**The Relationship Between Schools, Friends and Smoking Initiation
in Elementary School Students**

by

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

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Abstract

Introduction: Smoking rates among senior students have been related to smoking initiation in younger students. Opportunities to select smoking friends may be one explanation, however our understanding of this process has been limited by cross-sectional designs.

Objective: The purpose of this longitudinal study was to determine whether senior student smoking rates a) predict smoking initiation in younger elementary school students, controlling for individual exposure to family and friends who smoke and b) are related to the selection of smoking friends, increasing risk of smoking initiation as a result.

Method: This study involved secondary data analysis of 2798 students from 84 Ontario elementary schools involved with the Third Waterloo Smoking Prevention Project (WSPP3). Grade 8 students completed a questionnaire at baseline to obtain the percentage of senior students who smoke in each school. Students in grade 6 completed a similar questionnaire at baseline, and were surveyed again in grades 7 and 8. Multilevel regression analyses were used to examine school and individual characteristics simultaneously.

Results: Each 5% increase in the senior student smoking rate at a school increased the risk that a non-smoking grade 6 student would try smoking more than once by grade 8 (OR 1.05) and that a non-smoking grade 6 student with no smoking friends would gain a smoking friend by grade 7 (OR 1.10). Students who remained non-smokers in grade 7 but gained a smoking friend were more likely to try smoking more than once by grade 8 (OR 4.31).

Conclusion: In schools where a high proportion of senior students smoked, younger students were more likely to initiate smoking, and gain a smoking friend. Anti-smoking policies and interventions may be more urgently required in these schools to lower senior student smoking rates and reduce initiation among younger students. Tailoring the intensity and content of programs to match the needs of schools is one way to potentially maximize effectiveness.

Table of Contents

List of Appendices

List of Tables

List of Figures

1.0 Introduction

Tobacco use is the single most preventable cause of death in Canada (Makomaski Illing & Kaiserman, 2002). The average age of first trying a cigarette is 11 (Health Canada 2003; Health Canada, 1996) and 23% of Canadian youth have tried smoking before grade 9 (Health Canada, 2005). Early age of initiation is associated with increased risk of becoming a regular smoker, higher frequency of cigarette consumption, and less success with cessation efforts (Breslau & Peterson, 1996). Even youth who smoke at relatively low levels have a high probability of becoming regular smokers as adults (Mermelstein et al., 2002) and consequently increase their risk of morbidity and mortality later in life. Preventing smoking initiation among youth remains a public health priority.

The social environment has long been cited as an important factor in the smoking initiation process (Byrne, Byrne & Reinhart, 1993; Chassin, Clark, Presson, Sherman & Olshavsky, 1984). School-based prevention programs are one component of a comprehensive tobacco use reduction strategy. Many school-based smoking prevention initiatives have been developed (Manske, Brown & Cameron, 1997), but they have had limited success (Wiehe, Garrison, Christakis, Ebel & Rivara, 2005). Research has demonstrated that program effectiveness may depend on both student-level characteristics, such as exposure to family and friends who smoke (Best et al., 1984), and school-level characteristics, such as the rate of smoking in senior students (Cameron et al., 1999).

Smoking rates vary across schools (Ellickson, Bird, Orlando, Klein & McCaffrey, 2003; Ennett & Bauman, 1993; Maes & Lievens, 2003), although reasons for this are unclear. Ecological studies have revealed that variations in health behaviours may be due to the place, clustering of similar individuals within a place, or a combination of both factors (Diez-Roux, 2000; Duncan, Jones & Moon, 1998; Frolich, Potvin, Gauvin & Chabot, 2002). The

application of this knowledge to studies addressing school influence has been limited (Aveyard, Markham & Cheng 2004). A recent study by Aveyard and colleagues (2005) concluded that school variation in smoking is not caused solely by pupil composition but rather unidentified contextual influences. There is a need to disentangle the effects of school risk factors from individual risk factors to further our understanding of the impact of the social environment on youth smoking, so that prevention and cessation programs can be tailored to better suit the needs of students and schools.

2.0 Review of the Literature

2.1 Social Cognitive Theory

Social Cognitive Theory (SCT) provides a framework for studying behavioural influences in the social environment. SCT recognizes that behaviour is dynamic and influenced simultaneously by individuals and their surroundings (Bandura, 1986). According to SCT, both student and school characteristics, as well as interactions between these characteristics, are important to smoking initiation. SCT can help explain why similar students who attend different schools may develop different patterns of smoking behaviour.

SCT states that behaviour is influenced through observational learning (Bandura, 1986). By observing smokers and evaluating the response, an adolescent forms rules of behaviour which serve as a guide for their own action in future situations. The direction and strength of the impact depends on the adolescent's ability to execute the behaviour, perceptions of the modeled action as producing rewards or punishments, and the inference that similar or unlike consequences would result if they themselves were to perform the modeled behaviour. Models perceived as attractive, interesting, nurturing and desirable are

more likely to be influential (Bandura, 1986). Friends, family members and older students are potential models for smoking behaviour and their influence has been empirically supported.

2.2   Influence of Family and Friends on Smoking Initiation

Youth exposed to a parent, older sibling, or close friend who smokes are at increased risk for smoking initiation, although the strength of this influence varies. Reviews suggest that older sibling smoking is more strongly related to initiation than parental smoking, and the association with friend smoking is stronger still (Avenevoli & Merikangas, 2003; Tyas & Pederson, 1998).

Current smoking of at least one parent appears to be more closely related to adolescent smoking frequency than past parental smoking or cessation (Chassin, Presson, Rose, Sherman & Prost, 2002; Farkas, Distefan, Choi, Gilpin, & Pierce, 1999) however the influence of parental smoking may depend on age. Vitaro, Wanner, Brendgen, Grosselin and Gendreau (2004) found that parental smoking was related to smoking initiation only until age 13. Having an older brother or sister who smokes increases the likelihood that an adolescent will start to smoke (Chassin et al., 1984; Needle et al., 1986) regardless of whether an adolescent has a smoking parent or not (Rajan et al., 2003).

