | ***Conditional model*** | |
| ***Entire Youth Population*** | Ever NRT use | 0.1866 | 0.006404 | 96.6 |
| | Current NRT use | 0.3243 | 0.1387 | 57.2 |
| ***Current smokers*** | Ever NRT use | 0.09216 | 0.02103 | 77.2 |
| | Current NRT use | 0.3115 | 0.09235 | 70.4 |
| ***Non-smokers*** | Ever NRT use | 0.1123 | ~0 | ~100 |
| | Current NRT use | 0.3688 | 0.09914 | 73.1 |

# Chapter 6: Discussion

The overarching goals of this study were to examine the prevalence of current and ever NRT use among high school-aged Canadian youths in 2008-2009, and identify student and school characteristics associated with NRT use in this population. Other objectives were to investigate whether there was a significant change in the prevalence of NRT use from 2006-2007 to 2008-2009, and to determine whether there was significant between-school variation in likelihood of NRT use.

## 6.1 Prevalence of lifetime NRT use by Canadian youths in grades 9-12

The current study is one of two recent studies that examined the prevalence of NRT use among Canadian youths in grades 9-12. The first study by Lane et al (2011) examined the prevalence of ever and current NRT use in 2006-2007, among Canadian youths in grades 9-12. That study was limited however, in that it only examined NRT use among current and former smokers. The present study builds on this past work by examining the prevalence of ever and current NRT use in the entire population of high school-aged Canadian youth, as well as in the current smoker and non-smoker subpopulations. Within the entire population of Canadian youths in grades 9-12, 3.6% had ever used NRT. Although this represents a significant increase ($p = 0.0209$) from the prevalence of ever use by Canadian youths in 2006-2007 (3.3%), it is less than the 5.3% prevalence of ever NRT use found by Klesges et al. (2003) in their sample of 4,078 grade 11 students in Memphis, Tennessee, or the 5% prevalence of ever NRT use reported in a Finnish study of 5,840 youths aged 12-18 (Rainio et al., 2010).

One potential reason for the relatively low prevalence of ever NRT use among Canadian youths could be the relative ease of NRT access among youths in Memphis, where Johnson, Klesges, Somes, Coday and DeBon (2004) found that 81% of attempted NRT purchases by a minor were

successful. Unfortunately, there is no Canadian equivalent to Johnson et al.'s (2004) study of youth NRT access, therefore it is difficult to ascertain whether this is the cause of between-population differences in NRT use prevalence. In Finland, where Rainio et al. (2007) reported 5% ever NRT use among 12-18 year olds, the sale of NRT has been deregulated for adults, who can purchase NRT without a prescription and outside pharmacies (i.e., at grocery stores, convenience stores), however individuals under 18 can only purchase NRT at pharmacies with a doctor's prescription. One possible reason for the higher prevalence of ever NRT use by Finnish youth compared with Canadian youth – despite similar restrictions on sales of NRT to youths in these countries – is that 58% of NRT-using Finnish youth reported social sources as their primary means of accessing NRT (Rainio et al., 2007). These data suggest that regulations at the point of purchase would have a limited impact on restricting NRT use among youth, as most youth NRT users in Finland are not purchasing NRT directly. To date, there has been no study of how youths access NRT in Canada, therefore it is difficult to assess how social NRT sources impact prevalence of NRT use among Canadian youths.

Another factor to consider when comparing prevalence of NRT use between different regions is that NRT use rates could be correlated with rates of smoking in different populations. In Klesges et al.'s (2003) sample, 26% of youths were experimental smokers, 13.1% were regular smokers and 5.9% were former smokers. When these smoking rates are compared with the smoking rates in the present study (6.9% experimental smokers, 11.7% current smokers and 1.6% former smokers), it becomes apparent that the study reporting higher NRT use by youths also had higher rates of smoking in their study sample. This finding suggests that prevalence of NRT use and cigarette smoking may to be correlated in youth populations.

## 6.2 Changes in prevalence of ever and current NRT use between 2006-2007 YSS and 2008-2009 YSS cohorts

Changes in the prevalence of NRT use between the 2006-2007 and 2008-2009 YSS were examined to identify possible trends in NRT use over time. In keeping with *Hypothesis 1*, 21.1% of current youth smokers had ever used NRT in the 2008-2009 YSS cohort, which does not represent a significant change ($p = 0.4215$) from the 21.8% who were current users in the 2006-2007 cohort. In contrast with the outcome proposed in *Hypothesis 2*, there was a significant decline in current use of NRT by current smokers – from 8.3% to 5.1% ($p<0.0001$) – in the two years between the YSS cohorts studied. A statistically significant decline in the prevalence of current use of NRT was also noted in the overall youth population, from 1.1% in 2006-2007 to 0.9% in 2008-2009 ($p = 0.0001$).

The overall trends discernable from Table 1 of section ***5.2*** are that past 30 day NRT use was lower among Canadian youths in 2008-2009 than in 2006-2007, whereas lifetime NRT use increased only slightly among the overall population, but not in either of the subpopulations (smokers, non-smokers) studied. One possible explanation for these patterns of NRT use among Canadian youths is that, similar to the youths in Klesges et al.'s (2003) study, Canadian youths are accessing NRT from social sources, such as adults in their households. Between 2006 and 2009, rates of nicotine patch use among Canadian adults fell from 30.8% (95%CI: 27.9 – 33.8) of smokers who had made a quit attempt in the past two years to 29.3% (95% CI: 26.1-32.6), while rates of nicotine gum use remained relatively stable over the same time period (Reid & Hammond, 2011). The unchanged or slightly decreased prevalence of NRT use among Canadian youths over the same period could be a reflection of this static or slightly diminishing source of NRT from the adult population.

It is important to note when interpreting these findings that the sample sizes for both the 2006-2007 and 2008-2009 YSS's were very large (>29,000 students), therefore the potential exists to

detect significant effects based on chi-squared tests, even if the actual changes at the population level were fairly small. For example, the relatively minor changes in NRT use observed in this study could have been brought about by chance, random methodological error, or well-established seasonal differences in NRT use (Chandra, Gitchell, & Shiffman, 2011). Continued monitoring of NRT use by adolescents over time is required to determine whether this is the case.

## 6.3 Between province differences in NRT ever and current use

Similar to the between province differences in youth NRT use in 2006-2007 reported by Lane et al. (2011), ever and current NRT use were found to vary significantly by province in the current study. As shown in *Figure 4*, prevalence of current use of NRT among all Canadian youths was highest in Saskatchewan (1.5%) and New Brunswick (1.4%) and lowest in Alberta (0.5%) and Newfoundland (0.6%). These geographic patterns of NRT use do not align with those of Canadian adults in 2009, for which prevalence of nicotine gum use was highest in Manitoba (27.8%) and Nova Scotia (26.9%) and lowest in Ontario (20.0%) and Quebec (16.9%) (Reid & Hammond, 2011). This misalignment of youth and adult between-province differences in prevalence of NRT use suggests that although NRT-using adults may act as NRT access points for youths (Rainio et al., 2010), there are additional factors that influence NRT use patterns in the Canadian youth population.

One potential cause of the cross-Canada differences in NRT use is the significant variation in smoking prevalence across the country. For example, Saskatchewan has the highest rate of smoking among youths aged 15-19 (Reid & Hammond, 2011) and the highest rate of current NRT use. On the other hand, Alberta has the second lowest rate of smoking (12.4%) among 15-19 year olds in Canada and the lowest rate of current NRT use. These associations indicate that youths who live in provinces where they are more likely to smoke may also be more likely to access NRT. Deviations from this pattern of increased NRT use with increased smoking prevalence may be used as an indicator of

provinces where provision of cessation tools is not aligned with population need. For example, Newfoundland has the fourth highest prevalence of youth smoking in the country (13.0%), but some of the lowest rates of ever (3.0%) or current (0.6%) NRT use. This discrepancy and others like it could represent an area for future public health intervention, in the event that NRT is deemed appropriate for youth smoking cessation in Canada.

Interestingly, prevalence of both current and ever NRT use among the entire youth population, as well as the current-smoking subpopulation are relatively low in Quebec, despite the fact that its government has been subsidizing NRT (even among youth) since 2001 (Tremblay et al., 2009). This finding highlights that although some youths view NRT's cost as a barrier to its use (Balch et al., 2004), eliminating its cost does not necessarily lead to dramatic increases in its use by youth smokers.

## 6.4 NRT use by never smokers and smokers who had not made a quit attempt

Among adult smokers who use NRT, 18.7 to 34.8% use it for reasons other than quitting smoking (Hammond et al., 2008; Levy, Thordike, Biener & Rigotti, 2007). This "non-standard" use of NRT occurs for a variety of reasons, such as reducing cigarette intake or coping with cigarette cravings in environments where smoking is prohibited (Hammond et al., 2008). Use of NRT in the absence of a quit attempt has also been reported among youth populations. In Lane et al.'s (2011) study of NRT use among Canadian youth smokers in 2006-2007, 17.7% of ever NRT users and 23.3% current NRT users had never made a quit attempt. These results are replicated in the current study, in which 16.1% of ever NRT users 31.8% of current NRT users in the Canadian youth smoker subpopulation had never made a quit attempt. One limitation of both of these studies was that neither of them specifically asked youths why they used NRT, therefore it is impossible to tell what proportion of "non-standard" NRT use among these Canadian youths was for legitimate reasons (i.e.

reducing cigarette intake prior to a quit attempt), or represented inappropriate use of NRT. In Kleges et al.'s (2003) study of NRT use among Tennessee youths in grade 11, only 28% of NRT using youths reported that they were using NRT to try to quit smoking; 22.4% used NRT when they were unable to smoke and 29.4% used NRT and smoked concomitantly, potentially representing youths who were using NRT to reduce the number of cigarettes they smoke. These data suggest that similar to adult smokers (Hammond et al., 2008), a significant proportion of youth smokers who use NRT do so in the absence of a quit attempt. To date, it has not been investigated whether or not this non-standard NRT use in youths leads to improved long-term cessation rates or an increased number of quit attempts, as reported in adult smoker populations (Beard, McNeill, Aveyard, Fidler, Michie & West, 2011).

More troublesome than non-standard use of NRT by youth smokers, is use of NRT by youths who do not smoke at all. In Kleges et al.'s (2003) study of NRT use among 4,078 grade 11 students in Tennessee, 1.0% of youths who had never smoked were lifetime NRT users, and made up a total of 18% of total NRT users in the study population. Similarly, the current study found that 1.0% of non-smokers were lifetime NRT users, and never smokers made up a total of 7.2% of the youths who had ever used NRT in Canada. The proportion of never-smokers among NRT users doubled to 15% when current NRT use was examined in this study.

Although using NRT as a harm reduction approach (i.e., to reduce smoking, but not quit) has some potential merit when compared with continuation of smoking (Apelberg, Onicescu, Avilla-Tang & Samet, 2010; Joseph, Hennrikus, Thoele, Krueger & Hatsukami, 2004), use of NRT among never smokers exposes youths to the biological risks of nicotine (Cooke & Bitterman, 2004; Mills, Wu, Wilson & Ebbert, 2010), without the benefit of decreased exposure to smoking-related carcinogens. For example, nicotine has been associated with increased cancer risk due to its ability to stimulate

blood vessel proliferation in tumours (Cooke & Bitterman, 2004; Kleinsasser, Sassen, Semmier, Staudenmaier, Harreus & Richter, 2006). This study is the first to show that a significant number of never smoking Canadian youths may be getting exposed to these harmful effects through NRT use, without the health benefits of smoking cessation.

Another possibility is that youths classified as never smokers are regular users of other tobacco products, such as cigarillos or chewing tobacco. Although use of these tobacco products was not included as a parameter in this study, it is possible that some NRT-using youths classified as never smokers were in fact using NRT to aid in quitting use of these alternate tobacco products. Furthermore, given that only 1% of non-smokers reported using NRT, the possibility exists that this finding was the result of chance, or random methodological error. Further studies investigating the frequency and rationale behind NRT use in this sub-population is required to determine the policy implications of these findings.

## 6.5 Significant between-school differences in current and ever NRT use

As predicted in *Hypothesis 3*, this study found that there were significant between school differences in NRT use within the entire youth population, as well as the current smoking and non-smoking sub-populations. This finding was expected based on significant between school differences found in other health-related behaviours among youths (Leatherdale, 2010; Leatherdale et al., 2005). Without controlling for any student or school characteristics, the portion of variability in the odds of youths ever using NRT accounted for by differences between schools was 5.4%, 2.7% and 3.3% in the entire, current smoking and non-smoking youth populations respectively. Between school differences accounted for a much greater portion of variability in the odds of current NRT use, explaining 9.0%, 8.6% and 10.1% of variability in likelihood of use among youths in the entire population, current smokers and non-smokers, respectively. This is the first study to show that not

only does NRT use vary significantly between schools in Canada, but also that between school differences have a greater impact on last 30 day NRT use than lifetime NRT use.

Following the addition of student and school-level explanatory variables to the models of NRT use, between school variance in the odds of ever NRT use became negligible within the entire youth population and the non-smoking youth population, while 77.2% of between school differences in ever use among current smokers was accounted for. The addition of explanatory variables to models of current NRT use had significantly less impact on explaining between school variance, as shown in Table 3. These findings illustrate that not only do greater between-school differences exist in current NRT use than ever NRT use, but that the student and school level measures that are available to model NRT use do a poorer job at explaining the variability in current use than ever use.

There are several possible explanations for the observed patterns of between school variance in current and ever NRT use. One possibility is that there are significant school-level predictors of NRT use that were not measured in the current study, and were therefore unavailable for inclusion in the models. For example, data on whether school smoking cessation programs were in place at the time of the survey could help explain the significant, unexplained, between school differences in current NRT use, however these data were not available in the 2008-2009 YSS. Another possibility is that important student level predictors of current NRT use (i.e., disposable income) (Lane et al., 2011) were not included in conditional models of NRT use due to the backwards elimination technique used to determine final models. Although a plethora of student characteristics were available for inclusion in models of NRT use, analytic restrictions made it impossible to test their individual associations with NRT use as a means of determining whether they should be included in predictive models. The resulting use of backwards elimination may have resulted in some significant student characteristics being unduly eliminated from final predictive models.

The persistence of school-level effects on NRT use, even with the addition of numerous explanatory variables to the models, contrasts with Klesges et al.'s (2003) finding that once sex and race were controlled for in random effects models of NRT use, clustering of NRT use within schools was negligible. Although it is possible that between-school differences in NRT use only exist in Canada, but not in Tennessee, it is also possible that differences in the accuracy of modelling techniques or interpretation of what a significant school level effect is could be responsible for the between study differences in findings. Unfortunately, Klesges et al. (2003) did not report the ICC that they considered insignificant; therefore it is impossible to tell whether this was the case.

## 6.6 Student characteristics associated with use of NRT

In keeping with *Research Question 4*, student characteristics associated with use of NRT were investigated in this study, controlling for numerous demographic characteristics (as outlined in Table 2). Across the entire population of Canadian youths, as well as the current smoking and non-smoking sub-populations, gender was significantly associated with current and ever NRT use, with males more likely to be lifetime or current NRT users than females, especially among non-smoking youth. This general pattern of increased likelihood of NRT use among male youths is in agreement with past research (Dalton et al., 2010; Lane et al., 2011), and may be due to the fact that male smokers have been shown to have higher nicotine dependence scores than female smokers (Rojas et al., 1998), which was not accounted for in the present study. Non-smoking male youths have previously been shown to be more likely to use NRT than female youths who do not smoke, which Dalton and colleagues (2011) have attributed to greater propensity for risk-taking behaviour among male youths.

This was the first study of its kind to find significant, inverse relationships between age (as measured by grade) and NRT use. All previous studies of NRT use among youths showed that

likelihood of NRT use increased with age (Dalton et al., 2010; Lane et al., 2011; Rainio et al., 2010). The cause of this deviation from the literature is not clear, however given that an inverse relationship between grade 12 and NRT use only exists for past 30 day NRT use, this pattern could represent a recent shift away from NRT use among older Canadian youth. Another potential cause of this unexpected pattern of NRT use is the relatively low YSS response rate among youths in grade 12 compared with youths in lower grades. Past research has shown an association between school absenteeism and health risk behaviours like smoking (Eaton, Brener & Kann, 2008; Guttmacher, Weltzman, Kapadia, & Weinberg, 2002; Henry, 2007); therefore the grade 12 youths that were absent on the day of YSS data collection could be more likely to be smokers (hence, NRT users) than the youths that were present to take the survey. Future research should investigate this unexpected relationship to track whether it persists over time and across different samples.

Smoking status was also a significant predictor of NRT ever and current use, in all populations except for non-smokers, for whom smoking status was not significant in predicting current NRT use. Although smoking status has previously been associated with NRT use in youths (Dalton et al., 2010; Klesges et al., 2003; Lane et al., 2011), this was the first study to examine the impact of more nuanced categories of smoking status in predicting NRT ever and current use. Among the entire population of Canadian youths studied, former smokers were the most likely to report ever or past 30 day use of NRT, whereas among current smokers, current daily smokers were more likely to report ever and current use of NRT than current occasional smokers. Among individuals classified as "non-smokers" experimental smokers, past experimental smokers and puffers were all more likely to have ever used NRT than individuals who had never smoked, however past experimental smokers were the most likely. This finding highlights the heterogeneity of NRT-using behaviour in association

with smoking status, among youths typically classified as "never smokers" by the YSS (University of Waterloo, 2009).

Self-identification as a smoker was an important predictor of NRT ever and current use among the entire population of youths, but especially among non-smoking youths, even when controlling for detailed smoking status. This finding quantifies McNeill et al.'s (2005) qualitative finding that youths who do not consider themselves "serious" smokers are less likely to consider using NRT. It also highlights the fact that among youth who have smoked fewer than 100 cigarettes (non-smokers), considering themselves smokers is of paramount importance in determining whether they attempt to stop smoking. Self-identification as a smoker was likely not significant among youths classified as current smokers due to the fact that 91.5% of youths in this category responded "Yes" when queried as to whether they were smokers (Table 9).

In this study, number of previous quit attempts was only a significant predictor of ever NRT use among current smokers, but not current NRT use among current smokers. This finding is in partial disagreement with the finding by Lane et al. (2011), that number of previous quit attempts was highly statistically significant in predicting both current and ever NRT use. A possible explanation for this lies in the differences in referent groups used in the current study (*No previous quit attempts*) versus Lane et al.'s (2011) study (*One previous quit attempt*).