Smoking behaviour of close friends is strongly and consistently predictive of adolescent smoking in prospective studies (Flay et al., 1994; Santi, Best, Brown & Cargo, 1991; Simons-Morton, 2002; Urberg, Degirmenciolgu & Pilgrim, 1997; Vitaro et al., 2004; Wang, 2001) and the influence is generally robust across definitions (i.e. best friend, close friends) (Avenevoli & Merikangas, 2003). Both long- and short-term relationships are influential (Urberg et al., 1997). Hussong (2002) found that adolescents who were heavily embedded in substance-using peer contexts (i.e. best friend, clique and social crowd use)

were more likely to use substances themselves, although findings were not specific to cigarettes. Parental smoking has also been related to adolescent affiliation with smoking friends (Chassin, Presson, Todd, Rose & Sherman, 1998; Engels, Vitaro, Den Exter Blokland, de Kemp & Scholte, 2004; Melby, Conger, Conger & Lorenz, 1993).

In summary, evidence suggests that youth exposed to even one smoking parent, older sibling or close friend are at increased risk for smoking than youth with no exposure to family or friends who smoke. Exposure to smokers in two or three of these social model groups increases the risk that an adolescent will start smoking in elementary school (Best et al.,1984; Flay et al., 1985) and smoke regularly in high school (Flay et al., 1989) compared to youth who have no smoking parents, siblings or friends.

2.3   School Smoking Prevalence and Smoking Initiation

While many studies have demonstrated that perceived high smoking prevalence rates in schools increase risk of smoking (Botvin, Botvin, Baker, Dusenbury, & Goldberg, 1992; Chassin et al., 1984; Jackson, 1997; Simons-Morton, 2002; Sussman et al., 1988), there is limited research available on the effects of actual student smoking rates. Six studies that examined the relationship between actual school smoking prevalence rates and onset of smoking behaviour are reviewed here. The measures of school smoking prevalence employed varied from same grade peers to senior students. Accumulating evidence suggests a positive association between the rate of smoking among senior students and smoking initiation among younger students.

Patton et al. (1998) followed grade 9 students for three years and found no evidence that the smoking prevalence rate among the study cohort at baseline was related to future individual smoking initiation or cessation behaviours. There was some indication that

4

students attending schools with the highest smoking prevalence rates were less likely to quit smoking than those attending schools where fewer of their peers smoked, however this relationship weakened when personal smoking history was added to the analysis. A notable limitation of this study was the lack of a control variable addressing the smoking behaviour of close friends, one of the strongest predictors of smoking behaviour (Avenevoli & Merikangas, 2003; Tyas & Pederson, 1998).

Ellickson et al. (2003) found that smoking rates among same grade peers (grade 7) did not predict individual smoking one year later, although perceived smoking behaviour of older (grade 8) students was significantly related to individual smoking one year later. This effect was lessened by close friend use and frequency of cigarette offers in grade 7 but remained significant. Actual smoking rates among the older students were not available for this study.

Santi et al. (1991) were the first to report that risk of smoking in younger students is greatest in schools in which the smoking rate is high among the most senior students. In a longitudinal study of grade 6 students, the rate of smoking in senior (grade 8) students at baseline was related to the risk of the study cohort trying more than one cigarette over the next two years. However, when the study cohort started high-school in grade 9, the rate of smoking among senior (grade 11) students was not related to changes in smoking behaviour over the next two years. Due to the exploratory nature of this study, individual exposure to family and friend smoking was included in the analysis only after controlling for school and community variables, so it is unclear whether the observed relationships between senior student smoking and initiation in younger students would have remained when controlling for individual risk factors.

A series of cross-sectional analyses conducted with data from the School Smoking Profile Project (for details see Leatherdale, Cameron, Brown and McDonald, 2005) has revealed consistent, significant relationships between older student smoking and various stages of smoking onset among younger students, in both elementary and high-school students. Leatherdale and Manske (2005) found that the likelihood of a grade 6 or 7 student smoking at least one cigarette increased as the percentage of smoking senior (grade 8) students in a school increased. Students who were not exposed to smoking by their family or close friends were over twice as likely to smoke at least one cigarette if they attended a school where a high percent of senior students smoked, compared to similar students who attended a school where fewer senior students smoked.

Leatherdale, Cameron, Brown and McDonald (2005) found that in high-schools with an above average rate of senior (grades 12 and OAC[1]) student smoking, younger (grades 9, 10, and 11) students were more likely to be experimental smokers than tried-once smokers, meaning they had smoked more than once in the 30 days prior to the survey but smoked less than every or almost every day. The influence of high prevalence schools appeared to have the most impact on students with fewer smoking friends. Due to the cross-sectional design of the study, it is not clear whether students started to smoke before or after they select smoking friends, and how the senior student smoking rate at a school may influence that relationship.

Leatherdale, McDonald, Cameron and Brown (in press) found that as the prevalence of senior (grades 12 and OAC) student smoking increased, so did the likelihood that younger (grade 9, 10 and 11) students would be an occasional smoker versus a never smoker, and a regular smoker versus an occasional smoker. Significant contextual interactions were again

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[1] At the time of the survey, Ontario high-schools offered Ontario Academic Credits (OAC) for university-bound students. A student in OAC would normally have completed grade 12 and be in their fifth year of high school.

discovered between the senior student smoking rate at a school and the number of close friends a student had who smoked. As rates of senior student smoking increased, students with fewer close friends who smoked were more likely to be occasional smokers, while students with more close friends who smoked were more likely to be regular smokers. The cross-sectional design prevented any causal inferences.

2.4   School Smoking Prevalence and Selection of Smoking Friends

The common similarity between friend smoking and adolescent smoking is due to two processes: selection of friends with similar smoking habits, and socialization of youth to begin or maintain smoking habits similar to their friends (Cleveland & Wiebe, 2003; Ennett & Bauman 1994). Since most friendships in elementary school youth are formed at school and non-smokers typically select non-smoking friends (Ennett & Bauman 1994), a logical assumption would be that non-smokers who attend schools with a high smoking prevalence have fewer opportunities to select non-smoking friends and thereby increase their likelihood of future smoking. Conversely, students who smoke or are susceptible to smoking, that attend schools with a low smoking prevalence, may have fewer opportunities to develop friendships with smokers and thereby decrease their risk for future smoking.

Two existing studies provide evidence to support this relationship. Alexander, Piazza, Mekos and Valente (2001) found that in schools where smoking prevalence was high, popular students (determined by peer network linkages) were more likely to smoke than in schools where smoking prevalence was low, even after controlling for the smoking behaviour of close friends. Cleveland and Wiebe (2003) discovered that as school smoking prevalence increased, so did the similarity between student and friend cigarette use. Since both studies were based on cross-sectional findings, the processes of selection and socialization could not

be separated and the impact of school smoking prevalence on these processes remains unclear.

3.0 Study Purpose and Research Questions

Senior student smoking rates have been consistently related to smoking initiation in younger students, although our understanding of this process is limited by cross-sectional designs. A longitudinal study could help clarify whether rates of smoking among senior students at a school predict smoking initiation among younger students, while controlling for the possibility that some schools may contain more students at high risk for smoking based on their individual exposure to smoking social models. In other words, a longitudinal study could help separate student composition from the effects of school context over time (Aveyard et al., 2005).

The relationship between senior student smoking prevalence and peer selection has not previously been examined longitudinally. Since smoking friends are a risk factor for initiation, and non-smokers do not typically select smoking friends (Ennett & Bauman, 1994), it is important to determine if senior student smoking rates at a school are related to the likelihood that non-smoking students may acquire smoking friends, and thereby increase their risk of smoking in the future. This study will help clarify findings identified by previous cross-sectional analyses (Alexander et al., 2001; Cleveland & Wiebe, 2003; Leatherdale et al., 2005; in press) and address the call for a better understanding of the pathways by which schools may affect adolescent health behaviour (Aveyard et al., 2004; Maes & Lievens, 2003).

3.1 Research Questions

1. What is the relationship between the senior student smoking prevalence in a school and the likelihood that a non-smoking grade 6 student will smoke more than once by grade 8?

2. What is the relationship between the senior student smoking prevalence in a school and the likelihood that a non-smoking grade 6 student with no smoking friends will acquire one or more smoking friends by grade 7?

3. What is the likelihood that a non-smoking grade 6 student with no smoking friends who remained a non-smoker in grade 7, but gained a smoking friend, will try smoking more than once by grade 8?

4.0 Methods

4.1 Study Overview

This study involved secondary analysis of longitudinal data collected from elementary school students involved in the third Waterloo Smoking Prevention Project (WSPP3) from 1989-1992. WSPP3 (1988-1997) was a long-term evaluation of the effectiveness of a smoking prevention program in elementary and high-schools. Details of intervention conditions, the sampling procedures and data collection methods for WSSP3 have been described in detail elsewhere (Cameron et al., 1999). A brief summary is included in this report.

4.2 Sampling Procedures

4.2.1 School Recruitment

Ten school boards in five southwestern Ontario communities were approached to participate in the study. One board declined participation due to budget cuts, and two

declined because of cited inconsistencies between the intervention and their approach to smoking prevention. From the seven consenting school boards, one hundred eligible (schools that contained grades 6, 7, and 8) elementary schools were recruited. School recruitment rates ranged from 65% in one board to 100% in four boards.

4.2.2 Student Recruitment

Six of the seven school boards agreed to a passive informed consent procedure. Parents of grade 6 and grade 8 students in participating schools were mailed an information letter. Students were eligible to participate if parents did not indicate their refusal by returning a self-addressed stamped reply card. The seventh board required active consent for research participation. Parents were required to return a signed consent form. The final decision to participate in all school boards was made by individual students during data collection sessions.

4.3 Intervention Conditions

Schools were assigned randomly into five study conditions (four treatment and one control) to assess the impact of provider type and training method on program effectiveness (see Cameron et al., 1999). After baseline data collection, the intervention was administered in six weekly 40 minute sessions during grade 6, in three weekly 40 minute sessions during grade 7, and in six weekly 40 minute sessions during grade 8.

4.4 Data Collection Procedure

Senior (grade 8) students in each school were surveyed at baseline when the study cohort was in grade 6 (Fall 1989). The study cohort was surveyed at three time points: before the intervention curriculum was delivered in grade 6 (Winter 1990), at the end of grade 7

(Spring 1991), and at the end of grade 8 (Spring 1992). At each data collection point a questionnaire (see section 4.5) was administered to cohort students by trained data collectors using standardized procedures. Confidentiality of responses was assured, and pre-announced breath samples were collected to enhance the honesty of self-reported smoking behaviour (Patrick et al., 1994). Follow-up sessions were arranged with absent students.

4.5   Measures

A pencil and paper questionnaire was used to collect data on student demographics, smoking behaviour, reasons for smoking and other psychosocial characteristics. Separate questionnaires were used for the senior students at baseline and the grade 6 study cohort. The demographic and smoking behaviour items used in this study were consistent across all versions of the questionnaire. Copies of these questions are included in Appendix A.