Among youths who were current smokers, participation in smoking cessation counselling was associated with moderately increased odds of current NRT use, whereas participation in a quit and win contest was associated with increased odds of ever NRT use. Due to the lack of temporality in these data, the direction of these relationships cannot be determined, however it is possible that given the commonplace distribution of NRT in quit and win contests (Gomez-Zamudio et al., 2004; Hawk et al., 2006), it is possible that participating in quit and win contests increased youths chances of

using NRT. Similarly, although it cannot be determined with certainty from these data, youths attending smoking cessation counselling may have been more likely to receive encouragement to use NRT, as well as the required physician's prescription to purchase it in Canada (Kaplan et al., 2008).

Even when controlling for smoking status, past year marijuana use was a significant predictor of ever NRT use among current smokers, with individuals who had used marijuana having significantly increased odds of ever using NRT compared with individuals who had never used marijuana. Given that the increased rate of smoking among youths who use marijuana (Perkins, 1999; White et al.,2002) has been controlled for in this study, it is possible that this relationship represents marijuana-using youths abilities to access controlled substances. For example, youths who are able to access an illicit substance such as marijuana through social sources may also be more apt to access a controlled substance such as NRT through social sources as well. Alternatively, youths who use marijuana may have a higher propensity towards risk-taking behaviour in general, which has been associated with youth NRT use (Dalton et al., 2010).

## 6.7 School characteristics associated with use of NRT

This study is the first to show a positive association between attending school in an urban area and increased odds of ever and current NRT use among the entire population of Canadian youths, as well as current smokers. Given that this effect existed even when controlling for pharmacy density around a school, the association is unlikely a reflection of greater retail access to NRT in urban versus rural areas. One possibility is that this is due to increased anonymity in accessing NRT in urban versus rural areas, as youth smokers often prefer to remain anonymous during quit attempts (Lawrance, 2001). Another possible explanation is that public health programs to increase youth smoking cessation are more active in urban settings than rural settings, leading to increased uptake of NRT among youths attending schools in urban areas than rural ones. Although the exact cause of this

association cannot be determined from this study, it is clear that a school's location impacts the odds of students at that school using NRT, therefore urban/rural school status should be controlled for in all future studies of youth NRT use.

The inverse relationship between pharmacy density surrounding a school and the likelihood of current NRT use among the entire population and current smokers was unexpected. Pharmacy density was expected to have a positive association on NRT use, in the same way that tobacco retailer density has a positive association with cigarette use (Henriksen et al., 2008). It is possible that pharmacy density had a direct negative impact on current NRT use. For example, youths attending schools with a high density of pharmacies in a one kilometre radius may be more apt to attempt to access NRT via direct purchase (and be declined based on age), whereas youths with fewer pharmacies surrounding their schools may be more likely to access NRT successfully via social sources. It is also possible that this inverse relationship was the result of the inclusion of other confounding variables in the final models of NRT use, such as urban/rural status of a school. This possibility – as well as the possibility that pharmacy density was acting as a proxy variable for how built up an area was – was tested in Appendix M. The findings from these tests indicate that urban/rural status is not confounding the relationship between pharmacy density around a school and NRT use. There is however a possibility that pharmacy is acting as a proxy variable for a more distal school environment characteristic (such as how built up an area is), that causes pharmacy density and tobacco retailer density to have similar negative effects on current NRT use. Even so, it remains unclear why a school being in an area that was more built up with retailers would be associated with decreased likelihood of current NRT use. The existence of this unclear relationship highlights the need to include multiple school-level variables in studies such as these, to reduce the likelihood of inexplicable school-level effects.

Originally, interaction tests between significant built environment characteristics and student level characteristics were included in the analysis plan for this study. Given the unexpected (and largely unexplained) nature of pharmacy density's association with NRT use, these mesosystem (Brofenbrenner, 1977) effects were not investigated due to the foreseen difficulties in interpreting them in a meaningful way.

## 6.8 Limitations and strengths

Although many fascinating findings regarding the use of NRT by Canadian youth have come forth from this study, it is not without its limitations. Key among them was the necessary use of data that had already been collected as part of the 2008-2009 National Youth Smoking Survey. Because the YSS was not designed with this specific research topic in mind, there were limitations as to the breadth and depth of data that were collected regarding NRT use. For example, the original questionnaire given to students did not differentiate between the different forms of NRT they used (i.e., gum, patch, lozenge), therefore, youth smoker preference for a specific type of NRT, or combinations of different NRTs cannot be identified. Similarly, the YSS did not ask participants questions regarding sources of NRT or reasons for using NRT, therefore the findings from this study fall short in describing these key parameters of youth NRT use. More detailed measures of patterns of NRT use (beyond the crude *ever* and *current* classifications), as well as measures of frequency of use – such as those collected by Klesges et al. (2003) – also would have aided in making more meaningful conclusions from this study.

Also, although the YSS is conducted every two years, it does not follow a specific cohort of youths longitudinally. Due to the cross-sectional nature of the YSS, it is impossible to establish temporal relationships between the descriptive measures of interest in this study and NRT use. For instance, it would be useful for stakeholders planning youth smoking cessation programs to

understand whether attendance at smoking cessation counselling caused current smoking youth to use NRT, or whether NRT use was a stepping stone to attending smoking cessation counselling, however it is impossible to determine the direction of this relationship from these data.

Another limitation of this study was the urban/rural school classification system used, which may have led to significant heterogeneity in factors associated with NRT use between municipalities included in the same class. For instance, a school in a suburb outside of a large city and a school in a small farming township would both be classified as *rural*, however students attending the schools may experience very different access to NRT. Future work in this field would benefit from the use of more specific municipality classifications, such as *rural*, *suburban* and *urban*.

Furthermore, although the 1km radius around schools has been used in measures of built environment in past research (i.e., Henrikson et al., 2007), the sensitivity of this measure in different settings (i.e., urban versus rural) may vary significantly. Future work in this field may benefit from varying the radius around a school considered, depending on the school's urban, suburban or rural location.

One of the major limitations of this study was the paucity of school-level measures to include in the multilevel models of NRT use in Canadian youth. With only urban/rural location of school and pharmacy density around a school included in final models of NRT use, it is not surprising that significant between school differences in the odds of NRT use remained unexplained.

Beyond the paucity of data available for inclusion in this study, the analysis stage was subject to limitations inherent in the SAS NLMIXED procedure used to estimate multilevel models. Although this procedure did not allow for use of weighted data, future work could include weighting in model estimation, were the specific variables in the YSS from which the weights were derived

available. The inclusion of such weight variables in the modeling procedure would allow for estimation of unbiased parameter estimates with appropriate standard errors.

Despite these drawbacks, this study has many strengths, and makes several unique contributions to the scant youth-NRT literature. The YSS sample used in this study is a nationally representative sample of Canadian youths, therefore inferences made from the descriptive statistics presented regarding NRT use can be applied to the entire target population of Canadians in grades 9-12. Also, this study was the first study to examine between-school differences in odds NRT use in Canadian youth. Through the incorporation of Canadian census and built environment data, this research has set a starting point for future research on contextual determinants of NRT use among youths.

The models of NRT ever and current use developed in this study controlled for a variety of student and school characteristics and still identified a number of characteristics that are significantly associated with NRT use by Canadians in grades 9-12. Understanding how these characteristics operate with respect to NRT use in a real-world setting can provide valuable insights to policy planners attempting to target smoking cessation interventions or NRT-restrictions to high-need groups.

Additionally, the YSS survey from which the outcome and descriptive measures of this study were drawn was based on the self-report of youths in grades 9-12. Although youths have been known to misreport smoking behaviour in an attempt to please researchers in intervention trials, survey data has repeatedly been shown to be a reliable and valid measure of youth smoking behaviours, even when reports are biochemically validated (Dolcini, Adler, Lee & Bauman, 2003; Kentala, Utriainen, Pahkala & Mattila, 2004).

## 6.9 Implications for policy development

The findings from this study have several key implications for policy development in Canada. First, they indicate that despite restrictions on its sale, NRT had been used at least once by close to 60,000 Canadian youths in grades 9-12, a significant proportion of whom were not smokers. Given the potential harm NRT could cause among non-smoking youths (Cooke & Bitterman, 2004; Mills, Wu, Wilson & Ebbert, 2010) without any potential benefit (i.e., smoking cessation), policies to reduce youth use of NRT for non-therapeutic reasons should be strengthened. A starting point for such policies would be to identify how Canadian youths are accessing NRT. Surveys of youth similar to the ones Rainio et al (2010) administered in which youths report NRT use behaviours and their primary NRT sources is would be ideal; however, the addition of a single question regarding typical NRT sources to national surveys such as the YSS would be sufficient to inform policy discussions. In the event that most NRT-using youths report accessing NRT directly from a pharmacy without a doctor's prescription, policies requiring proof of age to purchase NRT in Canada should be strengthened. Although current laws in Canada mandate presentation of a doctor's prescription by youths who wish to purchase NRT (Physical Health Unit, 2004), the extent to which these laws are implemented is unknown. If the majority of youths report accessing NRT from social sources, punitive measures against individuals who supply youths with NRT should be put in place, similar to those that exist for individuals who provide youths with cigarettes (i.e., Government of Newfoundland and Labrador, 2009).

The current study identified that there was some alignment between the prevalence of NRT use by youths and the prevalence of smoking across Canadian provinces. In the event that Canada joins England and New Zealand in recommending NRT use for youth smoking cessation (MHNZ, 2007; Raw et al., 2005), provinces in which there is poor alignment between NRT use and smoking

prevalence could be targeted as regions to improve NRT uptake by Canadian youths. Several provinces, such as British Columbia, are taking steps to increase access to NRT within the general population (Kaplan et al., 2008). Examination of how the alignment between youth NRT use and smoking prevalence changes over time in the different provinces could be used as a gauge of the impact of these programs and policies on youth cessation behaviour.

Although more research is required to determine whether NRT use should be encouraged or restricted as a cessation tool for youth smokers (Fiore et al., 2008), Canadian health policy makers need to be able to identify the characteristics of youths who use NRT in Canada. In the event that NRT use is deemed an effective cessation aid for youth smokers, the student and school characteristics examined in this study can be used to identify populations in need of increased NRT intervention. Conversely, if NRT is determined to be inappropriate for use among youths, the characteristics presented in this study can help policy makers target NRT reduction strategies to the populations most likely to use NRT.

## 6.10 Implications for research

Although this study provided useful insights into the characteristics of Canadian youths who use NRT, more detail on patterns of use is required to fully inform future policies on NRT interventions in Canada. At the student level, future studies of NRT use among Canadian youths should identify how youths are accessing NRT, as well as their reason for using NRT. Collecting this more detailed level of data will allow for a clearer understanding of how and why youths are using NRT in Canada. Given that this is the second Canadian study to identify NRT use by youths as a prevalent health behaviour, future versions of the YSS should expand the number of questions inquiring about NRT use to include some of the aforementioned questions.

This study also identified that some youth smokers may be using NRT for reasons other than making a quit attempt. Although this "non-standard" use of NRT among adult smokers has been studied and shown to be associated with future quit attempts, equivalent research has not been done in youth smokers. Understanding the role non-standard NRT use plays in youth smoking trajectories is important for guiding future best practice guidelines for youth smoking cessation.

The current study was the first to report significant between school differences in odds of NRT use by Canadian youths. Although Canadian census and built environment data were incorporated with numerous measures of individual characteristics into models of NRT use, a significant portion of the between school variance in odds of current NRT use remained unexplained. To improve the present understanding of school affects on health behaviours such as NRT use, improved surveillance of contextual phenomena is required. An example of progress in this direction is the 2010-2011 version of the YSS, which is the first to include a school-level questionnaire that collects information on smoking policies and cessation initiatives at each school surveyed. By adding the numerous school characteristics included in the 2010-2011 YSS school survey to multilevel models such as the ones constructed in this study, future researchers could create more complete models of NRT use by Canadian youths. Additional measures from the Canadian Census – such as measures of economic deprivation in the catchment area of schools – could also help explain between school differences. This information could assist in planning future school interventions to increase or decrease NRT use by Canadian youth.

# Chapter 7: Conclusion

Smoking is one of the leading causes of death and disease in the world (Ezzati & Lopez, 2003), and yet more than one in ten Canadian youths smoke. Although most people who smoke initiated smoking as adolescents (Backinger et al., 2003; Everett et al., 1999), there is a paucity of smoking cessation tools designed for and targeted specifically at youths. NRT is uniquely positioned among youths as a smoking cessation tool that they would be willing to use that has also been proven effective in helping adult smokers quit (Fiore et al., 2008; Leatherdale & McDonald, 2007). Although NRT is available only by prescription for youths in Canada, past research has indicated that a significant proportion of Canadian youth have used NRT. The goal of this study was to identify the prevalence of current and ever NRT use among Canadian youths, and examine whether student and school characteristics were associated with its use.

The results from this study suggest that many Canadian youths are able to access NRT, despite restrictions on its sale to this population. Not only are a significant portion of youths who smoke using NRT, but NRT is also being used by thousands of Canadian youths who have never smoked a single cigarette. This finding highlights the need for improved enforcement of restrictions on youth access to NRT. Significant between school variation in the likelihood of NRT use was identified for the first time in this study, however more research is needed to fully understand what school characteristics are responsible for these between school differences. Although more detailed data are required to create a complete understanding of how and why youths are using NRT in Canada, this study contributes to our knowledge and advances our understanding of the student and school characteristics associated with use of NRT by Canadian youths.

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# Appendix A

# 2008-2009 Youth Smoking Survey Questionnaire

# 2008-2009
# Youth Smoking Survey
# Module B

To all students:

Thousands of students across Canada, just like you, have been asked to take part in this survey. Most of the questions are about smoking. There are a few questions about alcohol and drugs as well. This important survey will help Health Canada to better understand smoking, alcohol and other drug use among young people in Canada. Your help today is very important.

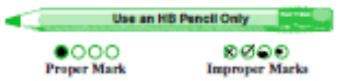
This is NOT a test. All of your answers will be kept confidential. No one, not even your parents or teachers, will ever know what you answered. So, please be honest when you answer the questions.

When filling out your responses please use a regular HB pencil and mark only one option per question unless the instructions tell you to do something else.

If you do not smoke, you will need to answer "I do not smoke" to many of the questions. We ask you to do this so that both smokers and non-smokers will take about the same amount of time to complete the questionnaire and teachers will not know which students smoke.

Thank You!

Please



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[ SERIAL ]

## 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, Metis
   - ○ Yes, Inuit
   - ○ No, I am not an aboriginal person

Do Not Forget This Column

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

7. On average, about how many hours a day do you do the following in your free time?

| | None | Less than 1 hour a day | 1 to 2 hours a day | More than 2 but less than 5 hours a day | 5 or more hours a day |
|---|---|---|---|---|---|
| a. Watch TV or videos | ○ | ○ | ○ | ○ | ○ |
| b. Play video games | ○ | ○ | ○ | ○ | ○ |
| c. Play/surf on a computer | ○ | ○ | ○ | ○ | ○ |
| d. Read for fun | ○ | ○ | ○ | ○ | ○ |

8. About how much money do you usually get <u>each week</u> to spend on yourself or to save?
*(Remember to include all money from allowances and jobs like babysitting, delivering papers...)*

- ○ Zero
- ○ $1 to $5
- ○ $6 to $10
- ○ $11 to $20
- ○ $21 to $40
- ○ $41 to $100
- ○ More than $100
- ○ I do not know how much money I get each week

**For the next 3 questions, choose the answer that describes how you feel about the statement.**

9. In general, I like the way I am.

- ○ True
- ○ Mostly true
- ○ Sometimes true / sometimes false
- ○ Mostly false
- ○ False

10. When I do something, I do it well.

- ○ True
- ○ Mostly true
- ○ Sometimes true / sometimes false
- ○ Mostly false
- ○ False

11. I like the way I look.

- ○ True
- ○ Mostly true
- ○ Sometimes true / sometimes false
- ○ Mostly false
- ○ False

○○○○○○○○○○○○○○○○○○○○○○○○ [ SERIAL ]

## Your Experience with Smoking

12. Are you a smoker?

- ○ Yes
- ○ No

13. Have you <u>ever</u> 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 <u>might try smoking</u> cigarettes?

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

**Do Not Forget This Column**

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 <u>next year</u> 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 <u>whole</u> cigarette?

- ○ Yes
- ○ No

20. How old were you when you smoked your first <u>whole</u> 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

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

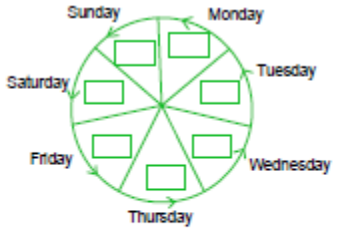
25. Think back over the last 7 days.