4.6   Operational Definitions

4.6.1   Study Cohort Smoking Status

A *non-smoker* was defined as someone who had never tried smoking, or had only tried smoking once. *Smoking initiation* was defined as trying a cigarette more than once. The coding procedures used to determine smoking status among students in the study cohort are outlined in Table 1.

Table 1: Operational Definitions and Variable Coding Procedures Used to Classify Smoking Status among Students in Study Cohort

Smoking Status	Operational Definition	Q4: Have you ever smoked? This means even one puff of one cigarette.	Q5: Have you ever smoked again since the first time you tried a cigarette?	Q6: Do you usually smoke every week? (Even if it is only one puff of one cigarette.)
Non-Smoker	never smoked even one puff of a cigarette or	No	I have never smoked	I have never smoked
	has smoked, but only once	Yes	No	No, I have only tried once
Smoking Initiation	has smoked more than once	Yes	Yes	⎯⎯

4.6.2   Senior Student Smoking Prevalence

Senior student smoking prevalence was represented by a ratio variable (0-100), indicating the proportion of senior (grade 8) students in each school who reported that they currently smoked, either less than once or at least once per week. Table 2 outlines the coding procedures used to determine smoking status among senior students.

Table 2: Operational Definitions and Variable Coding Procedures Used to Classify Smoking Status among Senior Students

Smoking Status	Operational Definition	Q4: Have you ever smoked? This means even one puff of one cigarette.	Q5: Have you ever smoked again since the first time you tried a cigarette?	Q6: Do you usually smoke every week? (Even if it is only one puff of one cigarette.)
Non-Smoker	never smoked even one puff of a cigarette *or*	No	I have never smoked	I have never smoked
	has smoked, but only once *or*	Yes	No	No, I have only tried once
	has smoked more than once but has quit for good	Yes	Yes	No, I have quit.
Smoker	currently smokes, but less than once per week *or*	Yes	Yes	No, I don't smoke that often
	currently smokes at least once per week or more	Yes	Yes	Yes

4.6.3 Family and Friend Smoking

Parent and older sibling smoking were each classified as a categorical (yes/no) variable. Students were considered to have a smoking parent if they indicated that either their mother or father smoked while they were in grade 6. Students were considered to have an older sibling who smoked if they indicated that they had an older brother and/or sister who smoked while they were in grade 6. Students who reported that that their father or mother used to smoke, or that they did not know if the respective family member smoked, or that they did not have the respective family member were considered to have a non-smoking

parent or older sibling. Friend smoking was classified as an ordinal variable (0-5) and measured by one item: "How many of your five closest friends smoke cigarettes?" Table 3 (Appendix B) lists the operational definitions and variable coding procedures for family and friend smoking.

4.6.4   Covariates

Table 3 (Appendix B) lists the operational definitions and variable coding procedures for the covariates included in this study. A brief description of each is included here.

4.6.4.1   School-Level Covariates

Three school-level variables were identified as potential confounders and were included as covariates in this study. Intervention condition had been previously related to smoking outcomes in the study cohort in higher prevalence schools (Cameron et al., 1999) and was classified as a categorical variable with one indicator for each condition. Since larger schools may present more opportunities to select smoking friends, the size of the student population was included as a covariate. School size was classified as a ratio variable determined by the total number of grade 6 students in each school invited to participate in the study at baseline. Finally, school board was included as a proxy for geographic area and to monitor whether any school-level effects discovered were contained in a specific school board. School board was classified as a categorical variable with one indicator for each board.

4.6.4.2   Student-Level Covariates

Gender is commonly related to adolescent smoking onset in published literature. During the period of data collection, boys typically started to smoke earlier than girls (Santi et al., 1991) and even now may smoke more often than girls (Cleveland & Wiebe, 2003;

14

Health Canada 2005). Gender was classified as a dichotomous categorical variable (male=0, female=1) and identified by responses to the question "Which are you?".

4.7   Study Sample and Inclusion Criteria

4.7.1   Schools

The average senior student participation rate among the 85 passive consent schools (87.6%) was substantially higher than that of the 15 active consent schools (63.7%). A similar pattern existed for the grade 6 cohort students where the average participation rate among passive consent schools (83.6%) was substantially higher than active consent schools (66.9%). Since smokers are usually less likely to participate in studies than are non-smokers (Severson & Biglan, 1989), senior student smoking rates in the active schools may have been underestimated. In order to minimize the potential for selection bias, only schools that used passive consent procedures were included in the study sample.[2] One school closed during the study period and was eliminated from the study sample. The study sample therefore contained 84 schools that used passive consent procedures and remained operational throughout the three year study period.

4.7.2   Senior Students

The 84 schools included in the study sample contained 5191 grade 8 students invited to complete the senior student survey at baseline of whom 4397 (84.7%) provided data.

4.7.3   Study Cohort

Students were included in this study if they were a non-smoker in grade 6, completed the survey for three consecutive years, and remained in the same school during the study

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[2] All analyses were conducted with and without the active consent schools included in the study sample. Results were significantly different depending on which sample was used. Excluding schools that used the active method of recruitment was favoured in order to produce the most unbiased estimates possible.

period. The 84 schools included in the study sample contained 5051 grade 6 students invited

to participate in the study of whom 3941 (78.0%) provided data in grade 6. Of these students,

3489 (88.7%) were classified as non-smokers. Non-smokers who did not complete the survey

in either grade 7 or grade 8 (11.7%), changed schools during the study period (7.8%), and

whose smoking status could not be classified in grade 7 or 8 (.003%) were excluded yielding

a final cohort of 2798 grade 6 students. Research Question 2 utilized a sub-sample of 2430