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

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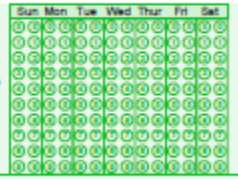


[ SERIAL ]

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
- Supersilm
- 100s
- Other

29. Why do you smoke the brand of cigarettes that you do? *(Mark all that apply)*

- I do not smoke
- I do not have a usual brand
- My friends smoke the same brand
- My parents smoke the same brand
- I like the packaging
- This brand costs less than other brands
- I like the image of this brand
- I like the taste
- They are the only ones that I can get
- They have less tar
- For the nicotine buzz
- Other

30. Where do you usually get your cigarettes?

- I do not smoke
- I buy them myself at a store
- I buy them from a friend or someone else
- I ask someone to buy them for me
- My brother or sister gives them to me
- My mother or father gives them to me
- A friend or someone else gives them to me
- I take them from my mother, father, or siblings
- I buy them from a First Nations Reserve
- Other

31. **Within the last 6 months, has a store clerk ever suggested a particular brand when you were buying cigarettes?**

- ○ I did not buy cigarettes from a store in the last 6 months
- ○ Yes, a store clerk suggested a brand
- ○ No, a store clerk did not suggest a brand

32. **Thinking about the last time you bought cigarettes in the last 12 months, what did you buy?**

- ○ I did not buy cigarettes in the last 12 months
- ○ A pack of 20 cigarettes
- ○ A pack of 25 cigarettes
- ○ A bag of 200 cigarettes
- ○ A single cigarette
- ○ A can or pouch of tobacco (loose tobacco)
- ○ A carton (200 cigarettes)
- ○ Another amount

33. **Thinking about the last time you bought cigarettes in the last 12 months, about how much did you pay for each single cigarette, pack, bag, or carton?**

- ○ I did not buy cigarettes in the last 12 months
- ○ I do not remember the price
- ○ Less than 10 cents
- ○ 10 cents to 50 cents
- ○ 51 cents to $4.50
- ○ $4.51 to $6.00
- ○ $6.01 to $20.00
- ○ $20.01 to $45.00
- ○ $45.01 to $60.00
- ○ $60.01 or more

**Do Not Forget This Column**

34. **Have you ever tried to quit smoking cigarettes?**

- ○ I have never smoked
- ○ I have only smoked a few times
- ○ I have never tried to quit
- ○ I have tried to quit once
- ○ I have tried to quit 2 or 3 times
- ○ I have tried to quit 4 or 5 times
- ○ I have tried to quit 6 or more times

35. **Have you ever tried any of the following?** *(Mark all that apply)*

- ○ Smoking pipe tobacco
- ○ Smoking cigarillos or little cigars (plain or flavoured)
- ○ Smoking cigars (not including cigarillos or little cigars, plain or flavoured)
- ○ Smoking roll-your-own cigarettes (tobacco only)
- ○ Using smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
- ○ Using nicotine patches, nicotine gum, or nicotine lozenges
- ○ I have not tried any of these things

36. **In the last 30 days, did you use any of the following?** *(Mark all that apply)*

- ○ Pipe tobacco
- ○ Cigarillos or little cigars (plain or flavoured)
- ○ Cigars (not including cigarillos or little cigars, plain or flavoured)
- ○ Roll-your-own cigarettes (tobacco only)
- ○ Smokeless tobacco (chewing tobacco, pinch, snuff, or snus)
- ○ Nicotine patches, nicotine gum, or nicotine lozenges
- ○ I have not used any of these things in the last 30 days

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

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

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

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

**Do Not Forget This Column**

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

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

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

- ○ Yes
- ○ No

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

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

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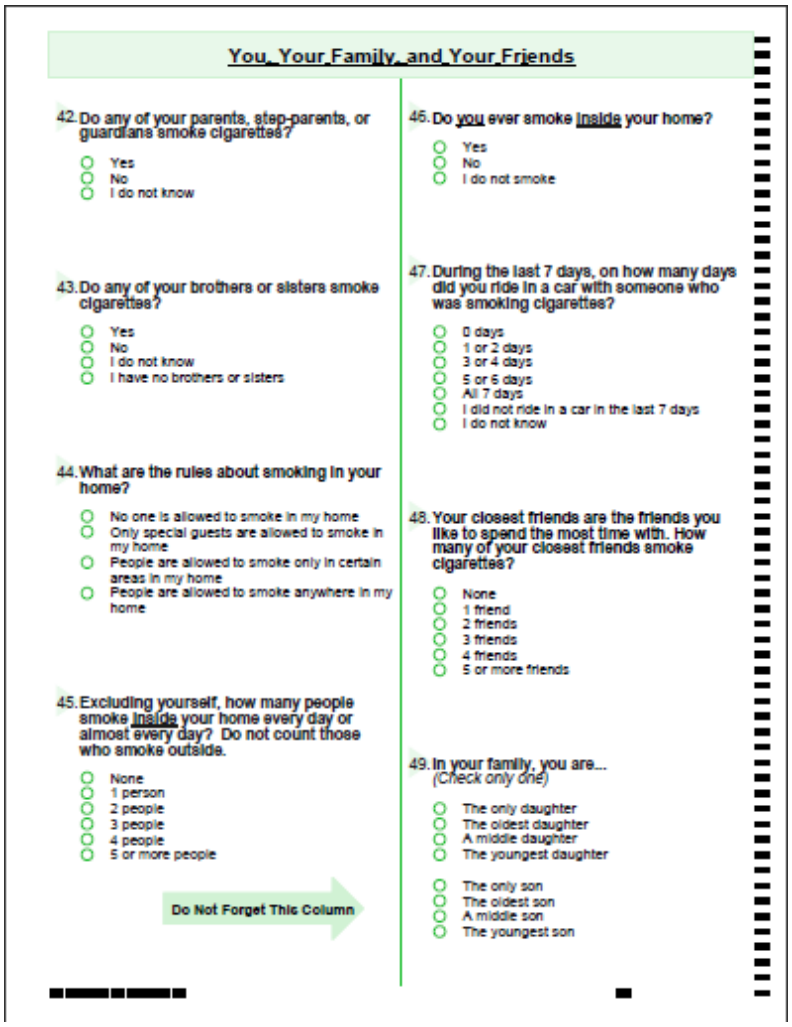


## You, Your Family, and Your Friends

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

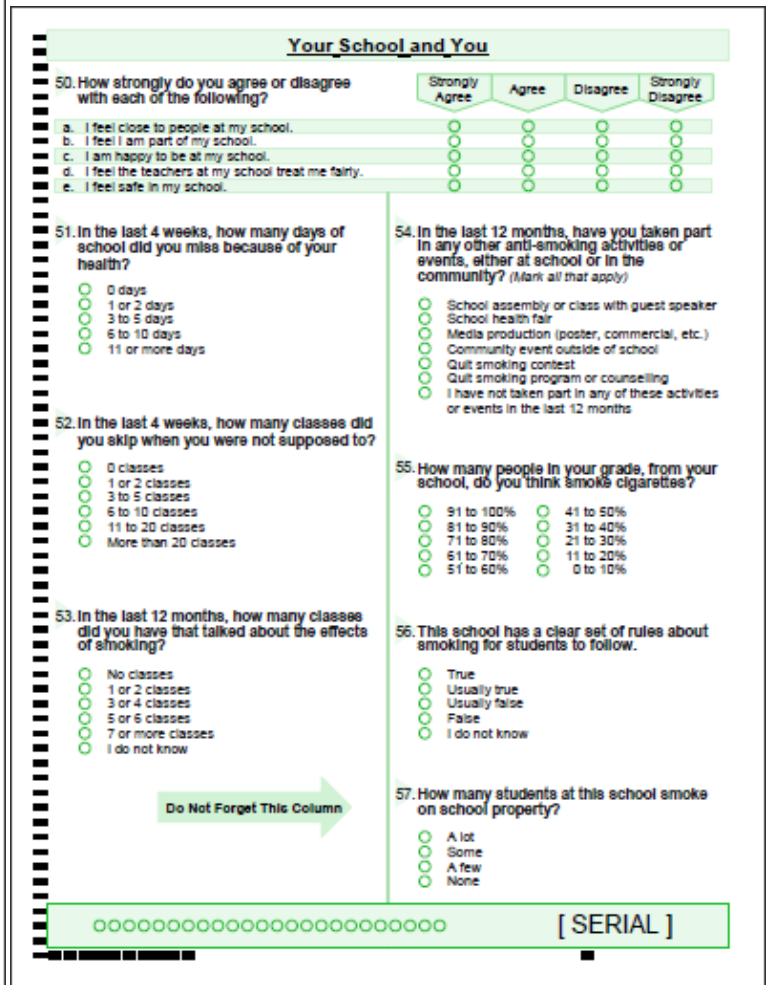
Do Not Forget This Column

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. | ○ | ○ | ○ | ○ |
| b. I feel I am part of my school. | ○ | ○ | ○ | ○ |
| c. I am happy to be at my school. | ○ | ○ | ○ | ○ |
| d. I feel the teachers at my school treat me fairly. | ○ | ○ | ○ | ○ |
| e. I feel safe in my school. | ○ | ○ | ○ | ○ |

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?
- 91 to 100%
- 81 to 90%
- 71 to 80%
- 61 to 70%
- 51 to 60%
- 41 to 50%
- 31 to 40%
- 21 to 30%
- 11 to 20%
- 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

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## 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

## Other Drug 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.

**64. This chart asks about your drug use. If you have ever used or tried any of the following drugs, mark the age at which you first used or tried. Then mark if you have used or tried the drug in the last 12 months.**

| | If you have ever used or tried, how old were you when you first used or tried this? | | | | | | | | Have you used or tried this in the last 12 months? | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I have never done this | 11 years or younger | 12 | 13 | 14 | 15 | 16 | 17 years or older | Yes | No |
| a. Amphetamines (speed, ice, meth...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| b. MDMA (ecstasy, E, X...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| c. Hallucinogens (LSD, PCP, acid, magic mushrooms, mesc...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| d. DACS (links...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| e. Heroin (smack, junk, crank...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| f. Cocaine (crack, blow, snow...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| g. Steroids (testosterone, growth hormones, Dianobol, juice, roids...) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

**65. If you have ever used or tried any of the following, mark the age at which you first used or tried. Then mark if you have used or tried in the last 12 months.**

| | If you have ever used or tried, how old were you when you first used or tried this? | | | | | | | | Have you used or tried this in the last 12 months? | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I have never done this | 11 years or younger | 12 | 13 | 14 | 15 | 16 | 17 years or older | Yes | No |
| a. Sedatives or tranquillizers (such as Valium, Ativan, Xanax, also known as "tranqs", "downers", etc.) to get high and NOT for medical purposes? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| b. Stimulants such as diet pills and stay awake pills (uppers, bennies) or medicine that is usually used to treat ADHD (such as Ritalin, Concerta, Adderall, Dexedrine) to get high and NOT for medical purposes? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| c. Pain relievers (such as Percocet, Percodan, Demerol, Oxycontin, or any pain reliever with codeine) to get high and NOT for medical purposes? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| d. Used or tried glue, gasoline, or other solvents to get high? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| e. Salvia (Divine Sage, Magic Mint, Sally D), to get high? | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

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# Appendix B

## Basic and detailed smoker classifications

Table 4: Basic and detailed smoker classifications

| Basic smoker status | Detailed smoker status | YSS Criteria |
|---|---|---|
| ***Non-smoker*** | *Never tried* | "Have you ever tried cigarette smoking, even just a few puffs?" (No) |
| | *Puffer* | "Have you ever tried cigarette smoking, even just a few puffs?" (Yes)<br>"Have you ever smoked a whole cigarette?" (No) |
| | *Past experimental smoker* | "Have you ever smoked a whole cigarette?" (Yes)<br>"Have you ever smoked 100 or more whole cigarettes in your life?" (No)<br>"On how many of the last 30 days did you smoke one or more cigarettes?" (None) |
| | *Experimental smoker (Beginner)* | "Have you ever smoked a whole cigarette?" (Yes)<br>"Have you ever smoked 100 or more whole cigarettes in your life?" (No)<br>"On how many of the last 30 days did you smoke one or more cigarettes?" (1-30) |
| ***Former smoker*** | *Former daily smoker* | "Have you ever smoked 100 or more whole cigarettes in your life?" (Yes)<br>"On how many of the last 30 days did you smoke one or more cigarettes?" (None)<br>"Have you ever smoked every day for at least 7 days in a row?" (Yes) |
| | *Former occasional smoker* | "Have you ever smoked 100 or more whole cigarettes in your life?" (Yes)<br>"On how many of the last 30 days did you smoke one or more cigarettes?" (None)<br>"Have you ever smoked every day for at least 7 days in a row?" (No) |
| ***Current smoker*** | *Current occasional smoker* | "Have you ever smoked 100 or more whole cigarettes in your life?" (Yes)<br>"On how many of the last 30 days did you smoke one or more cigarettes?" (1-29) |
| | *Current daily smoker* | "Have you ever smoked 100 or more whole cigarettes in your life?" (Yes)<br>"On how many of the last 30 days did you smoke one or more cigarettes?" (30) |

# Appendix C

## Pearson correlation coefficients for CPD measures with NRT ever use

Table 5: Pearson correlation coefficients for CPD measures with NRT ever use

| Parameter | YSS Survey Question | Pearson Correlation Coefficient[†] |
|---|---|---|
| Usual number of cigarettes smoked on each day that youths smoked in the last 30 days. | 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). | 0.31069 |
| Average number of whole cigarettes smoked per day in the past week. | "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." Number provided was divided by seven. | 0.25977 |
| Average number of whole cigarettes smoked on the days that the respondent smoked in past 30 days. | Response from question above, divided by number of days student reported smoking. | 0.28009 |

[†]With Ever NRT use within entire population of Canadian youths, grades 9 – 12.

# Appendix D

## Multilevel modelling in SAS and interclass correlation coefficient (ICC) calculation

This study implemented both conditional and unconditional multilevel models. These models took the general forms outlined below.

*Unconditional multilevel model*: $Y_{ij} = \beta_0 + u_{0j}$ (Equation 1)

*Conditional multilevel model*: $Y_{ij} = \beta_0 + \beta_1 x_{ij} + u_{0j}$ (Equation 2)

Where:

$Y_{ij}$ = log [p(student$_{ij}$ at school$_j$ using NRT)/ 1 – p(student$_{ij}$ at school$_j$ using NRT)]

$\beta_0$ = random intercept; the log-odds that $Y_{ij} = 1$ when explanatory variables ($x_{ij}$) = 0 and $u_{0j} = 0$

$\beta_1$ = slope of explanatory variable $x_{ij}$; the effect of a 1-unit change in the explanatory variable $x_{ij}$ on the log-odds that $Y_{ij} = 1$, holding constant the group effect $u_{0j}$

$u_{0j}$ = level-2 random effect; unique effect associated with school *j*, $u_{0j} \sim N(0, \sigma_u^2)$

$\sigma_u^2$ = variance among the intercepts; between-school variability

Multilevel modelling in SAS and interclass correlation coefficient (ICC) calculation

The unconditional models formulated as part of Analysis Stage 3 contained only the random intercept as a predictor variable and hence took the form Equation 1. The ICC was determined from these null models using the following equation from Merlo and colleagues (2006):

$$ICC = \sigma_u^2/( \sigma_u^2 + 3.29) \quad \text{(Equation 3)}$$

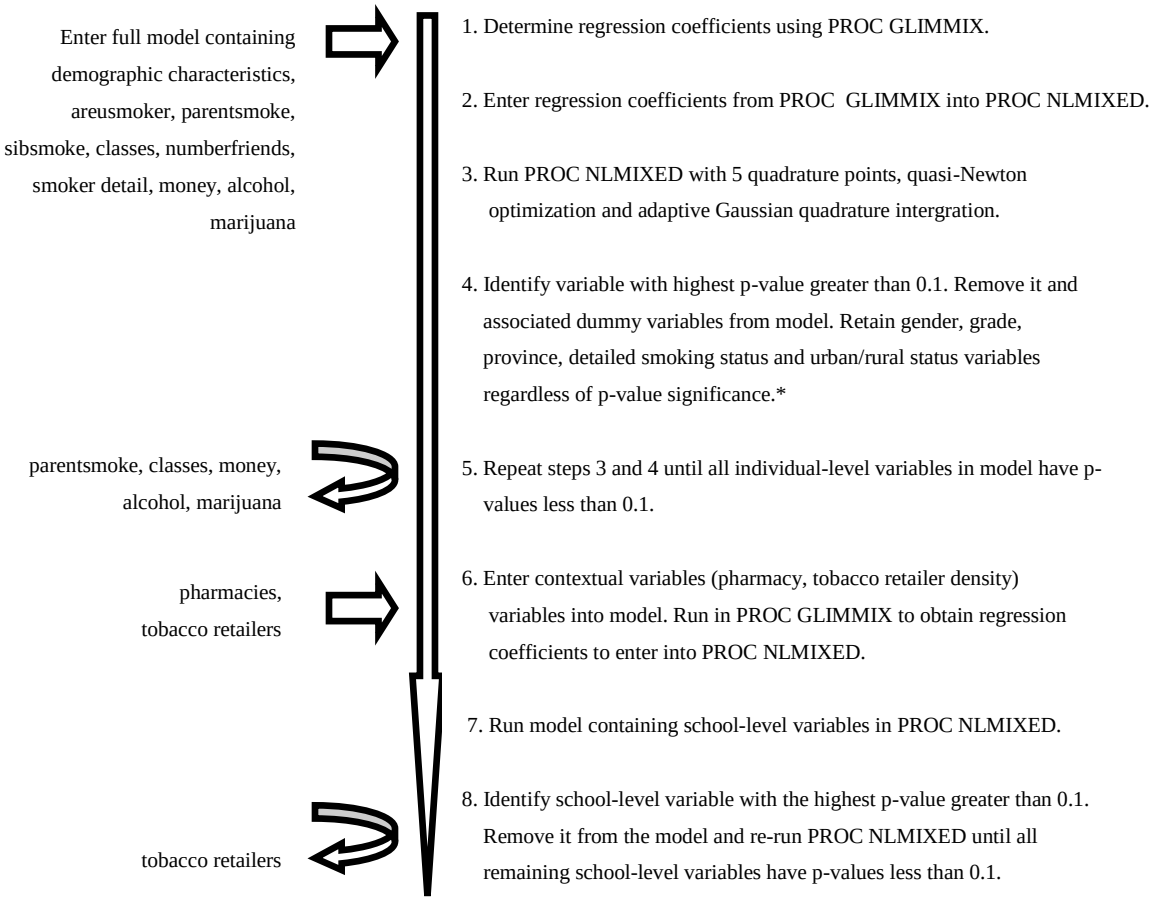
This method of calculating the ICC is called the *linear threshold model method* (Merlo et al., 2006). In this method of ICC calculation, 3.29 represents the constant student-level variation in a logistic multilevel model. Using 3.29 as a constant assumes that the propensity for using NRT is a continuous latent variable underlying the binary variable of NRT use (yes/no). In keeping with this assumption, every student has a certain propensity for using NRT, but only students whose propensity surpasses a certain threshold actually use NRT. The latent variable is assumed to follow a logistic distribution with the student-level variance equal to $\pi^2/3$ (=3.29) (Goldstein, Brown, Rasbash, 2002; Merlo et al., 2006).

The strength of this means of calculating ICC over other formulae is that it recognizes that student-level variance (measured on the probability scale) and school-level variance (measured on the logistic scale) are not directly comparable. By converting student-level variance to the logistic scale before computing ICC, this new method improves the legitimacy of this measure (Merlo et al., 2006).