(86.9%) students who had no smoking friends in grade 6. Research Question 3 further limited

this sub-sample to the 2284 (81.6%) students with no smoking friends in grade 6 who were

still non-smokers in grade 7. Figure 1 illustrates the sample selection process.
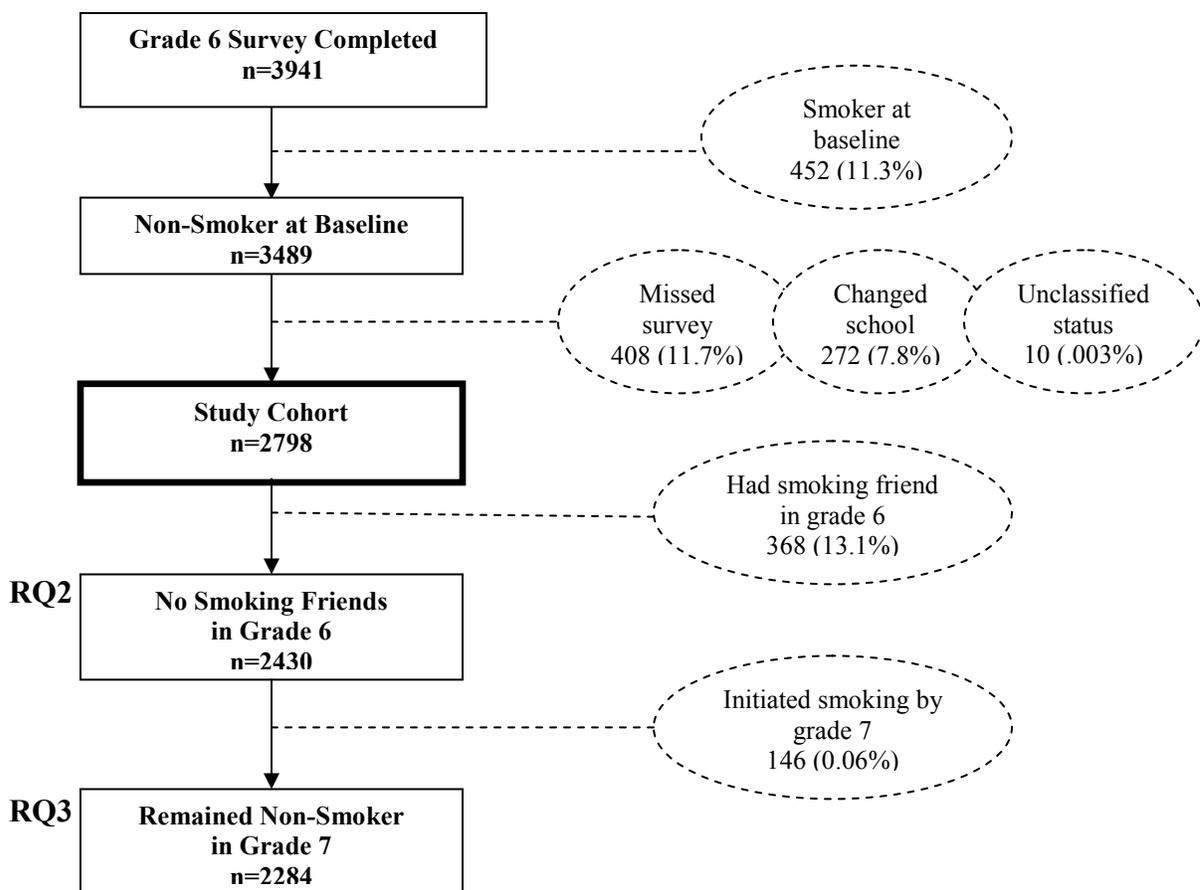
Figure 1: Sample Selection Process for Study Cohort and Sub-Samples

5.0 Data Analysis

5.1 Benefits of a Multilevel Modelling Approach

Studies that recruit students from more than one school must recognize that similar students tend to congregate within schools (Aveyard et al., 2004), and the resulting observations are not entirely independent. Consequently, greater variation in smoking behaviour can be expected between schools than within schools. Multilevel modeling can be used to examine data from individuals nested within schools to avoid producing incorrect inferences (Diez-Roux, 1998).

Multilevel modeling is ideal for examining outcomes at one level as a function of variables defined at another, higher level (Diez-Roux, 2000). A two-level model allows determination of individual change within a contextual setting (Duncan, Jones & Moon, 1996). In this study, a two-level model was used where schools comprised the higher level (level 2) and students within these schools constituted the lower level (level 1). Figure 2 illustrates this model (Appendix C). By working at more than one level, student composition can be separated from school contextual differences (Duncan et al., 1996) and the ecological (using school-level data at the student-level) and atomistic (using student-level data at the school-level) fallacies can be avoided (Diez-Roux, 1998). Multilevel modelling can be used to examine why students with similar characteristics may not behave the same way in different types of schools.

5.2 Data Analysis Procedures

The first step in data analysis was to compare students included and excluded from the study cohort using a multilevel logistic regression model containing all school- and student-level variables. Similar comparisons were performed with students included and

17

excluded from the sub-samples used for Research Questions 2 and 3. Descriptive summary statistics were calculated for the baseline characteristics of the grade 6 study cohort and the schools included in the study.

To address the student outcomes outlined in the research questions, multilevel logistic regression models were constructed in three phases. In the first phase, an empty model was created to determine whether there was significant variation in student outcomes among study schools. In the second phase, a model containing all school-level variables was constructed to determine any direct effects of senior student smoking prevalence on student outcomes. In the third phase, a model containing all school-level and student-level variables was constructed to determine the direct effects of senior student smoking prevalence on student outcomes while controlling for student-level influences. All variables were entered as non-centered fixed parameters. All analyses were conducted using SAS 9.1 for Windows and the GLIMMIX procedure was used for multilevel analyses.

6.0 Results

6.1 Comparison of Retained Sample vs. Portion Lost to Follow-up

Of the 3489 non-smokers providing data in grade 6, 2798 (80.2%) were retained in the study sample and 691 (19.8%) were not. Students were more likely to be excluded if they were male (p<.05), had a parent or close friend who smoked (p<.0001), and as their school level of senior student smoking increased (p<.05). Significant differences were noted between those retained and those lost by school board (p<.001). No significant differences were seen by school size, intervention condition or older sibling smoking.

6.2 Descriptive Statistics

6.2.1 Students in Study Cohort

Table 4 presents summary statistics of the grade 6 students. The study cohort contained fewer males than females (48.0% vs. 52.0%) (χ^2 = 4.65, p<.05). Almost half (43.2%) of students had at least one parent who smoked, while very few had an older sibling (10.8%) or close friend (13.1%) who smoked while the student was in grade 6.

Table 4: Descriptive Summary of Student-Level Characteristics at Baseline

Characteristic		%	(N)
Gender	Female	52.0	1456
	Male	48.0	1342
Parent Smoking	None	56.8	1590
	One or More	43.2	1208
Older Sibling Smoking	None	89.2	2497
	One or More	10.8	301
Close Friend Smoking	None	86.9	2430
	One or More	13.1	368

By grade 7, 12.9% (361) of the non-smoking grade 6 students in the study cohort had tried smoking more than once (Figure 3). By grade 8, 27% (756) of the non-smoking grade 6 students in the study cohort had tried smoking more than once.
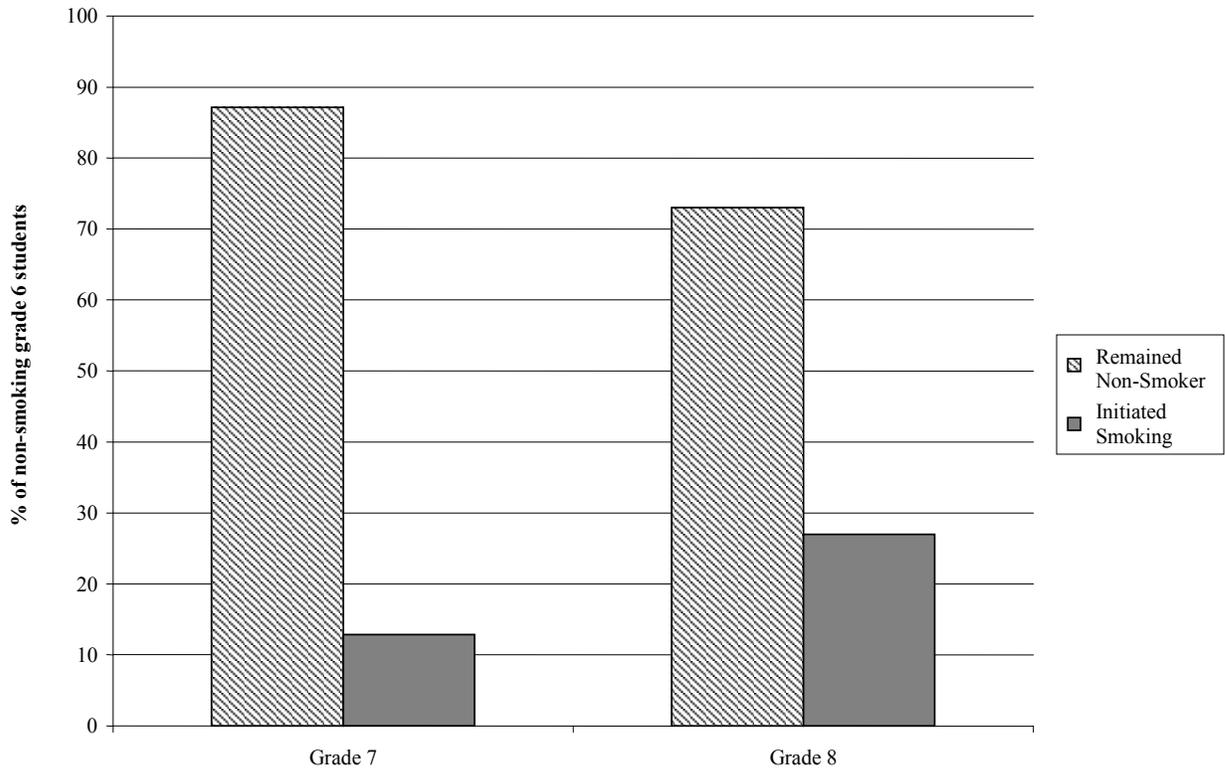
Figure 3: Proportion of Non-Smoking Grade 6 Students Initiating Smoking by Grade 7 and Grade 8