# Appendix E

## Multilevel logistic model implementation

The following is a schematic representation of how all multilevel predictor models of NRT use were developed in this study. This example illustrates the steps that were taken in developing Model 1 of ever NRT use within the entire population of high school-aged youth.




$$\log [p(\text{student}_{ij} \text{ using NRT})/ 1 - p(\text{student}_{ij} \text{ using NRT})] = \beta_0 + \beta_1 \text{male}_{ij} + \beta_2 \text{grade10}_{ij} + \beta_3 \text{grade11}_{ij} + \beta_4 \text{grade12}_{ij} + \beta_5 \text{PEI}_{ij} + \beta_6 \text{NovaScotia}_{ij} + \beta_7 \text{NewBrunswick}_{ij} + \beta_8 \text{Quebec}_{ij} + \beta_9 \text{Ontario}_{ij} + \beta_{10} \text{Manitoba}_{ij} + \beta_{11} \text{Saskatchewan}_{ij} + \beta_{12} \text{Alberta}_{ij} + \beta_{13} \text{BC}_{ij} + \beta_{14} \text{urban}_{j} + \beta_{15} \text{currentdaily}_{ij} + \beta_{16} \text{currentocca}_{ij} + \beta_{17} \text{former}_{ij} + \beta_{18} \text{experimental}_{ij} + \beta_{19} \text{pastexperimental}_{ij} + \beta_{20} \text{puffer}_{ij} + \beta_{21} \text{areusmoker}_{ij} + \beta_{22} \text{sibsmoke}_{ij} - \beta_{23} \text{pharmacies}_{j} + u_{0j}$$

*Note: In some cases, where PROC NLMIXED models would not converge, variables with p-values greater than 0.5 in PROC GLIMMIX, or variables with Pearson Correlation Coefficients greater than 0.7 were eliminated from models to facilitate convergence in PROC NLMIXED.

# Appendix F

## Calculation of explained variance

The following formula for *explained variance* (from Merlo et al., 2006), identifies the portion of the random between school variance found in unconditional models that is eliminated by adding student and school level variables to produce a conditional model.

$$\text{Explained Variance} = \frac{(\sigma_u^2{}_U - \sigma_u^2{}_C)}{\sigma_u^2{}_U} \times 100\% \qquad \text{(Equation 4)}$$

Where:

$\sigma_u^2{}_U$ = between school variance in the unconditional model

$\sigma_u^2{}_C$ = between school variance in the conditional model

# Appendix G

## Impact of missing values in logistic models of NRT use

Table 6: Analysis of missing variables in multilevel logistic models

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Total *n* | 29,296 | 29,296 | 3,630 | 3,630 | 25,219 | 25,219 |
| *n* in model | 28,994 | 28,994 | 3,147 | 3,630 | 24,977 | 25,110 |
| *n* missing from model | 302 | 302 | 483 | 0 | 242 | 109 |
| *n* students with missing values for following variables: | | | | | | |
| Are you a smoker? | 128 | 128 | - | - | 109 | 109 |
| Do any of your siblings smoke? | 197 | 197 | - | - | 156 | - |
| Number of previous quit attempts? | - | | 256 | - | - | - |
| Have you ever participated in smoking cessation counselling? | - | - | - | 0 | - | - |
| Have you ever participated in a quit and win contest? | - | - | 0 | - | - | - |
| Past year marijuana use | - | - | 369 | - | - | - |
| Total possible missing *n* with missing variables: | 325 | 325 | 625 | 0 | 265 | 109 |

Notes:
" – " variable not included in model

Table 7: Impact of missing values on multilevel model of ever NRT use among by smokers (Model 3)

| Parameters | | Model 3a Standard (n=3,147[a]) | Model 3b Including missing (n=3,630[a]) |
|---|---|---|---|
| **Gender**[b] | Female[c] | 1.00 | 1.00 |
| | Male | **1.22 (1.01, 1.47)** | **1.29 (1.08, 1.53)** |
| **Grade**[b] | 9[c] | 1.00 | 1.00 |
| | 10 | 0.82 (0.62, 1.07) | 0.80 (0.62, 1.03) |
| | 11 | 0.92 (0.70, 1.20) | 0.96 (0.75, 1.24) |
| | 12 | 0.97 (0.73, 1.29) | 0.96 (0.73, 1.26) |
| **School location**[b] | Rural[c] | 1.00 | 1.00 |
| | Urban | **1.28 (1.03, 1.60)** | **1.28 (1.05, 1.57)** |
| **Smoking status** | Current daily smoker | **2.44 (2.00, 2.97)** | **2.51 (2.09, 3.03)** |
| | Current occasional smoker | 1.00[c] | 1.00 |
| **Number of previous quit attempts** | None[c] | 1.00 | 1.00 |
| | One | **1.39 (1.05, 1.82)** | 0.97 (0.64, 1.46) |
| | Two to three times | **2.41 (1.86, 3.11)** | **2.27 (1.78, 2.91)** |
| | Four to five times | **3.22 (2.24, 4.64)** | **3.04 (2.14, 4.33)** |
| | Six or more times | **4.18 (2.99, 5.84)** | **4.10 (2.99, 5.64)** |
| | *Missing* | N/A | 1.41 (0.93, 2.15) |
| **Have you ever participated in a quit and win contest?** | No[c] | 1.00 | 1.00 |
| | Yes | **1.87 (1.09, 3.20)** | **1.72 (1.07, 2.77)** |
| **Past year marijuana use.** | Never use of marijuana[c] | 1.00 | 1.00 |
| | Lifetime use, but not in last 12 months | **2.68 (1.64, 4.39)** | **2.63 (1.63, 2.24)** |
| | Less than once a month | **1.98 (1.21, 3.23)** | **2.02 (1.26, 3.23)** |
| | One to three times a month | **1.69 (1.02, 2.78)** | 1.62 (1.003, 2.63) |
| | One to three times a week | **1.78 (1.10, 2.89)** | **1.85 (1.16, 2.94)** |
| | Four to six times a week | **1.83 (1.13, 2.96)** | **1.84 (1.16, 2.93)** |
| | Every day | **2.17 (1.39, 3.38)** | **2.23 (1.45, 3.42)** |
| | *Missing* | N/A | 1.45 (0.87, 2.44) |
| **Pharmacy density within 1km radius of school (continuous)** | | 0.96 (0.91, 1.004) | **0.96 (0.92, 0.999)** |
| **Pharmacy density within 1km radius of school** | 0 | N/A | N/A |
| | 1 | N/A | N/A |
| | 2 | N/A | N/A |
| | 3+ | N/A | N/A |
| **School level random variance** | | 0.02103 | 0.01183 |
| **ICC**[d] | | 0.00635 | 0.00358 |

Notes:
Odds ratios adjusted for all other variables in the table and controlling for province of residence
[a] Sum of individuals in same population may vary between different models due to missing values;
[b] Variables retained in model regardless of significance during backwards elimination;
[c] Reference group;
[d] Measure of the proportion of the total variance that is between-schools
**Bold**: $p<0.05$

# Appendix H

## Weighted and unweighted descriptive statistics by gender and smoking status Canadian youths in grades 9 to 12

Table 8: Weighted and unweighted descriptive statistics by gender for entire sample of Canadian youths in grades 9 to 12, 2008-2009

| Parameters | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Females | | Males | | Total | |
| | | ***Weighted*** (n = 802,008) | ***Unweighted*** (n = 14,597 ) | ***Weighted*** (n = 858,883) | ***Unweighted*** (n = 14,699 ) | ***Weighted*** (n = 1,660,892) | ***Unweighted*** (n =29,296) |
| **Outcome Measures** | | | | | | | |
| Ever use of nicotine replacement therapy | Yes | 3.1 | 3.0 | 4.1 | 4.5 | 3.6 | 3.7 |
| | No | 96.9 | 97.0 | 95.9 | 95.5 | 96.4 | 96.3 |
| Current use of nicotine replacement therapy | Yes | 0.6 | 0.7 | 1.0 | 1.4 | 0.8 | 1.0 |
| | No | 99.4 | 99.3 | 99.0 | 98.6 | 99.2 | 99.0 |
| **Descriptive Measures** | | | | | | | |
| ***Level 1 – Student characteristics*** | | | | | | | |
| *Personal Determinants* | | | | | | | |
| Gender | Boy | - | - | - | - | 51.7 | 49.8 |
| | Girl | - | - | - | - | 48.3 | 50.2 |
| Grade | 9 | 25.6 | 29.4 | 25.3 | 29.4 | 24.5 | 29.4 |
| | 10 | 25.7 | 29.1 | 26.4 | 28.6 | 26.0 | 28.8 |
| | 11 | 25.5 | 24.4 | 25.3 | 24.7 | 25.4 | 24.6 |
| | 12 | 23.2 | 17.0 | 23.1 | 17.2 | 23.1 | 17.1 |
| Spending money ($/week) | Zero | 11.3 | 10.8 | 13.8 | 13.8 | 12.6 | 12.3 |
| | $1-$5 | 5.4 | 5.4 | 4.7 | 4.9 | 5.0 | 5.1 |
| | $6-$10 | 6.9 | 7.4 | 8.3 | 7.9 | 7.6 | 7.6 |
| | $11-$20 | 14.7 | 15.5 | 13.1 | 13.5 | 13.9 | 14.5 |
| | $21-$40 | 13.2 | 15.2 | 13.4 | 14.3 | 13.3 | 14.7 |
| | $41-$100 | 16.9 | 15.7 | 13.3 | 13.1 | 15.0 | 14.4 |
| | >$100 | 17.4 | 15.9 | 21.3 | 20.1 | 19.4 | 18.0 |
| | I do not know | 14.2 | 14.0 | 12.2 | 12.5 | 13.2 | 13.3 |
| Are you a smoker? | Yes | 12.1 | 13.2 | 17.3 | 17.1 | 14.8 | 15.1 |
| | No | 87.9 | 86.8 | 82.7 | 82.9 | 85.2 | 84.9 |
| Do you believe that smokers can quit any time they want? | Yes | 31.3 | 29.6 | 26.1 | 26.1 | 28.6 | 27.9 |
| | No | 55.5 | 56.2 | 58.4 | 56.5 | 57.0 | 56.4 |
| | I do not know | 13.2 | 14.2 | 15.5 | 17.4 | 14.4 | 15.8 |

| Parameters | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Females | | Males | | Total | |
| | | ***Weighted*** (n = 802,008) | ***Unweighted*** (n = 14,597 ) | ***Weighted*** (n = 858,883) | ***Unweighted*** (n = 14,699 ) | ***Weighted*** (n = 1,660,892) | ***Unweighted*** (n =29,296) |
| *Personal Determinants (continued)* | | | | | | | |
| Do you believe that smokers can quit any time they want? | Yes | 31.3 | 29.6 | 26.1 | 26.1 | 28.6 | 27.9 |
| | No | 55.5 | 56.2 | 58.4 | 56.5 | 57.0 | 56.4 |
| | I do not know | 13.2 | 14.2 | 15.5 | 17.4 | 14.4 | 15.8 |
| *Behavioural Determinants* | | | | | | | |
| Smoker status (basic) | Current smoker | 9.9 | 10.9 | 13.2 | 13.9 | 11.7 | 12.4 |
| | Former smoker | 1.8 | 1.5 | 1.4 | 1.5 | 1.6 | 1.5 |
| | Non-smoker | 88.2 | 87.6 | 85.4 | 84.6 | 86.7 | 86.1 |
| Smoker status (detailed) | Current daily smoker | 5.4 | 5.8 | 6.7 | 7.2 | 6.1 | 6.5 |
| | Current occasional smoker | 4.6 | 5.1 | 6.5 | 6.7 | 5.6 | 5.9 |
| | Former daily/occasional smoker | 1.7 | 1.5 | 1.3 | 1.5 | 1.5 | 1.5 |
| | Experimental smoker (beginner) | 7.1 | 6.7 | 6.8 | 7.2 | 6.9 | 7.0 |
| | Past experimental smoker | 10.3 | 10.3 | 9.2 | 9.6 | 9.7 | 10.0 |
| | Puffer | 14.9 | 15.2 | 15.8 | 15.1 | 15.3 | 15.2 |
| | Never tried | 56.0 | 55.3 | 53.6 | 52.7 | 54.8 | 54.0 |
| Participated in a quit and win? | Yes | 0.7 | 0.8 | 0.9 | 1.1 | 0.8 | 1.0 |
| | No | 99.3 | 99.2 | 99.1 | 98.9 | 99.2 | 99.0 |
| Participated in quit smoking program or counselling? | Yes | 0.6 | 0.6 | 1.1 | 0.9 | 0.8 | 0.7 |
| | No | 99.4 | 99.4 | 98.9 | 99.1 | 99.2 | 99.3 |
| In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? | I did not drink alcohol in the last 12 months | 18.5 | 20.2 | 20.1 | 22.3 | 19.3 | 21.2 |
| | I have only had a sip of alcohol | 14.4 | 15.2 | 11.3 | 12.0 | 12.8 | 13.6 |
| | Less than once a month | 17.0 | 18.5 | 15.2 | 15.1 | 16.1 | 16.8 |
| | Once a month | 9.6 | 9.9 | 8.9 | 9.4 | 9.2 | 9.6 |
| | 2 or 3 times a month | 18.8 | 17.4 | 16.1 | 15.0 | 17.4 | 16.2 |
| | Once a week | 8.0 | 7.1 | 10.6 | 9.5 | 9.3 | 8.3 |
| | 2 to 3 times a week | 8.5 | 6.5 | 10.3 | 8.4 | 9.4 | 7.5 |
| | 4 to 6 times a week | 1.1 | 1.0 | 2.2 | 2.2 | 1.6 | 1.6 |
| | Every day | 0.8 | 0.7 | 2.2 | 2.5 | 1.5 | 1.6 |
| | I do not know | 3.3 | 3.5 | 3.1 | 3.6 | 3.4 | 3.6 |

| Parameters | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Females** | | **Males** | | **Totals** | |
| | | ***Weighted*** (n = 802,008) | ***Unweighted*** (n = 14,597 ) | ***Weighted*** (n = 858,883) | ***Unweighted*** (n = 14,699 ) | ***Weighted*** (n = 1,660,892) | ***Unweighted*** (n =29,296) |
| *Behavioural Determinants (continued)* | | | | | | | |
| | I have never used marijuana | 58.8 | 62.7 | 53.6 | 57.3 | 56.1 | 60.0 |
| | I have used marijuana, but not in the last 12 months | 7.5 | 6.9 | 5.8 | 5.5 | 6.6 | 6.4 |
| In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...) | Less than once a month | 11.6 | 10.2 | 10.8 | 9.4 | 11.1 | 9.8 |
| | Once a month | 3.3 | 2.9 | 3.1 | 3.2 | 3.2 | 3.0 |
| | 2 or 3 times a month | 4.8 | 4.4 | 5.0 | 4.3 | 4.9 | 4.4 |
| | Once a week | 1.8 | 1.8 | 2.2 | 2.4 | 2.0 | 2.1 |
| | 2 or 3 times a week | 3.3 | 2.9 | 4.6 | 3.8 | 4.0 | 3.3 |
| | 4 to 6 times a week | 2.7 | 2.5 | 4.6 | 4.0 | 3.7 | 3.2 |
| | Every day | 3.7 | 3.3 | 8.2 | 7.4 | 6.0 | 5.3 |
| | I do not know | 2.5 | 2.4 | 2.2 | 2.5 | 2.4 | 2.4 |
| In the last 12 months, how many classes did you have that talked about the effects of smoking? | No classes | 48.5 | 51.0 | 48.2 | 50.9 | 48.39 | 51.0 |
| | 1 or 2 classes | 33.7 | 31.5 | 31.0 | 28.6 | 32.35 | 30.0 |
| | 3 or 4 classes | 6.1 | 5.9 | 6.5 | 6.2 | 6.31 | 6.1 |
| | 5 or more classes | 3.7 | 3.4 | 5.1 | 4.5 | 4.42 | 4.0 |
| | I do not know | 7.9 | 8.2 | 9.1 | 9.7 | 8.54 | 8.9 |
| *Social Determinants* | | | | | | | |
| Any parents/step-parents/guardians smoke? | Yes | 42.6 | 45.5 | 42.2 | 44.7 | 42.4 | 45.1 |
| | No[a] | 57.4 | 54.5 | 57.8 | 55.3 | 57.6 | 54.9 |
| Any brothers or sisters smoke? | Yes | 22.5 | 23.2 | 19.1 | 21.8 | 20.7 | 22.5 |
| | No[b] | 77.2 | 76.8 | 80.9 | 78.2 | 79.3 | 77.5 |
| Number of closest friends who smoke | None | 52.2 | 51.8 | 51.1 | 50.3 | 51.6 | 51.0 |
| | 1 | 14.8 | 13.7 | 12.6 | 12.6 | 13.7 | 13.1 |
| | 2 | 10.4 | 10.2 | 10.3 | 10.3 | 10.3 | 10.3 |
| | 3 | 6.2 | 6.2 | 6.0 | 6.1 | 6.1 | 6.2 |
| | 4 | 2.2 | 2.4 | 2.5 | 2.3 | 2.4 | 2.4 |
| | 5+ | 14.2 | 15.7 | 17.4 | 18.5 | 15.9 | 17.1 |

Note:
# Data not reportable due to low numbers in the numerator or denominator
[a] Includes youths who do not know whether their parents or guardians smoke
[b] Includes youths who have no siblings or do not know whether their siblings smoke