6.2.2 School Characteristics

The 84 schools in the study sample belonged to six different school boards: four school boards included 15 study schools, one included 14 study schools (where the school closure occurred) and one included 10 schools. Schools were distributed equally among the intervention conditions. The average number of grade 6 students in each school was 56.4 (s=52.7) and ranged from 10-241. Senior student smoking prevalence rates for each school are shown in rank order in Figure 4. The average senior student smoking prevalence among the study schools was 14.9% (s=11.1) and ranged from 0% to 66.7%. Five schools had a senior student smoking rate of 0%.
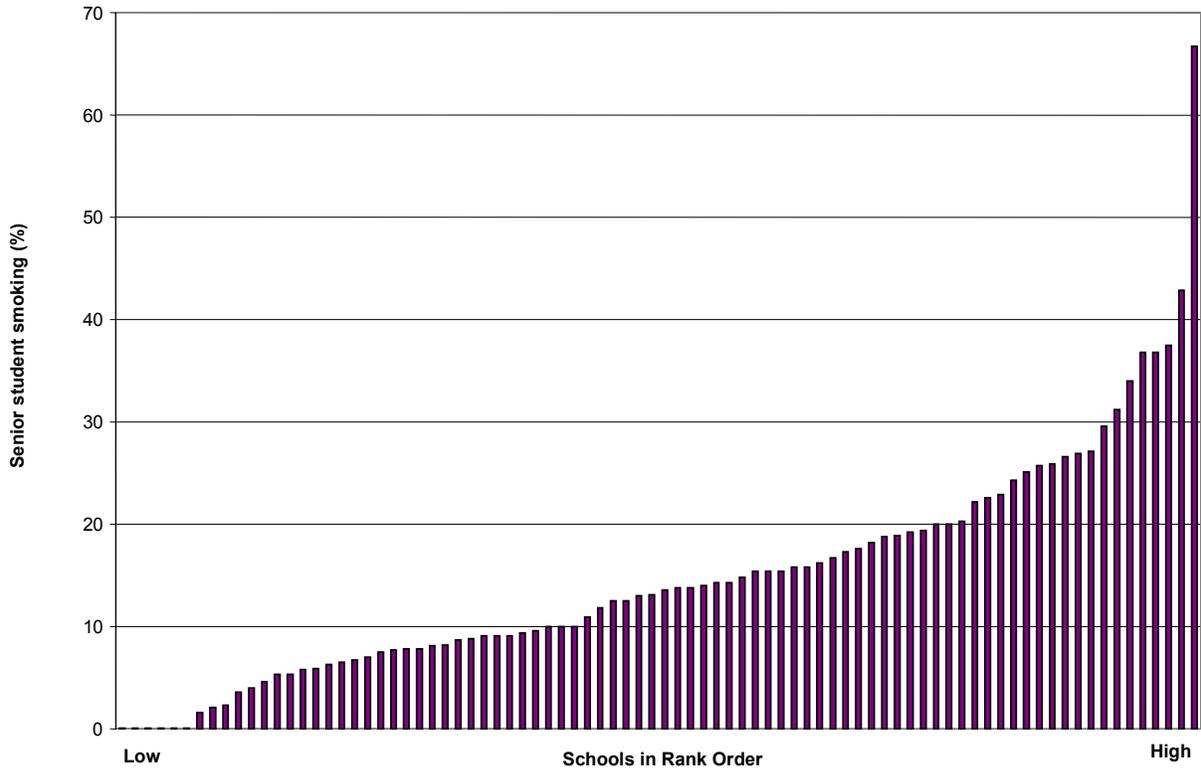
Figure 4: Senior Student Smoking Rates at Baseline among Study Schools Ranked Lowest to Highest.

6.3 *Research Question 1:* **Effect of School Prevalence on Smoking Initiation**

Of the 2798 non-smoking grade 6 students in the study cohort, 756 (27%) tried smoking more than once by grade 8. Table 5 presents the combined results of the multilevel logistic regression models examining the contribution of school and student level characteristics to smoking initiation outcomes in grade 8.

Table 5: Multilevel Analysis of Variables Related to the Odds of Smoking Initiation by Grade 8 among Students who were Non-Smokers in Grade 6

Parameter		Model 1	Model 2	Model 3
		Model Estimates (Standard Error)		
Fixed	Intercept	-0.976 (0.071)	-0.929 (0.333)	-1.551(0.341)
STUDENT-LEVEL				
Gender				0.108 (0.090)
Parent Smoking				0.537 (0.091)
Older Sibling Smoking				0.863 (0.131)
Close Friend Smoking				0.864(0.122)
SCHOOL-LEVEL				
Senior Student Smoking Prevalence			0.016 (0.007)	0.014 (0.007)
Size of Student Population			-0.001 (0.002)	-0.001 (0.002)
School Board	A		0.377 (0.209)	0.348 (0.207)
	B		-0.255 (0.283)	-0.142 (0.283)
	C		0.055 (0.308)	0.004 (0.309)
	D		0.114 (0.304)	0.064 (0.306)
	E		-0.333 (0.298)	-0.252 (0.299)
	F		-	-
Intervention Condition	1		-0.016 (0.208)	0.043 (0.207)
	2		-0.292 (0.215)	-0.301 (0.214)
	3		-0.340 (0.207)	-0.292 (0.206)
	4		-0.387 (0.212)	-0.351(0.211)
(control)	5		-	-
Random				
School-Level Random Variance $\sigma^2{}_{\mu 0}$		0.209 (0.070)	0.161 (0.065)	0.148 (0.062)

Model 1 examined school-level differences in the odds of trying a cigarette more than once by grade 8. Significant [$\sigma^2{}_{\mu 0}$ = 0.209 (0.070), p<.01] between school random variation was identified.

Model 2 examined the influence of senior student smoking prevalence on the odds of trying a cigarette more than once, controlling for school size, board, and intervention condition. Senior student smoking prevalence was significantly related to the odds of smoking initiation by grade 8 ($\hat{\beta}$ = 0.016, p<.05).

Model 3 examined both the influence of senior student smoking prevalence and the influence of student-level social models on the odds of trying a cigarette more than once by

grade 8. Senior student smoking prevalence remained significant after controlling for individual student characteristics ($\hat{\beta}$ = 0.014, p=.05). Table 6 presents the estimated odds ratios for this model.