Table 9: Weighted and unweighted descriptive statistics by basic smoking status for the sample of Canadian youths in grades 9 to 12, 2008-2009, Canada

| Parameters | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Current Smokers | | Former Smokers | | Non-Smokers | |
| | | ***Weighted*** (n = 193,456) | ***Unweighted*** (n = 3,630) | ***Weighted*** (n = 26756) | ***Unweighted*** (n = 447) | ***Weighted*** (n= 1,440,679) | ***Unweighted*** (n = 25,219) |
| **Outcome Measures** | | | | | | | |
| Ever use of nicotine replacement therapy | Yes | 21.1 | 21.0 | 16.3 | 16.1 | 1.0 | 1.0 |
| | No | 78.9 | 79.0 | 83.7 | 83.9 | 99.0 | 99.0 |
| Current use of nicotine replacement therapy | Yes | 5.1 | 5.6 | # | # | 0.3 | 0.3 |
| | No | 95.0 | 94.4 | 98.3 | 97.3 | 99.7 | 99.7 |
| **Descriptive Measures** | | | | | | | |
| ***Level 1 – Individual Measures*** | | | | | | | |
| *Personal Determinants* | | | | | | | |
| Gender | Boy | 58.7 | 56.3 | 45.2 | 50.3 | 50.89 | 49.3 |
| | Girl | 41.3 | 43.7 | 54.8 | 50.0 | 49.1 | 50.7 |
| Grade | 9 | 15.3 | 19.5 | 12.2 | 17.7 | 27.1 | 31.1 |
| | 10 | 25.5 | 27.9 | 21.0 | 30.9 | 26.2 | 28.9 |
| | 11 | 24.6 | 28.9 | 24.6 | 27.1 | 25.0 | 23.9 |
| | 12 | 30.9 | 23.6 | 42.2 | 24.4 | 21.7 | 16.1 |
| Spending money ($/week) | Zero | 7.5 | 6.7 | 3.2 | 6.5 | 13.5 | 13.2 |
| | $1-$5 | 2.3 | 2.9 | 4.3 | 4.7 | 5.4 | 5.5 |
| | $6-$10 | 4.8 | 4.8 | 2.6 | 6.3 | 8.1 | 8.1 |
| | $11-$20 | 12.7 | 12.6 | 13.2 | 11.4 | 14.1 | 14.8 |
| | $21-$40 | 14.7 | 16.2 | 11.5 | 14.1 | 13.1 | 14.5 |
| | $41-$100 | 17.6 | 17.4 | 12.2 | 13.9 | 14.7 | 14.0 |
| | >$100 | 28.2 | 27.4 | 25.5 | 28.5 | 18.1 | 16.5 |
| | I do not know | 12.3 | 12.0 | 27.5 | 14.6 | 13.0 | 13.4 |
| Are you a smoker? | Yes | 91.7 | 90.6 | 7.1 | 12.6 | 4.6 | 4.3 |
| | No | 8.3 | 9.4 | 92.9 | 87.4 | 95.4 | 95.7 |
| Do you believe that smokers can quit any time they want? | Yes | 34.5 | 32.7 | 36.6 | 37.3 | 27.7 | 27.0 |
| | No | 56.7 | 56.7 | 56.5 | 52.8 | 57.0 | 56.4 |
| | I do not know | 8.9 | 10.6 | 5.9 | 9.9 | 15.29 | 16.6 |

| Parameters | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Current Smokers | | Former Smokers | | Non-smokers | |
| | | ***Weighted*** (n = 193,456) | ***Unweighted*** (n = 3,630) | ***Weighted*** (n = 26756) | ***Unweighted*** (n = 447) | ***Weighted*** (n= 1,440,679) | ***Unweighted*** (n = 25,219) |
| *Behavioural Determinants* | | | | | | | |
| Participated in a quit and win? | Yes | 2.3 | 2.5 | 1.3 | 2.9 | 0.6 | 0.7 |
| | No | 97.7 | 97.5 | 98.7 | 97.1 | 99.4 | 99.3 |
| Participated in quit smoking program or counselling? | Yes | 2.0 | 1.8 | 1.6 | 2.7 | 0.68 | 0.6 |
| | No | 98.0 | 98.2 | 98.3 | 97.3 | 99.3 | 99.4 |
| In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? | I have never/have not drank alcohol in the last 12 months | 4.0 | 2.9 | 9.8 | 9.0 | 21.5 | 24.1 |
| | I have only had a sip of alcohol | 2.3 | 2.7 | # | # | 14.4 | 15.3 |
| | Less than once a month | 9.1 | 9.6 | 10.3 | 14.7 | 17.1 | 17.9 |
| | Once a month | 6.6 | 8.5 | 9.0 | 10.3 | 9.6 | 9.8 |
| | 2 or 3 times a month | 20.0 | 21.7 | 27.4 | 20.5 | 16.7 | 15.4 |
| | Once a week | 16.0 | 15.9 | 8.6 | 14.3 | 8.4 | 7.1 |
| | 2 to 3 times a week | 25.9 | 22.8 | 19.5 | 12.9 | 7.0 | 5.2 |
| | 4 to 6 times a week | 5.9 | 5.9 | # | # | 1.0 | 0.9 |
| | Every day | 7.1 | 6.8 | # | # | 0.8 | 0.8 |
| | I do not know | 3.1 | 3.2 | # | # | 3.5 | 3.5 |
| In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...) | I have never used marijuana | 9.4 | 7.5 | 14.2 | 16.6 | 63.1 | 68.2 |
| | I have used marijuana, but not in the last 12 months | 7.8 | 9.0 | 25.3 | 20.7 | 6.1 | 5.7 |
| | Less than once a month | 9.8 | 11.8 | 16.9 | 13.4 | 11.2 | 9.5 |
| | Once a month | 4.2 | 4.3 | # | # | 3.1 | 2.8 |
| | 2 or 3 times a month | 7.0 | 7.6 | 6.6 | 8.1 | 4.6 | 3.8 |
| | Once a week | 4.3 | 5.3 | # | # | 1.7 | 1.7 |
| | 2 to 3 times a week | 10.4 | 9.9 | 5.6 | 7.1 | 3.1 | 2.3 |
| | 4 to 6 times a week | 13.9 | 13.5 | 6.7 | 9.0 | 2.3 | 1.7 |
| | Every day | 30.5 | 27.9 | 12.7 | 12.2 | 2.6 | 2.0 |
| | I do not know | 2.7 | 3.4 | # | # | 2.2 | 2.3 |
| Usual number of cigarettes smoked on days smoked (cigarettes/day) *among youths who had ever smoked a whole cigarette | None | # | # | 89.2 | 86.2 | 54.9 | 56.9 |
| | Few puffs to one | 8.6 | 8.4 | # | # | 31.2 | 27.8 |
| | 2-3 | 21.4 | 21.9 | # | # | 11.3 | 11.7 |
| | 4-5 | 21.3 | 19.5 | # | # | 1.3 | 2.0 |
| | 6-10 | 24.8 | 24.4 | # | # | 0.7 | 0.9 |
| | 11-20 | 12.7 | 13.5 | # | # | # | # |
| | 21-29 | 2.5 | 3.4 | # | # | # | # |
| | 30+ | 8.2 | 8.2 | # | # | # | # |

| Parameters | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Current Smokers | | Former Smokers | | Non-smokers | |
| | | ***Weighted*** (n = 193,456) | ***Unweighted*** (n = 3,630) | ***Weighted*** (n = 26756) | ***Unweighted*** (n = 447) | ***Weighted*** (n= 1,440,679) | ***Unweighted*** (n = 25,219) |
| *Behavioural Determinants* | | | | | | | |
| In the last 12 months, how many classes did you have that talked about the effects of smoking? | No classes | 54.1 | 55.0 | 48.8 | 52.2 | 47.6 | 50.4 |
| | 1 or 2 classes | 28.9 | 28.8 | 34.6 | 27.2 | 32.8 | 30.3 |
| | 3 or 4 classes | 5.9 | 6.0 | # | # | 6.5 | 6.1 |
| | 5 or more classes | 4.8 | 4.2 | # | # | 4.3 | 3.9 |
| | I do not know | 6.3 | 6.0 | 9.3 | 9.2 | 8.2 | 9.4 |
| *Social Determinants* | | | | | | | |
| Any parents/step-parents/guardians smoke? | Yes | 65.1 | 69.8 | 55.9 | 58.1 | 39.1 | 41.3 |
| | No[a] | 34.9 | 30.2 | 44.1 | 41.9 | 60.9 | 58.7 |
| Any brothers or sisters smoke? | Yes | 42.3 | 48.1 | 35.2 | 40.3 | 17.6 | 18.5 |
| | No[b] | 57.7 | 51.9 | 64.8 | 59.7 | 82.4 | 81.5 |
| Number of closest friends who smoke | None | 5.2 | 4.1 | 34.0 | 24.1 | 58.1 | 58.2 |
| | 1 | 4.4 | 5.2 | 11.1 | 11.8 | 15.0 | 14.3 |
| | 2 | 11.2 | 9.5 | 12.6 | 14.1 | 10.2 | 10.3 |
| | 3 | 9.8 | 9.2 | 7.1 | 10.9 | 5.6 | 5.6 |
| | 4 | 5.5 | 5.4 | 8.0 | 5.0 | 1.9 | 1.9 |
| | 5+ | 64.0 | 66.7 | 27.3 | 34.1 | 9.2 | 9.6 |

Notes:
# Data not reportable due to low numbers in the numerator or denominator
[a] Includes youths who do not know whether their parents or guardians smoke
[b] Includes youths who have no siblings or do not know whether their siblings smoke

Table 10: Weighted and unweighted descriptive statistics by gender for Canadian ***youths who smoke*** in grades 9 to 12, 2008-2009, Canada

| Parameters | | Grade 9-12 Students in Canada who smoke % | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Females** | | **Males** | | **Total** | |
| | | ***Weighted*** (n = 79,817) | ***Unweighted*** (n = 1587) | ***Weighted*** (n = 113,639) | ***Unweighted*** (n = 2043) | ***Weighted*** (n =193,456) | ***Unweighted*** (n = 3630 ) |
| **Outcome Measures** | | | | | | | |
| Ever use of nicotine replacement therapy | Yes | 21.1 | 19.1 | 21.1 | 22.5 | 21.1 | 21.0 |
| | No | 78.9 | 80.1 | 78.9 | 77.5 | 78.9 | 79.0 |
| Current use of nicotine replacement therapy | Yes | 5.4 | 4.5 | 4.9 | 6.5 | 5.1 | 5.6 |
| | No | 94.6 | 95.5 | 95.1 | 93.5 | 94.9 | 94.4 |
| **Descriptive Measures** | | | | | | | |
| ***Level 1 – Individual Measures*** | | | | | | | |
| *Personal Determinants* | | | | | | | |
| Sex | Boy | - | - | - | - | 58.7 | 56.3 |
| | Girl | - | - | - | - | 41.3 | 43.7 |
| Grade | 9 | 17.6 | 21.5 | 13.7 | 18.0 | 15.3 | 19.5 |
| | 10 | 24.8 | 27.8 | 26.0 | 28.0 | 25.5 | 27.9 |
| | 11 | 27.7 | 28.7 | 28.8 | 29.2 | 28.3 | 29.0 |
| | 12 | 29.9 | 22.0 | 31.6 | 24.9 | 30.1 | 23.6 |
| Spending money ($/week) | Zero | 7.0 | 6.2 | 7.8 | 7.0 | 7.5 | 6.7 |
| | $1-$10 | # | 8.4 | # | 7.2 | # | 7.7 |
| | $11-$20 | 14.2 | 14.0 | 11.6 | 11.5 | 12.6 | 12.6 |
| | $21-$40 | 13.1 | 16.2 | 15.9 | 16.3 | 14.7 | 16.2 |
| | $41-$100 | 19.1 | 17.5 | 16.5 | 17.3 | 17.6 | 17.4 |
| | >$100 | 28.4 | 24.5 | 28.1 | 28.9 | 28.2 | 27.4 |
| | I do not know | 11.1 | 12.1 | 13.2 | 11.9 | 12.3 | 12.0 |
| Are you a smoker? | Yes | 91.5 | 90.9 | 91.9 | 90.4 | 91.7 | 90.6 |
| | No | 8.5 | 9.1 | 8.1 | 9.6 | 8.3 | 9.4 |
| Do you believe that smokers can quit any time they want? | Yes | 35.1 | 31.6 | 34.0 | 33.5 | 34.5 | 32.7 |
| | No | 56.9 | 59.1 | 56.5 | 54.9 | 56.7 | 56.7 |
| | I do not know | 8.0 | 9.3 | 9.5 | 11.6 | 8.9 | 10.6 |
| Smoker status (detailed) | Current daily smoker | 54.1 | 53.5 | 49.3 | 48.4 | 52.1 | 52.3 |
| | Current occasional smoker | 45.9 | 46.7 | 50.7 | 51.6 | 47.9 | 47.7 |

| Parameters | | Grade 9-12 Students in Canada who smoke<br>% | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Females** | | **Males** | | **Total** | |
| | | ***Weighted***<br>(n = 79,817) | ***Unweighted***<br>(n = 1587) | ***Weighted***<br>(n = 113,639) | ***Unweighted***<br>(n = 2043) | ***Weighted***<br>(n =193,456) | ***Unweighted***<br>(n = 3630 ) |
| *Behavioural Determinants* | | | | | | | |
| Usual number of cigarettes smoked on days smoked (cigarettes/day)<br>*among youths who had ever smoked a whole cigarette | | # | # | # | # | # | # |
| | None | | | | | | |
| | Few puffs to one | 7.2 | 8.3 | 9.7 | 8.7 | 8.6 | 8.5 |
| | 2-3 | 22.3 | 23.0 | 21.0 | 21.4 | 21.5 | 22.1 |
| | 4-5 | 20.9 | 20.5 | 21.8 | 18.9 | 21.4 | 19.6 |
| | 6-10 | 27.7 | 26.8 | 22.9 | 22.9 | 24.9 | 24.6 |
| | 11-20 | 13.1 | 12.9 | 12.5 | 14.2 | 12.7 | 13.6 |
| | 21-29 | 2.5 | 2.7 | 2.6 | 3.9 | 2.6 | 3.4 |
| | 30+ | 6.4 | 5.8 | 9.6 | 10.1 | 8.3 | 8.2 |
| Mean #CPD on days smoked in last 30 days<br>*among all youths who had ever smoked a whole cigarette | - | 7.1<br>(sd: 39.0) | 5.5<br>(sd: 5.1) | 7.1<br>(sd: 42.6) | 6.3<br>(sd: 6.3) | 7.1<br>(sd: 41.0) | 6.0<br>(sd: 5.8) |
| Number of previous quit attempts<br>*among youths who had ever tried smoking a cigarette, even a few puffs) | Only smoked a few times | 3.9 | 3.7 | 5.2 | 6.0 | 4.6 | 5.0 |
| | Zero | 22.2 | 22.4 | 28.2 | 28.6 | 25.7 | 25.9 |
| | 1 | 25.8 | 26.9 | 27.5 | 24.7 | 26.8 | 25.7 |
| | 2-3 | 34.8 | 32.4 | 25.3 | 25.9 | 29.2 | 28.7 |
| | 4-5 | 7.5 | 7.4 | 6.4 | 6.2 | 6.8 | 6.7 |
| | 6+ | 5.8 | 7.2 | 7.4 | 8.6 | 6.7 | 8.0 |

| Parameters | | Grade 9-12 Students in Canada who smoke % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Females | | Males | | Total | |
| | | ***Weighted*** (n = 79,817) | ***Unweighted*** (n = 1587) | ***Weighted*** (n = 113,639) | ***Unweighted*** (n = 2043) | ***Weighted*** (n =193,456) | ***Unweighted*** (n = 3630 ) |
| *Behavioural Determinants (continued)* | | | | | | | |
| Cigarette source – "Where do you usually get your cigarettes?" | Direct Purchase – I buy them myself at a store/I buy them from a First Nations reserve | 38.3 | 31.8 | 53.6 | 46.8 | 47.4 | 40.3 |
| | Indirect Purchase – I buy them from a friend or someone else/I ask someone to buy them for me | 40.6 | 43.8 | 30.2 | 31.5 | 34.4 | 36.8 |
| | Given by family/taken from parents or siblings | 9.7 | 12.2 | 5.9 | 7.9 | 7.4 | 9.8 |
| | Given by friend or other | 5.8 | 6.5 | 5.0 | 5.8 | 5.4 | 6.1 |
| | Other | 5.6 | 5.7 | 5.3 | 8.0 | 5.4 | 7.0 |
| Participated in a quit and win? | Yes | 2.5 | 2.3 | 2.2 | 2.6 | 2.3 | 2.5 |
| | No | 97.5 | 97.7 | 97.8 | 97.4 | 97.7 | 97.5 |
| Participated in quit smoking program or counselling? | Yes | # | # | 2.5 | 2.1 | 2.0 | 1.8 |
| | No | 98.7 | 98.6 | 97.5 | 97.9 | 98.0 | 98.2 |
| In the last 12 months, how many classes did you have that talked about the effects of smoking? | No classes | 54.9 | 55.5 | 53.4 | 54.6 | 54.0 | 55.0 |
| | 1 or 2 classes | 29.7 | 30.4 | 28.4 | 27.5 | 28.9 | 28.8 |
| | 3 or 4 classes | 5.7 | 5.7 | 5.9 | 6.2 | 5.9 | 6.0 |
| | 5 or more classes | 4.1 | 3.3 | 5.3 | 5.0 | 4.8 | 4.2 |
| | I do not know | 5.5 | 5.1 | 6.9 | 6.8 | 6.3 | 6.0 |

| Parameters | | Grade 9-12 Students in Canada who smoke % | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Females** | | **Males** | | **Total** | |
| | | ***Weighted*** (n = 79,817) | ***Unweighted*** (n = 1587) | ***Weighted*** (n = 113,639) | ***Unweighted*** (n = 2043) | ***Weighted*** (n =193,456) | ***Unweighted*** (n = 3630 ) |
| *Behavioural Determinants (continued)* | | | | | | | |
| 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 | 3.3 | 5.5 | 8.5 | 5.85 | 6.4 | 5.6 |
| | Less than once a month | 9.3 | 10.9 | 9.0 | 8.6 | 9.1 | 9.6 |
| | Once a month | 8.0 | 9.0 | 5.7 | 8.2 | 6.6 | 8.5 |
| | 2 or 3 times a month | 27.1 | 26.1 | 14.9 | 18.2 | 20.0 | 21.7 |
| | Once a week | 12.1 | 14.8 | 18.7 | 16.7 | 16.0 | 15.9 |
| | 2 to 3 times a week | 25.6 | 21.7 | 26.1 | 23.6 | 25.9 | 22.8 |
| | 4 to 6 times a week | 5.1 | 4.8 | 6.5 | 6.8 | 5.9 | 5.9 |
| | Every day | 5.2 | 3.7 | 8.4 | 9.2 | 7.1 | 6.8 |
| | I do not know | 4.2 | 3.7 | 2.3 | 2.9 | 3.1 | 3.2 |
| In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...) | I have never used marijuana | 5.5 | 6.7 | 12.3 | 8.1 | 9.4 | 7.5 |
| | I have used marijuana, but not in the last 12 months | 9.6 | 11.3 | 6.5 | 7.2 | 7.8 | 9.0 |
| | Less than once a month | 12.9 | 14.1 | 7.6 | 9.9 | 9.8 | 11.8 |
| | 1 to 3 times a month | 13.0 | 13.6 | 9.9 | 10.4 | 11.2 | 11.8 |
| | 1 to 3 times a week | 15.8 | 16.2 | 13.9 | 14.2 | 14.7 | 15.1 |
| | 4 to 6 times a week | 14.3 | 13.6 | 13.7 | 13.4 | 13.9 | 13.5 |
| | Every day | 25.8 | 21.2 | 33.8 | 33.2 | 30.5 | 27.9 |
| | I do not know | 3.2 | 3.3 | 2.3 | 3.5 | 2.7 | 3.4 |

| Parameters | | Grade 9-12 Students in Canada who smoke % Females | | Males | | Total | |
|---|---|---|---|---|---|---|---|
| | | ***Weighted*** (n = 79,817) | *Unweighted* (n = 1587) | ***Weighted*** (n = 113,639) | *Unweighted* (n = 2043) | ***Weighted*** (n =193,456) | *Unweighted* (n = 3630 ) |
| *Social Determinants* | | | | | | | |
| Any parents/step-parents/guardians smoke? | Yes | 70.8 | 72.9 | 61.1 | 67.4 | 65.1 | 70.0 |
| | No[a] | 29.2 | 27.1 | 38.9 | 32.6 | 34.9 | 30.2 |
| Any brothers or sisters smoke? | Yes | 47.4 | 49.7 | 38.7 | 46.9 | 42.3 | 48.1 |
| | No[b] | 52.6 | 50.3 | 61.3 | 53.1 | 57.7 | 51.9 |
| Number of closest friends who smoke | 0-1 | 9.2 | 9.8 | 9.8 | 8.8 | 9.6 | 9.2 |
| | 2 | 12.2 | 9.7 | 10.4 | 9.3 | 11.2 | 9.5 |
| | 3 | 11.2 | 9.4 | 8.9 | 9.0 | 9.8 | 9.2 |
| | 4 | 4.7 | 5.4 | 6.0 | 5.3 | 5.5 | 5.4 |
| | 5+ | 62.6 | 65.6 | 64.9 | 67.6 | 64.0 | 66.7 |

Notes:
# Data not reportable due to low numbers in the numerator or denominator
[a] Includes youths who do not know whether their parents or guardians smoke
[b] Includes youths who have no siblings or do not know whether their siblings smoke

Table 11: Weighted and unweighted descriptive statistics by gender for ***non-smoking*** Canadian youths in grades 9 to 12, 2008-2009, Canada

| Parameters | | Non-smoking grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Females** | | **Males** | | **Total** | |
| | | ***Weighted*** (n = 707,529) | ***Unweighted*** (n = 12,788) | ***Weighted*** (n = 733,150) | ***Unweighted*** (n = 12,431) | ***Weighted*** (n= 1,440,679) | ***Unweighted*** (n=25,219 ) |
| **Outcome Measures** | | | | | | | |
| Ever use of nicotine replacement therapy | Yes | 0.8 | 0.7 | 1.3 | 1.4 | 1.0 | 1.0 |
| | No | 99.2 | 99.3 | 98.7 | 98.6 | 99.0 | 98.9 |
| Current use of nicotine replacement therapy | Yes | 0.1 | 0.2 | 0.4 | 0.5 | 0.3 | 0.3 |
| | No | 99.9 | 99.8 | 99.6 | 99.5 | 99.7 | 99.7 |
| **Descriptive Measures** | | | | | | | |
| ***Level 1 – Individual Measures*** | | | | | | | |
| *Personal Determinants* | | | | | | | |
| Sex | Boy | - | - | - | - | 50.9 | 50.7 |
| | Girl | - | - | - | - | 49.1 | 49.3 |
| Grade | 9 | 26.8 | 30.6 | 27.3 | 31.5 | 27.1 | 31.1 |
| | 10 | 25.9 | 29.2 | 26.4 | 28.6 | 26.2 | 28.9 |
| | 11 | 25.1 | 23.8 | 24.9 | 24.1 | 25.0 | 23.9 |
| | 12 | 22.1 | 16.3 | 21.4 | 15.8 | 21.7 | 16.1 |
| Spending money ($/week) | Zero | 12.0 | 11.4 | 14.9 | 15.0 | 13.4 | 13.2 |
| | $1-$5 | 5.7 | 5.7 | 5.1 | 5.3 | 5.4 | 5.5 |
| | $6-$10 | 7.3 | 7.7 | 8.9 | 8.5 | 8.1 | 8.1 |
| | $11-$20 | 14.8 | 15.8 | 13.4 | 13.8 | 14.1 | 14.8 |
| | $21-$40 | 13.3 | 15.1 | 13.0 | 13.9 | 13.1 | 14.5 |
| | $41-$100 | 16.7 | 15.6 | 12.8 | 12.4 | 14.7 | 14.0 |
| | >$100 | 16.0 | 14.5 | 20.2 | 18.5 | 18.1 | 16.5 |
| | I do not know | 14.2 | 14.2 | 11.9 | 12.6 | 13.0 | 13.4 |
| Are you a smoker? | Yes | 3.2 | 96.5 | 5.9 | 5.1 | 4.6 | 4.3 |
| | No | 96.8 | 3.5 | 94.1 | 94.9 | 95.4 | 95.7 |
| Smoker status (detailed) | Experimental smoker (beginner) | 8.0 | 7.7 | 7.9 | 8.5 | 8.0 | 8.1 |
| | Past experimental smoker | 11.6 | 11.8 | 10.8 | 11.3 | 11.2 | 11.6 |
| | Puffer | 16.8 | 17.4 | 18.5 | 17.8 | 17.7 | 17.6 |
| | Never tried | 63.5 | 63.2 | 62.8 | 62.3 | 63.1 | 62.8 |

| Parameters | | Non-smoking grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Females | | Males | | Total | |
| | | ***Weighted*** (n = 707,529) | *Unweighted* (n = 12,788) | ***Weighted*** (n = 733,150) | *Unweighted* (n = 12,431) | ***Weighted*** (n= 1,440,679) | *Unweighted* (n=25,219 ) |
| *Behavioural Determinants* | | | | | | | |
| In the last 12 months, how often did you have a drink of alcohol that was more than just a sip? | I have never/have not drank alcohol in the last 12 months | 20.5 | 22.6 | 22.6 | 25.6 | 21.5 | 24.1 |
| | I have only had a sip of alcohol | 16.1 | 16.9 | 12.6 | 13.6 | 14.4 | 15.3 |
| | Less than once a month | 18.0 | 19.5 | 16.2 | 16.1 | 17.1 | 17.9 |
| | Once a month | 9.8 | 10.0 | 9.4 | 9.6 | 9.6 | 9.8 |
| | 2 or 3 times a month | 17.6 | 16.2 | 16.3 | 14.5 | 16.9 | 15.4 |
| | Once a week | 7.5 | 6.0 | 9.4 | 8.3 | 8.4 | 7.1 |
| | 2 to 3 times a week | 6.4 | 4.6 | 7.6 | 5.8 | 7.0 | 5.2 |
| | 4 to 6 times a week | 0.6 | 0.6 | 1.5 | 1.3 | 1.0 | 0.9 |
| | Every day | 0.3 | 0.30 | 1.3 | 1.4 | 0.8 | 0.8 |
| | I do not know | 3.4 | 3.5 | 3.2 | 3.8 | 3.3 | 3.6 |
| In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash...) | I have never used marijuana | 65.8 | 70.3 | 60.4 | 65.9 | 63.1 | 68.2 |
| | I have used marijuana, but not in the last 12 months | 6.7 | 6.1 | 5.6 | 5.3 | 6.1 | 5.7 |
| | Less than once a month | 11.2 | 9.7 | 11.2 | 9.3 | 11.2 | 9.5 |
| | 1 to 3 times a month | 7.6 | 6.3 | 7.7 | 7.0 | 7.7 | 6.7 |
| | 1 to 3 times a week | 3.9 | 3.3 | 5.7 | 4.8 | 4.8 | 4.0 |
| | 4 to 6 times a week | 1.4 | 1.0 | 3.1 | 2.3 | 2.3 | 1.7 |
| | Every day | 1.0 | 1.0 | 4.2 | 3.1 | 2.6 | 2.0 |
| | I do not know | 2.3 | 2.2 | 2.1 | 2.3 | 2.2 | 2.3 |
| In the last 12 months, how many classes did you have that talked about the effects of smoking? | No classes | 47.9 | 50.4 | 47.4 | 50.4 | 47.6 | 50.4 |
| | 1 or 2 classes | 34.1 | 31.7 | 31.4 | 23.8 | 32.8 | 30.3 |
| | 3 or 4 classes | 6.2 | 5.0 | 6.7 | 6.3 | 6.5 | 6.1 |
| | 5 or more classes | 3.6 | 3.4 | 5.0 | 4.4 | 4.3 | 3.9 |
| | I do not know | 8.2 | 3.6 | 9.4 | 10.2 | 8.8 | 9.4 |

| Parameters | | Non-smoking grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Females** | | **Males** | | **Total** | |
| | | ***Weighted*** (n = 707,529) | *Unweighted* (n = 12,788) | ***Weighted*** (n = 733,150) | *Unweighted* (n = 12,431) | ***Weighted*** (n= 1,440,679) | *Unweighted* (n=25,219 ) |
| *Social Determinants* | | | | | | | |
| Any parents/step-parents/guardians smoke? | Yes | 39.2 | 41.9 | 39.0 | 40.7 | 39.1 | 41.3 |
| | No[a] | 60.8 | 58.1 | 61.0 | 59.3 | 61.0 | 58.7 |
| Any brothers or sisters smoke? | Yes | 19.2 | 19.5 | 16.0 | 17.5 | 17.6 | 18.5 |
| | No[b] | 80.8 | 80.5 | 84.0 | 82.5 | 82.4 | 81.5 |
| Number of closest friends who smoke | None | 58.0 | 58.2 | 58.3 | 58.5 | 58.2 | 58.2 |
| | 1 | 15.9 | 14.6 | 14.0 | 14.0 | 15.0 | 14.3 |
| | 2 | 10.1 | 10.2 | 10.3 | 10.4 | 10.2 | 10.3 |
| | 3 | 5.6 | 5.7 | 5.6 | 5.6 | 5.6 | 5.6 |
| | 4 | 1.8 | 2.1 | 1.9 | 1.7 | 1.9 | 1.9 |
| | 5+ | 8.5 | 9.2 | 9.9 | 10.1 | 9.2 | 9.6 |

Notes:
# Data not reportable due to low numbers in the numerator or denominator
[a] Includes youths who do not know whether their parents or guardians smoke
[b] Includes youths who have no siblings or do not know whether their siblings smoke

# Appendix I

## Weighted and unweighted demographic and school environment descriptive statistics by urban/rural status for grade 9-12 students in Canada

Table 12: Weighted and unweighted demographic and school environment descriptive statistics by urban/rural status for entire sample of Canadian youths in grades 9 to 12, 2008-2009, Canada

| School characteristic | | Grade 9-12 Students in Canada % | | | | | |
|---|---|---|---|---|---|---|---|
| | | Rural | | Urban | | Total | |
| | | ***Weighted*** (n = 561,985) | ***Unweighted*** (n = 10,885) | ***Weighted*** (n=1,098,907) | ***Unweighted*** (n = 18,411 ) | ***Weighted*** (1,660,892) | ***Unweighted*** (n = 29,296 ) |
| Province | Newfoundland | 1.9 | 6.9 | 1.4 | 7.7 | 1.6 | 7.4 |
| | Prince Edward Island | 0.8 | 10.0 | 0.4 | 6.6 | 0.5 | 7.9 |
| | Nova Scotia | 2.8 | 14.2 | 2.7 | 8.9 | 2.7 | 10.9 |
| | New Brunswick | 3.4 | 17.5 | 1.8 | 13.2 | 2.4 | 14.8 |
| | Quebec | 7.2 | 7.9 | 21.2 | 24.6 | 16.4 | 18.2 |
| | Ontario | 24.2 | 8.2 | 51.4 | 21.9 | 42.2 | 16.8 |
| | Manitoba | 6.2 | 15.5 | 2.8 | 6.8 | 4.0 | 10.0 |
| | Saskatchewan | 6.1 | 8.3 | 2.1 | 2.8 | 3.5 | 4.8 |
| | Alberta | 13.2 | 5.0 | 11.4 | 2.8 | 12.0 | 4.0 |
| | British Columbia | 34.3 | 6.6 | 4.8 | 4.7 | 14.8 | 5.4 |
| Region | Atlantic[a] | 8.8 | 48.6 | 6.3 | 36.4 | 7.1 | 40.9 |
| | Quebec | 7.2 | 7.9 | 21.2 | 24.6 | 16.4 | 18.4 |
| | Ontario | 24.2 | 8.2 | 51.4 | 21.9 | 42.2 | 16.8 |
| | Prairies[b] | 25.5 | 28.7 | 16.3 | 12.3 | 19.4 | 18.4 |
| | British Columbia | 34.3 | 6.6 | 4.8 | 4.7 | 14.8 | 5.4 |
| Built environment features (within 1 km radius of school) | Pharmacy density | 0.9 (sd: 6.0) | 1.0 (sd: 1.1) | 2.9 (sd: 36.2) | 1.9 (sd: 2.9) | 2.3 (sd: 29.8) | 1.6 (sd: 2.4) |
| | Tobacco retailer density | 3.6 (sd: 22.1) | 3.4 (sd: 2.9) | 6.9 (sd: 92.5) | 3.8 (sd: 5.0) | 5.8 (sd: 75.5) | 3.6 (sd: 4.4) |

Note: [a]Alberta, Saskatchewan and Manitoba, [b]New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland

# Appendix J

## Chi-square tests for differences in frequency of NRT use between 2006-2007and 2008-2009 YSS cohorts

Table 13: NRT Ever use within entire population by YSS Data Collection Year

| | YSS Data Collection Years | |
|---|---|---|
| | ***2006-2007*** | ***2008-2009*** |
| **NRT Ever Use** | 1384 (3.30%) | 1062 (3.62%) |
| **No NRT Ever Use** | 40502 | 28234 |

$\boldsymbol{X}^2$ = 5.3350, *df*=1, *P*= 0.0209

Table 14: NRT Current use within entire population by YSS Data Collection Year

| | YSS Data Collection Years | |
|---|---|---|
| | ***2006-2007*** | ***2008-2009*** |
| **NRT Current Use** | 480 (1.14%) | 249 (0.85%) |
| **No NRT Current Use** | 41406 | 29047 |

$\boldsymbol{X}^2$ = 14.8979, *df*=1, *P*= 0.0001

Table 15: NRT Ever use among current smoking youth, by YSS Data Collection Year

| | YSS Data Collection Years | |
|---|---|---|
| | ***2006-2007*** | ***2008-2009*** |
| **NRT Ever Use** | 933 (21.83%) | 719 (21.08%) |
| **No NRT Ever Use** | 3339 | 2693 |

$\boldsymbol{X}^2$ =0.6461, *df*=1, *P*= 0.4215

Table 16: NRT Current use among current smoking youth, by YSS Data Collection Year

| | YSS Data Collection Years | |
|---|---|---|
| | ***2006-2007*** | ***2008-2009*** |
| **NRT Current Use** | 355 (8.31%) | 173 (5.07%) |
| **No NRT Current Use** | 3917 | 3239 |

$\boldsymbol{X}^2$ = 31.1003 , *df*=1, *P*<0.001

Table 17: NRT Ever use among non-smoking youth, by YSS Data Collection Year

| | YSS Data Collection Years | |
|---|---|---|
| | ***2006-2007*** | ***2008-2009*** |
| **NRT Ever Use** | *377 (1.02%)* | *265 (1.04%)* |
| **No NRT Ever Use** | *36567* | *25146* |

$\boldsymbol{X^2}$ =0.0888, *df*=1, *P*=0.7657

Table 18: NRT Current use among non-smoking youth, by YSS Data Collection Year

| | YSS Data Collection Years | |
|---|---|---|
| | ***2006-2007*** | ***2008-2009*** |
| **NRT Current Use** | *114 (0.31%)* | *68 (0.27%)* |
| **No NRT Current Use** | *36831* | *25344* |

$\boldsymbol{X^2}$ =0.8895, *df*=1, *P*=0.3456

# Appendix K

# Equations, estimates and ICC calculations for unconditional multilevel logistic models of NRT use by Canadian youth

All unconditional multilevel logistic models discussed in this section are assumed to take the form of Equation 1, as outlined in Appendix D.

Table 19: Between school variation in ever NRT use by the entire population of Canadian youths (Model 1)

| Parameter | Estimate (NLMIXED) |
|---|---|
| $\beta_{0j}$ | -3.3336 |
| $\sigma_u^2$ | 0.1866 |

$ICC = \sigma_u^2/( \sigma_u^2 + 3.29)$

$= (0.1866)/( 0.1866 + 3.29)$

$= 0.0537$

Therefore, 5.4% of the variability in a high school-aged Canadian youth's odds of ever using NRT is accounted for by school-level differences.

Table 20: Between school variation in current NRT use by the entire population of Canadian youths (Model 2)

| Parameter | Estimate (NLMIXED) |
|---|---|
| $\beta_{0j}$ | -4.7817 |
| $\sigma_u^2$ | 0.3243 |

$ICC = \sigma_u^2/( \sigma_u^2 + 3.29)$

$= (0.3243)/( 0.3243 + 3.29)$

$= 0.0897$

Therefore, 9.0% of the variability in a high school-aged Canadian youth's odds of currently using NRT is accounted for by school-level differences.

Table 21: Between school variation in ever NRT use by Canadian youth smokers (Model 3)

| Parameter | Estimate (NLMIXED) |
|---|---|
| $\beta_{0j}$ | -1.3146 |
| $\sigma_u^2$ | 0.09216 |

ICC = $\sigma_u^2/(\sigma_u^2 + 3.29)$

= $(0.09216)/(0.09216 + 3.29)$

= 0.0272

Therefore, 2.7% of the variability in a high school-aged Canadian youth smokers' odds of ever using NRT is accounted for by school-level differences.

Table 22: Between school variation in current NRT use by Canadian youth smokers (Model 4)

| Parameter | Estimate (NLMIXED) |
|---|---|
| $\beta_{0j}$ | -2.9350 |
| $\sigma_u^2$ | 0.3115 |

ICC = $\sigma_u^2/(\sigma_u^2 + 3.29)$

= $(0.3115)/(0.3115 + 3.29)$

= 0.0865

Therefore, 8.6% of the variability in a high school-aged, Canadian youth smokers' odds of currently using NRT is accounted for by school-level differences.

Table 23: Between school variation in ever NRT use by non-smoking Canadian youth (Model 5)

| Parameter | Estimate (NLMIXED) |
|---|---|
| $\beta_{0j}$ | -4.6133 |
| $\sigma_u^2$ | 0.1123 |

ICC = $\sigma_u^2/(\sigma_u^2 + 3.29)$

= $(0.1123)/(0.1123 + 3.29)$

= 0.0330

Therefore, 3.3% of the variability in a high school-aged, non-smoking, Canadian youth's odds of ever using NRT is accounted for by school-level differences.

Table 24: Between school variation in current NRT use by non-smoking Canadian youth (Model 6)

| Parameter | Estimate (NLMIXED) |
|---|---|
| $\beta_{0j}$ | -5.9174 |
| $\sigma_u^2$ | 0.3688 |

ICC = $\sigma_u^2/(\sigma_u^2 + 3.29)$

= $(0.3688)/(0.3688 + 3.29)$

= 0.1010

Therefore, 10.1% of the variability in a high school-aged, non-smoking, Canadian youth's odds of currently using NRT is accounted for by school-level differences.

# Appendix L

# Estimates for conditional multilevel logistic models of NRT use by Canadian youth

The parameter estimates in the following tables are derived from a conditional multilevel model that takes the general form of Equation 2 in Appendix D.

Table 25: Parameter estimates, standard errors and adjusted odds ratios for individual and school-level predictors of NRT ever use among Canadian youths in grades 9-12, controlling for demographic characteristics

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Intercept** | -5.9656 | 0.2008 | |
| ***Student characteristics*** | | | |
| **Gender** | | | |
| Female[b] | - | - | 1.00 |
| Male | 0.2858 | 0.06950 | 1.33 (1.16, 1.53)*** |
| **Grade** | | | |
| 9[b] | | | 1.00 |
| 10 | -0.1350 | 0.09867 | 0.87 (0.72, 1.06) |
| 11 | -0.05635 | 0.09848 | 0.95 (0.78, 1.15) |
| 12 | -0.00448 | 0.1055 | 1.00 (0.81, 1.22) |
| **Province of residence** | | | |
| Newfoundland[b] | | | 1.00 |
| Prince Edward Island | 0.3314 | 0.1941 | 1.39 (0.95, 2.04)* |
| Nova Scotia | 0.4148 | 0.1765 | 1.51 (1.07, 2.14)** |
| New Brunswick | 0.6273 | 0.1655 | 1.87 (1.35, 2.59)** |
| Quebec | -0.05552 | 0.1704 | 0.95 (0.68, 1.32) |
| Ontario | 0.3986 | 0.1714 | 1.49 (1.06, 2.08)** |
| Manitoba | 0.4456 | 0.1872 | 1.56 (1.08, 2.25)** |
| Saskatchewan | 0.5353 | 0.1964 | 1.71 (1.16, 2.51)** |
| Alberta | 0.6100 | 0.2349 | 1.84 (1.16, 2.92)** |
| British Columbia | 0.8403 | 0.1939 | 2.32 (1.58, 3.39)*** |
| **Are you a smoker?** | | | |
| No[b] | | | 1.00 |
| Yes | 0.9465 | 0.1370 | 2.58 (1.97, 3.37)*** |
| **Do any of your siblings smoke?** | | | |
| No[bc] | | | 1.00 |
| Yes | 0.1947 | 0.07148 | 1.21 (1.06, 1.40)** |

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Smoking status** | | | |
| Never tried[b] | | | 1.00 |
| Current daily smoker | 3.3740 | 0.1844 | 29.20 (20.34, 41.91)*** |
| Current occasional smoker | 2.5442 | 0.1814 | 12.73 (8.92, 18.17) *** |
| Former daily/occasional smoker | 3.4686 | 0.1774 | 32.09 (22.67, 45.44) *** |
| Experimental smoker | 1.4531 | 0.1848 | 4.28 (2.98, 6.14) *** |
| Past experimental smoker | 1.3153 | 0.1757 | 3.73 (2.64, 5.26) *** |
| Puffer | 0.8196 | 0.1794 | 2.27 (1.60, 3.23) *** |
| ***School characteristics*** | | | |
| **Location of school** | | | |
| Rural[b] | | | 1.00 |
| Urban | 0.2058 | 0.07977 | 1.23 (1.05, 1.44)** |
| **Pharmacy density** | -0.02801 | 0.01668 | 0.97 (0.94, 1.005)* |
| **School-level random variance** | 0.006404 | | |
| **ICC[d]** | 0.00194 | | |

***Notes:***
[a] Odds ratios adjusted for all the variables in the table
[b] Referent group
[c] Includes youths who do not have siblings or do not know whether their siblings smoke
[d] Measure of the proportion of the total variance that is between-schools, calculated with Equation 3
*p<0.1, **p<0.05, ***p<0.0001

Table 26: Parameter estimates, standard errors and adjusted odds ratios for individual and school-level predictors of NRT current use among Canadian youths in grades 9-12, controlling for demographic characteristics

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Intercept** | -7.2078 | 0.3904 | |
| ***Student characteristics*** | | | |
| **Gender** | | | |
| Female[b] | - | - | |
| Male | 0.5978 | 0.1308 | 1.82 (1.41, 2.35)*** |
| **Grade** | | | |
| 9[b] | - | - | 1.00 |
| 10 | -0.2463 | 0.1690 | 0.78 (0.56, 1.09) |
| 11 | -0.1935 | 0.1677 | 0.82 (0.59, 1.14) |
| 12 | -0.7247 | 0.2066 | 0.48 (0.32, 0.73)** |
| **Province of Residence** | | | |
| Newfoundland[b] | - | - | 1.00 |
| Prince Edward Island | 0.1330 | 0.4315 | 1.14 (0.49, 2.66) |
| Nova Scotia | 0.2560 | 0.3922 | 1.29 (0.60, 2.79) |
| New Brunswick | 0.4629 | 0.3734 | 1.59 (0.76, 3.30) |
| Quebec | 0.04752 | 0.3812 | 1.05 (0.50, 2.21) |
| Ontario | 0.3009 | 0.3770 | 1.35 (0.65, 2.83) |
| Manitoba | 0.3537 | 0.3980 | 1.42 (0.65, 3.11) |
| Saskatchewan | 0.5099 | 0.4159 | 1.67 (0.74, 3.76) |
| Alberta | 0.5842 | 0.4806 | 1.79 (0.70, 4.60) |
| British Columbia | 0.5843 | 0.4125 | 1.79 (0.80, 4.03) |
| **Smoking status** | | | |
| Never tried[b] | - | - | 1.00 |
| Current daily smoker | 1.9964 | 0.3227 | 7.36 (3.91, 13.86)*** |
| Current occasional smoker | 1.1820 | 0.3300 | 3.26 (1.71, 6.23)** |
| Former daily/occasional smoker | 2.2070 | 0.3608 | 9.09 (4.48)*** |
| Experimental smoker | 0.3609 | 0.3571 | 1.43 (0.71, 2.89) |
| Past experimental smoker | 0.1158 | 0.3966 | 1.12 (0.52, 2.44) |
| Puffer | 0.4158 | 0.3042 | 1.52 (0.83, 2.75) |

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Are you a smoker?** | | | |
| No[b] | - | - | 1.00 |
| **Do any of your siblings smoke?** | | | |
| No[bc] | - | - | |
| Yes | 0.2184 | 0.1297 | 1.24 (0.96, 1.60) |
| ***School characteristics*** | | | |
| **School location** | | | |
| Rural[b] | - | - | 1.00 |
| Urban | 0.5530 | 0.1776 | 1.74 (1.23, 2.46)** |
| **Pharmacy density** | -0.1534 | 0.05033 | 0.86 (0.78, 0.95)** |
| **School-level random variance** | 0.1387 | | |
| **ICC[d]** | 0.0404 | | |

***Notes:***
[a] Odds ratios adjusted for all the variables in the table
[b] Referent group
[c] Includes youths who do not have siblings or do not know whether their siblings smoke
[d] Measure of the proportion of the total variance that is between-schools, calculated with Equation 3
*p<0.1, **p<0.05, ***p<0.0001

Table 27: Parameter estimates, standard errors and adjusted odds ratios for individual and school-level predictors of NRT ever use among Canadian youths who smoke in grades 9-12, controlling for demographic characteristics

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Intercept** | -3.7778 | 0.3291 | |
| ***Student Characteristics*** | | | |
| **Gender** | | | |
| Female[b] | - | - | 1.00 |
| Male | 0.1975 | 0.09446 | 1.22 (1.01, 1.47)** |
| **Grade** | | | |
| 9[b] | - | - | 1.00 |
| 10 | -0.2041 | 0.1410 | 0.82 (0.62, 1.07) |
| 11 | -0.08237 | 0.1368 | 0.92 (0.70, 1.20) |
| 12 | -0.03204 | 0.1464 | 0.97 (0.73, 1.29) |
| **Province of residence** | | | |
| Newfoundland[b] | - | - | 1.00 |
| Prince Edward Island | 0.6332 | 0.2549 | 1.88 (1.14, 3.10)** |
| Nova Scotia | 0.5500 | 0.2389 | 1.73 (1.09, 2.77)** |
| New Brunswick | 0.6889 | 0.2252 | 1.99 (1.28, 3.10)** |
| Quebec | 0.03557 | 0.2280 | 1.04 (0.66, 1.62) |
| Ontario | 0.5165 | 0.2344 | 1.68 (1.06, 2.65)** |
| Manitoba | 0.6661 | 0.2620 | 1.95 (1.16, 3.25)** |
| Saskatchewan | 0.5882 | 0.2582 | 1.80 (1.09, 2.99)** |
| Alberta | 0.8676 | 0.3347 | 2.38 (1.24, 4.59)** |
| British Columbia | 0.9258 | 0.2705 | 2.52 (1.49, 4.29)** |
| **Smoking status** | | | |
| Current occasional smoker[b] | - | - | 1.00 |
| Current daily smoker | 0.8906 | 0.1009 | 2.44 (2.00, 2.97)*** |
| **Number of previous quit attempts** | | | |
| None[b] | - | - | 1.00 |
| One | 0.3268 | 0.1398 | 1.39 (1.05, 1.82)** |
| Two to three times | 0.8778 | 0.1307 | 2.41 (1.86, 3.11)*** |
| Four to five times | 1.1706 | 0.1854 | 3.22 (2.24, 4.64)*** |
| Six or more times | 1.4307 | 0.1704 | 4.18 (2.99, 5.84)*** |

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Have you ever participated in a quit and win Contest?** | | | |
| No[b] | - | - | 1.00 |
| Yes | 0.6257 | 0.2749 | 1.87 (1.09, 3.20)** |
| **Past year marijuana use** | | | |
| Never use of marijuana[b] | - | - | 1.00 |
| Lifetime use, but not in last 12 months | 0.9867 | 0.2519 | 2.68 (1.64, 4.39)** |
| Less than once a month | 0.6818 | 0.2499 | 1.98 (1.21, 3.23)** |
| One to three times a month | 0.5223 | 0.2543 | 1.69 (1.02, 2.78)** |
| One to three times a week | 0.5789 | 0.2459 | 1.78 (1.10, 2.89)** |
| Four to six times a week | 0.6045 | 0.2453 | 1.83 (1.13, 2.96)** |
| Every day | 0.7726 | 0.2272 | 2.17 (1.39, 3.38)** |
| ***School characteristics*** | | | |
| **School location** | | | |
| Rural[b] | - | - | 1.00 |
| Urban | 0.2464 | 0.1128 | 1.28 (1.03, 1.60)** |
| **Pharmacy density** | -0.04273 | 0.02363 | 0.96 (0.91, 1.00)* |
| **School-level random variance** | 0.02103 | | |
| **ICC[d]** | 0.00635 | | |

***Notes:***
[a] Odds ratios adjusted for all the variables in the table
[b] Referent group
[d] Measure of the proportion of the total variance that is between-schools, calculated with Equation 3
*p<0.1, **p<0.05, ***p<0.0001

Table 28: Parameter estimates, standard errors and adjusted odds ratios for individual and school-level predictors of NRT current use among Canadian youths who smoke in grades 9-12, controlling for demographic characteristics

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Intercept** | -4.1740 | 0.4073 | 0.02 (0.01, 0.03)*** |
| ***Student Characteristics*** | | | |
| **Gender** | | | |
| Female[b] | - | - | 1.00 |
| Male | 0.4096 | 0.1551 | 1.51 (1.11, 2.04)** |
| **Grade** | | | |
| 9[b] | - | - | 1.00 |
| 10 | -0.3691 | 0.2093 | 0.69 (0.46, 1.04)* |
| 11 | -0.3212 | 0.2019 | 0.73 (0.49, 1.08) |
| 12 | -0.7734 | 0.2391 | 0.46 (0.29, 0.74)** |
| **Province of residence** | | | |
| Newfoundland[b] | - | - | 1.00 |
| Prince Edward Island | 0.1725 | 0.4658 | 1.19 (0.48, 2.96) |
| Nova Scotia | 0.2585 | 0.4110 | 1.29 (0.58, 2.90) |
| New Brunswick | 0.3402 | 0.3953 | 1.41 (0.65, 3.05) |
| Quebec | -0.03377 | 0.4000 | 0.97 (0.44, 2.12) |
| Ontario | 0.2953 | 0.4045 | 1.34 (0.61, 2.97) |
| Manitoba | 0.3667 | 0.4369 | 1.44 (0.61, 3.40) |
| Saskatchewan | 0.3263 | 0.4558 | 1.39 (0.57, 3.39) |
| Alberta | 0.8854 | 0.5317 | 2.42 (0.85, 6.87) |
| British Columbia | 0.4857 | 0.4524 | 1.63 (0.67, 3.94) |
| **Smoking status** | | | |
| Current occasional smoker[b] | - | - | 1.00 |
| Current daily smoker | 1.0097 | 0.1655 | 2.74 (1.98, 3.80)*** |
| **Have you ever participated in smoking cessation counselling?** | | | |
| No[b] | - | - | 1.00 |
| Yes | 1.0388 | 0.3584 | 2.83 (1.40, 5.70)** |

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| ***School Characteristics*** | | | |
| **School location** | | | |
| Rural[b] | - | - | 1.00 |
| Urban | 0.6555 | 0.1950 | 1.93 (1.31, 2.82)** |
| **Pharmacy density** | -0.1621 | 0.05433 | 0.85 (0.76, 0.95)** |
| **School-level random variance** | 0.09235 | | |
| **ICC[d]** | 0.0273 | | |

***Notes:***
[a] Odds ratios adjusted for all the variables in the table
[b] Referent group
[d] Measure of the proportion of the total variance that is between-schools, calculated with Equation 3
*p<0.1, **p<0.05, ***p<0.0001

Table 29: Parameter estimates, standard errors and adjusted odds ratios for individual and school-level predictors of NRT ever use among non-smoking Canadian youths in grades 9-12, controlling for demographic characteristics

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Intercept** | -5.8124 | 0.3276 | |
| ***Student characteristics*** | | | |
| **Gender** | | | |
| Female[b] | - | - | 1.00 |
| Male | 0.5328 | 0.1310 | 1.70 (1.32, 2.20)*** |
| **Grade** | | | |
| 9[b] | | | 1.00 |
| 10 | -0.01943 | 0.1618 | 0.98 (0.71, 1.35) |
| 11 | -0.1282 | 0.1775 | 0.88 (0.62, 1.25) |
| 12 | -0.2068 | 0.1968 | 0.81 (0.55, 1.20) |
| **Province of residence** | | | |
| Newfoundland[b] | | | 1.00 |
| Prince Edward Island | 0.04853 | 0.3590 | 1.05 (0.52, 2.12) |
| Nova Scotia | 0.2681 | 0.3231 | 1.31 (0.69, 2.46) |
| New Brunswick | 0.5062 | 0.2989 | 1.66 (0.92, 2.98)* |
| Quebec | -0.4395 | 0.3336 | 0.64 (0.34, 1.24) |
| Ontario | 0.07280 | 0.3199 | 1.08 (0.57, 2.01) |
| Manitoba | -0.07927 | 0.3423 | 0.92 (0.47, 1.81) |
| Saskatchewan | 0.3408 | 0.3671 | 1.41 (0.68, 2.89) |
| Alberta | -1.1002 | 0.6637 | 0.33 (0.09, 1.22)* |
| British Columbia | 0.4413 | 0.3688 | 1.55 (0.75, 3.20) |
| **School location** | | | |
| Rural[b] | | | 1.00 |
| Urban | 0.1942 | 0.1617 | 1.21 (0.88, 1.67) |
| **Smoking Status** | | | |
| Never tried[b] | | | 1.00 |
| Experimental Smoker (beginner) | 0.7687 | 0.2079 | 2.16 (1.44, 3.24)** |
| Past Experimental Smoker | 1.1515 | 0.1785 | 3.16 (2.23, 4.49)*** |
| Puffer | 0.6834 | 0.1808 | 1.98 (1.39, 2.82)** |

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Do any of your siblings smoke?** | | | |
| No[bc] | | | 1.00 |
| Yes | 0.3963 | 0.1386 | 1.49 (1.13, 1.95)** |
| **Are you a smoker?** | | | |
| No[b] | | | 1.00 |
| Yes | 2.0013 | 0.1749 | 7.40 (5.25, 10.42)*** |
| ***School characteristics*** | | | |
| **School location** | | | |
| Rural[b] | | | 1.00 |
| Urban | 0.1942 | 0.1617 | 1.21 (0.88, 1.67) |
| **School-level random variance** | ~ 0 | | |
| **ICC[d]** | NC | | |

***Notes:***
[a] Odds ratios adjusted for all the variables in the table
[b] Referent group
[c] Includes youths who do not have siblings or do not know whether their siblings smoke
[d] Measure of the proportion of the total variance that is between-schools, calculated with Equation 3
*p<0.1, **p<0.05, ***p<0.0001
NC: not computed due to insignificant school-level variance

Table 30: Parameter estimates, standard errors and adjusted odds ratios for individual and school-level predictors of NRT current use among non-smoking Canadian youths in grades 9-12, controlling for demographic characteristics

| Parameter | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|
| **Intercept** | -7.3069 | 0.7010 | |
| ***Student characteristics*** | | | |
| **Gender** | | | |
| Female[b] | | | |
| Male | 0.9903 | 0.2611 | 2.69 (1.61, 4,49)*** |
| **Grade** | | | |
| 9[b] | | | 1.00 |
| 10 | -0.02259 | 0.2868 | 0.98 (0.56, 1.72) |
| 11 | 0.03524 | 0.3042 | 1.04 (0.57, 1.88) |
| 12 | -0.5567 | 0.3951 | 0.57 (0.26, 1.24) |
| **Province of residence** | | | |
| Newfoundland[b] | | | 1.00 |
| Prince Edward Island | -0.09289 | 0.8401 | 0.91 (0.18, 4.73) |
| Nova Scotia | 0.3189 | 0.7239 | 1.38 (0.33, 5.68) |
| New Brunswick | 0.9671 | 0.6576 | 2.63 (0.72, 9.54) |
| Quebec | -0.1077 | 0.7094 | 0.90 (0.22, 3.61) |
| Ontario | 0.4987 | 0.6651 | 1.65 (0.45, 6.06) |
| Manitoba | -0.08814 | 0.7619 | 0.92 (0.21, 4.08) |
| Saskatchewan | 1.1915 | 0.7212 | 3.29 (0.80, 13.53) |
| Alberta | -0.5075 | 1.1736 | 0.60 (0.06, 6.01) |
| British Columbia | 0.9274 | 0.7104 | 2.53 (0.63, 10.17) |
| **Smoking Status** | | | |
| Never tried[b] | | | 1.00 |
| Experimental Smoker (beginner) | -0.2364 | 0.3725 | 0.79 (0.38, 1.64) |
| Past Experimental Smoker | -0.1342 | 0.4020 | 0.87 (0.40, 1.92) |
| Puffer | 0.3470 | 0.2953 | 1.41 (0.79, 2.52) |
| **Are you a smoker?** | | | |
| No[b] | - | - | 1.00 |
| Yes | 2.5031 | 0.2962 | 12.22 (6.84, 21.84)*** |

| Parameter | | Estimate | Standard Error | Adjusted Odds Ratio[a] (95% C.I.) |
|---|---|---|---|---|
| ***School characteristics*** | | | | |
| **School location** | | | | |
| | Rural[b] | - | - | 1.00 |
| | Urban | 0.1742 | 0.2738 | 1.19 (0.70, 2.04) |
| **School-level random variance** | | 0.09914 | | |
| **ICC[d]** | | 0.0295 | | |

***Notes:***
[a] Odds ratios adjusted for all the variables in the table
[b] Referent group
[d] Measure of the proportion of the total variance that is between-schools, calculated with Equation 3
*p<0.1, **p<0.05, ***p<0.0001

Table 31: Complete models of ever and current NRT use among Canadian youths in grades 9-12, with proportions of NRT ever and current users reported for each category examined

| Parameters | | Entire Youth Population | | | | Current smokers | | | | Non-smokers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ever NRT use | | Current NRT use | | Ever NRT use | | Current NRT use | | Ever NRT use | | Current NRT use | |
| | | **Model 1** (n=28,994[a]) | *% NRT ever use[e]* | **Model 2** (n=28,994[a]) | *% NRT current use[e]* | **Model 3** (n=3,471[a]) | *% NRT ever use[e]* | **Model 4** (n=3,630[a]) | *% current NRT use[e]* | **Model 5** (24,977[a]) | *% ever NRT use[e]* | **Model 6** (n=25,11[a]) | *% current NRT use[e]* |
| **Gender[b]** | Female[c] | 1.00 | *3.0* | 1.00 | *0.7* | 1.00 | *19.1* | 1.00 | *4.5* | 1.00 | *0.8* | 1.00 | *#* |
| | Male | **1.33 (1.16, 1.53)** | *4.5* | **1.82 (1.41, 2.35)** | *1.4* | **1.22 (1.01, 1.47)** | *22.5* | **1.51 (1.11, 2.04)** | *6.5* | **1.70 (1.32, 2.20)** | *1.4* | **2.69 (1.61,4,49)** | *0.5* |
| **Grade[b]** | 9[c] | 1.00 | *2.8* | 1.00 | *1.0* | 1.00 | *20.8* | 1.00 | *7.6* | 1.00 | *1.1* | 1.00 | *#* |
| | 10 | 0.87 (0.72, 1.06) | *3.3* | 0.78 (0.56, 1.09) | *1.0* | 0.82 (0.62, 1.07) | *17.8* | 0.69 (0.46, 1.04) | *5.1* | 0.98 (0.71, 1.35) | *1.1* | 0.98 (0.56, 1.72) | *#* |
| | 11 | 0.95 (0.78, 1.15) | *4.2* | 0.82 (0.59, 1.14) | *1.2* | 0.92 (0.70, 1.20) | *22.1* | 0.73 (0.49, 1.08) | *6.0* | 0.88 (0.62, 1.25) | *0.9* | 1.04 (0.57, 1.88) | *#* |
| | 12 | 1.00 (0.81, 1.22) | *5.4* | **0.48 (0.32, 0.73)** | *0.9* | 0.97 (0.73, 1.29) | *23.7* | **0.46 (0.29, 0.74)** | *4.1* | 0.81 (0.55, 1.20) | *1.1* | 0.57 (0.26, 1.24) | *#* |
| **School location[b]** | Rural[c] | 1.00 | *4.0* | 1.00 | *0.9* | 1.00 | *20.4* | 1.00 | *4.3* | 1.00 | *1.1* | 1.00 | *0.3* |
| | Urban | **1.23 (1.05, 1.44)** | *3.6* | **1.74 (1.23, 2.46)** | *1.1* | **1.28 (1.03, 1.60)** | *21.4* | **1.93 (1.31, 2.82)** | *6.6* | 1.21 (0.88, 1.67) | *1.0* | 1.19 (0.70, 2.04) | *0.3* |
| **Smoking Status[b]** | Never tried | 1.00[c] | *0.5* | 1.00[c] | *0.3* | N/A | | N/A | | 1.00[c] | *0.5* | 1.00[c] | *0.3* |
| | Current daily smoker | **29.20 (20.34, 41.91)** | *28.3* | **7.36 (3.91, 13.86)** | *7.9* | **2.44 (2.00, 2.97)** | *28.3* | **2.74 (1.98, 3.80)** | *7.9* | N/A | | N/A | |
| | Current occasional smoker | **12.73 (8.92, 18.17)** | *13.0* | **3.26 (1.71, 6.23)** | *3.1* | 1.00[c] | *13.0* | 1.00[c] | *3.1* | N/A | | N/A | |
| | Former daily/occasional smoker | **32.09 (22.67, 45.44)** | *16.1* | **9.09 (4.48, 18.43)** | *2.7* | N/A | | N/A | | N/A | | N/A | |
| | Experimental smoker | **4.28 (2.98, 6.14)** | *3.2* | 1.43 (0.71, 2.89) | *0.8* | N/A | | N/A | | **2.16 (1.44, 3.24)** | *3.2* | 0.79 (0.38,1.64) | *#* |
| | Past experimental smoker | **3.73 (2.64, 5.26)** | *2.0* | 1.12 (0.52, 2.44) | *0.3* | N/A | | N/A | | **3.16 (2.23, 4.49)** | *2.0* | 0.87 (0.40, 1.92) | *#* |
| | Puffer | **2.27 (1.60, 3.23)** | *1.2* | 1.52 (0.83, 2.75) | *0.4* | N/A | | N/A | | **1.98 (1.39, 2.82)** | *1.2* | 1.41 (0.79, 2.52) | *#* |
| **Are you a smoker?** | No[c] | 1.00 | *1.1* | 1.00 | *0.3* | - | | - | | 1.00 | *0.7* | 1.00 | *0.22* |
| | Yes | **2.58 (1.97, 3.37)** | *18.3* | **5.72 (3.36, 9.74)** | *5.2* | - | | - | | **7.40 (5.25, 10.42)** | *7.9* | **12.22 (6.84, 21.84)** | *#* |
| **Do any of your siblings smoke?** | No[c] | 1.00 | *2.5* | 1.00 | *0.7* | - | | - | | 1.00 | *0.8* | - | |
| | Yes | **1.21 (1.06, 1.40)** | *7.8* | 1.24 (0.96, 1.60) | *2.1* | - | | - | | **1.49 (1.13, 1.95)** | *1.8* | - | |

| Parameters | | Entire Youth Population | | | | Current smokers | | | | Non-smokers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ever NRT use | | Current NRT use | | *Ever NRT use* | | Current NRT use | | Ever NRT use | | Current NRT use | |
| | | **Model 1** (n=28,994[a]) | *% NRT ever use[e]* | **Model 2** (n=28,994[a]) | *% NRT current use[e]* | **Model 3** (n=3,471[a]) | *% NRT ever use[e]* | **Model 4** (n=3,630[a]) | *% current NRT use[e]* | **Model 5** (24,977[a]) | *% ever NRT use[e]* | **Model 6** (n=25,11[a]) | *% current NRT use[e]* |
| Number of previous quit attempts | None[c] | N/A | | N/A | | 1.00 | *14.2* | - | | N/A | | N/A | |
| | One | N/A | | N/A | | **1.39 (1.05, 1.82)** | *17.0* | - | | N/A | | N/A | |
| | Two to three times | N/A | | N/A | | **2.41 (1.86, 3.11)** | *25.5* | - | | N/A | | N/A | |
| | Four to five times | N/A | | N/A | | **3.22 (2.24, 4.64)** | *29.7* | - | | N/A | | N/A | |
| | Six or more times | N/A | | N/A | | **4.18 (2.99, 5.84)** | *38.5* | - | | N/A | | N/A | |
| Have you ever participated in smoking cessation counselling? | No[c] | - | | - | | - | | 1.00 | *5.4* | - | | - | |
| | Yes | - | | - | - | - | | **2.83 (1.40, 5.70)** | *#* | - | | - | |
| Have you ever participated in a quit and win contest? | No[c] | - | | - | | 1.00 | *20.6* | - | | - | | - | |
| | Yes | - | | - | | **1.87 (1.09, 3.20)** | *34.4* | - | | - | | - | |
| Past year marijuana use. | Never use of marijuana[c] | - | | - | | 1.00 | *11.5* | - | | - | | - | |
| | Lifetime use, but not in last 12 months | - | | - | | **2.68 (1.64, 4.39)** | *26.3* | - | | - | | - | |
| | Less than once a month | - | | - | | **1.98 (1.21, 3.23)** | *19.7* | - | | - | | - | |
| | One to three times a month | - | | - | | **1.69 (1.02, 2.78)** | *16.4* | - | | - | | - | |
| | One to three times a week | - | | - | | **1.78 (1.10, 2.89)** | *17.4* | - | | - | | - | |
| | Four to six times a week | - | | - | | **1.83 (1.13, 2.96)** | *19.5* | - | | - | | - | |
| | Every day | - | | - | | **2.17 (1.39, 3.38)** | *27.6* | - | | - | | - | |
| Pharmacy density within 1km radius of school | | 0.97 (0.94, 1.005) | | **0.86 (0.78, 0.95)** | | 0.96 (0.91, 1.004) | | **0.85 (0.76, 0.95)** | | - | | - | |
| School level random variance | | 0.00640 | | 0.1387 | | 0.02103 | | 0.09235 | | <0.0001 | | 0.09914 | |
| ICC[d] | | 0.00194 | | 0.0404 | | 0.00635 | | 0.0273 | | NC | | 0.0295 | |

Notes:
Odds ratios adjusted for all other variables in the table and controlling for province of residence.
[a] Sum of individuals in same population may vary between different models due to missing values
[b] Variables retained in model regardless of significance during backwards elimination.
[c] Reference group
[d] Measure of the proportion of the total variance that is between-schools
[e] Percent of youths in given group/classification that are current or ever NRT users within unweighted sample
# Data not reportable due to low numbers in the numerator or denominator
**Bold**: p<0.05
N/A – not included in original backwards elimination model
NC – not computed
Model 1 (For entire youth population): 1 = Ever use of NRT (n=1,071), 0 = Has never used NRT (n = 27,923)
Model 2 (For entire youth population): 1 = Current use of NRT (n= 287), 0 = Does not currently use NRT (n = 28,707)
Model 3 (For current smokers in youth population): 1 = Ever use of NRT (n= 679), 0 = Has never used NRT (n =2,468)
Model 4 (For current smokers in youth population): 1 = Current use of NRT (n= 204), 0 = Does not currently use NRT (n =3,426)
Model 5 (For non-smokers in youth population): 1 = Ever use of NRT (n=250), 0 = Has never used NRT (n =24,727)
Model 6 (For non-smokers in youth population): 1 = Current use of NRT (n=75), 0 = Does not currently use NRT (n =25,035)

# Appendix M

# Exploratory analyses to identify potential causes of the inverse relationship between pharmacy and current NRT use among the general youth population and current smokers

Pharmacy density was shown to have an inverse relationship with current NRT use when controlling for numerous student-level variables in the multilevel models. Although this could possibly reflect a direct relationship between pharmacy density and current NRT use, it is also possible that other factors were involved in producing this statistically significant effect. For instance, it is possible that the direction and magnitude of pharmacy density's effect in the models is a result of controlling for other variables that could be associated with pharmacy density, such as the urban/rural location of schools (Scenario 1). Alternatively, it is possible that pharmacy density around schools is actually acting as a proxy variable for an unmeasured school-level factor, such as the density of retailers or how built-up the area around schools is (Scenario 2). To test these potential associations, the following analyses were performed.

**Analysis 1: Correlation coefficient and sensitivity analysis of pharmacy density and urban/rural school location**

To explore the likelihood of Scenario 1, two different types of tests were performed. First, SAS 9.2 was used to determine the Pearson correlation coefficient (PCC) between urban/rural status of schools and pharmacy density within a 1 km radius of schools. The PCC for these two school-level variables was 0.18725, which suggests that inclusion of urban/rural status of schools in the model likely is not confounding the relationship between pharmacy and current NRT use. To confirm this finding, a sensitivity analysis was done as outlined below:

Three separate models were examined in the entire youth population:

1) A multilevel logistic analysis of the log-odds of current NRT use with only a random intercept and pharmacy density as predictors.

2) A multilevel logistic analysis of the log-odds of current NRT use with only a random intercept and urban/rural school status as predictors.

3) A multilevel logistic analysis of the log-odds current NRT use with a random intercept, pharmacy density and urban/rural school status as predictors.

The results of these analyses are presented in Table 32, on the following page. They indicate that when no other variables are controlled for in the model, both pharmacy density surrounding a school and urban/rural status of a school are negatively associated with current NRT use. This pattern holds true for both variables when they are placed in a model together without the moderating effect of student-level predictor variables. The results of this sensitivity analysis confirm that the negative association between pharmacy and current NRT use is not an artefact of controlling for urban/rural school location in models of current NRT use.

**Analysis 2: Correlation coefficient and sensitivity analysis of pharmacy density and tobacco retailer density in full (conditional) models**

To explore the likelihood of Scenario 2, two different types of tests were performed. First, SAS 9.2 was used to determine the PCC between tobacco retailer density and pharmacy density within a 1 km radius of schools. The PCC for these two school-level variables was 0.75363. This high correlation indicates that the density of pharmacies and the density of tobacco retailers around schools tend to vary together, which may be an indication that a more distal factor (i.e., how built up with retailers an area is) is causing this covariance.

Table 32: Sensitivity analysis of pharmacy density and urban rural status as predictors of log-odds of current NRT use with the Canadian youth population in grades 9 to 12 (2008-2009)

| Model | Estimate | Standard Error | p-value ($\alpha = 0.5$) |
|---|---|---|---|
| Pharmacy density only | | | |
| **Intercept** | -3.3443 | 0.05900 | <.0001 |
| **Pharmacy density** | -0.02818 | 0.02244 | 0.2115 |
| **School-level random variance** | 0.1797 | 0.05113 | 0.0006 |
| Urban/rural status only | | | |
| **Intercept** | -3.2945 | 0.08319 | <.0001 |
| **Urban/rural school location** | -0.07271 | 0.1120 | 0.5174 |
| **School-level random variance** | 0.1825 | 0.05153 | 0.0006 |
| Pharmacy density and urban/rural status | | | |
| **Intercept** | -3.3190 | 0.08574 | <.0001 |
| **Pharmacy density** | -0.02634 | 0.02280 | 0.2502 |
| **Urban/rural school location** | -0.04568 | 0.1136 | 0.6882 |
| **School-level random variance** | 0.1775 | 0.05098 | 0.0007 |

To test whether pharmacy density around schools is actually acting as a proxy for how built-up the area around schools is, a sensitivity analysis of tobacco retailer density alongside pharmacy density was performed as follows:

1) A full multilevel model of the log-odds of current NRT use in the entire youth population was developed. All of the predictor variables in Model 2 (Table 2, pg. 56) of current NRT use among Canadian youth were included, with the exception of pharmacy density, which was replaced by tobacco retailer density, to form *Model 1* (in Table 33, next page).

2) Pharmacy density was added to the model developed in Step 1, so that both pharmacy density and tobacco retailer density were included in the same multilevel model (*Model 3*, Table 33).

3) Estimates and direction of association from the models developed in Step 1 and 2 were compared with the estimates and directions of association in *Model 2* (Table 2 and Table 33) of current NRT use among the entire population.

Table 33: Model estimates for sensitivity analysis of pharmacy density and tobacco retailer density's impact on current NRT use in the Canadian youth population

| **Parameter** | **Estimate (*p*-value, α = 0.05)** | | |
|---|---|---|---|
| | ***Model 1*** Full model + tobacco retailerdensity | ***Model 2*** Full model + pharmacy density | ***Model 3*** Full model + pharmacy density + tobacco retailer density |
| Pharmacy density within a 1 km radius of school | - | - 0.1534 ($p$ =0.0028) | - 0.1362 ($p$ = 0.0523) |
| Tobacco retailer density within a 1 km radius of school | - 0.06813 ($p$ = 0.0177) | - | - 0.01348 ($p$ = 0.7248) |

Notes:
*Model 1*: Full model + tobacco retailer density
*Model 2*: Full model + pharmacy density
*Model 3*: Full model + pharmacy density + tobacco retailer density
'*Full model'* is a multilevel logistic regression model of current NRT use within the entire grade 9-12 Canadian population and contains all student characteristics outlined in Model 2 (Table 2, page 56), as well as province of residence and the urban-rural status of the school. Although the estimates for all of these variables are not listed here, they were consistent in magnitude and direction of effect across all three models.

As shown in Table 33, the negative association pharmacy density has with current use of NRT persists, even when tobacco retailer density is controlled for in the model (Model 3). Both the magnitude and significance of pharmacy density's association with current NRT use are less when controlling for tobacco retailer density, which is likely due to the fact that pharmacy density and tobacco retailer density are such highly correlated variables. In Model 1, tobacco retailer density was negatively associated with current NRT use and the relationship was statistically insignificant ($p$ = 0.0177). If the highly correlated nature of pharmacy density and tobacco retailer density was a result of them both being measures of a common, more distal factor (i.e., how build up the area around a school is), it would be expected that

tobacco retailer density would have a statistically significant negative association with current NRT use, similar to pharmacy density. The fact that such a relationship exists suggests that pharmacy density and tobacco retailer density could be acting as proxy measures of how built-up with retailers a school's environment is, or another unmeasured factor.

In summary, it remains unclear what the exact cause of pharmacy's inverse relationship with current NRT use is. Although three data sets (YSS, census, DMTI) were combined to account for as many school-level sources of variation as possible, there are likely other unmeasured school-level factors that are impacting this relationship. Additionally, Model 3 in Table 33 contains the two highly correlated school-level measures of tobacco retailer density and pharmacy density; given that the very high correlation between these two variables, the results from the logistic regression analysis used in the above sensitivity analysis should be interpreted with caution.