Table 6: Estimated Odds Ratios for Smoking Initiation by Grade 8 among Students who were Non-Smokers in Grade 6

		Odds Ratio (95% CI)	
STUDENT-LEVEL			
Gender		1.11 (0.93, 1.33)	
Parent Smoking		1.71 (1.43, 2.04)	**
Older Sibling Smoking		2.37 (1.83, 3.07)	**
Close Friend Smoking		2.37 (1.87, 3.01)	**
SCHOOL-LEVEL			
Senior Student Smoking Prevalence (5% interval)		1.05 (1.00,1.16)	*
Size of Student Population		0.99 (0.99, 1.00)	
School Board	A	1.42 (0.94, 2.13)	
	B	0.87 (0.50, 1.51)	
	C	1.00 (0.55, 1.84)	
	D	1.07 (0.59, 1.94)	
	E	0.78 (0.43, 1.40	
	F	-	
Intervention Condition	1	1.04 (0.70, 1.57)	
	2	0.74 (0.49, 1.13)	
	3	0.75 (0.50, 1.12)	
	4	1.00 (0.47, 1.06)	
(control)	5	-	
*=p≤ .05, **=p<.0001		CI = Confidence Interval	

Each 5% increase in the smoking rate among senior students at baseline increased the odds that a grade 6 student would try smoking more than once by grade 8 ($\hat{}$OR 1.05). This relationship is illustrated in Figure 5. The odds of a student trying smoking more than once by grade 8 also increased if they had a parent who smoked ($\hat{}$OR 1.71), an older sibling who smoked ($\hat{}$OR 2.37) or a close friend who smoked ($\hat{}$OR 2.37). Gender and the size of the student population in a student's school were not significantly related to the odds of trying a cigarette more than once by grade 8.
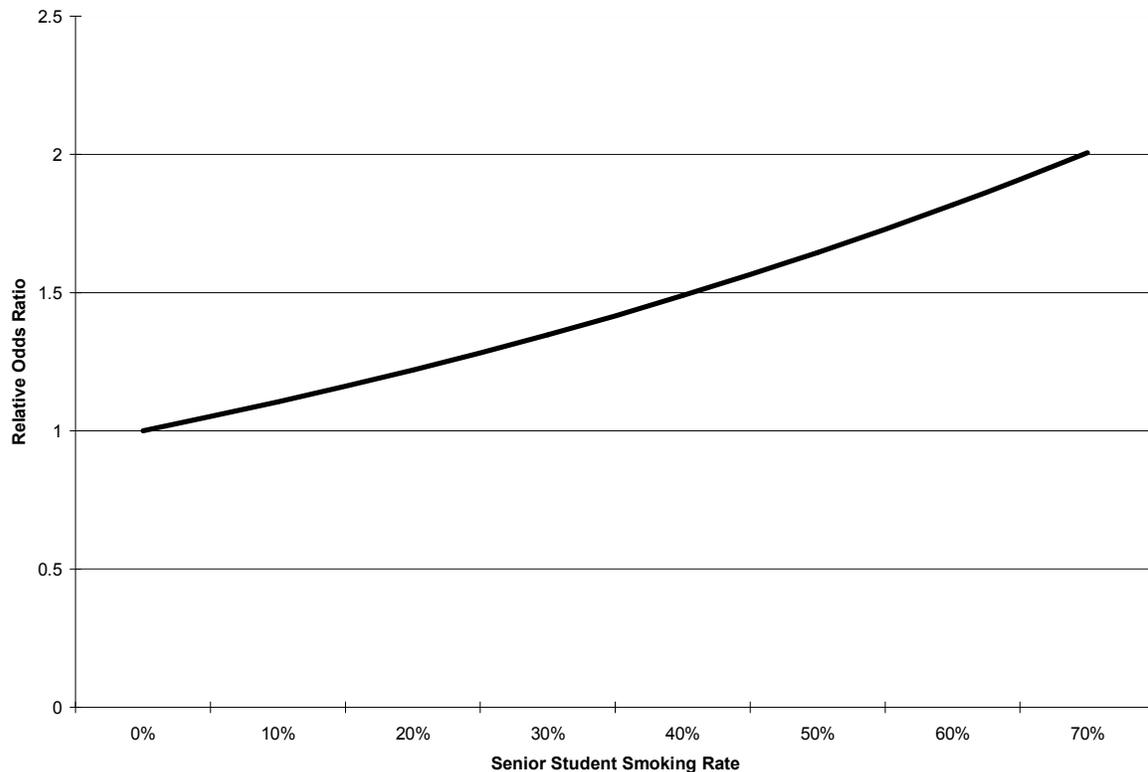
Figure 5: Estimated Odds Ratios for Smoking Initiation by Grade 8 as a Function of the Senior Student Smoking Rate at a School among Students who were Non-Smokers in Grade 6

6.4 *Research Question 2:* Effect of School Prevalence on Friend Selection

A sub-sample of the study cohort (students with no smoking friends in grade 6) was used to address Research Question 2. Table 7 presents baseline characteristics of students with and without a smoking friend in grade 6. A multilevel logistic regression model was constructed to compare students included and excluded from this sub-sample. Students with a parent (p<.01) or an older sibling (p<.001) who smoked were more likely to have a smoking friend in grade 6 and be excluded from the sub-sample used to investigate Research Question

2. No significant differences were seen by gender, senior student smoking rate, or size of student population controlling for assigned intervention condition.[3]

Table 7: Comparison of Student-Level Characteristics at Baseline by Close Friend Smoking Status in Grade 6

Characteristic		No Smoking Friends		One or More Smoking Friends	
		%	(N)	%	(N)
Gender	Female	87.2	1269	12.8	187
	Male	86.5	1161	13.5	181
Parent Smoking	None	89.1	1416	10.9	174
	One or More	83.9	1014	16.1	194
Older Sibling Smoking	None	87.8	2193	12.2	237
	One or More	78.7	304	21.3	64

Of the 2430 students who had no smoking friends in grade 6, 22% (n=539) gained a smoking friend by grade 7. Table 8 presents the combined results of the multilevel logistic regression models used to examine the contribution of school- and student-level characteristics to the odds of non-smoking grade 6 student with no smoking friends acquiring a smoking friend by grade 7.

Model 1 examined school-level differences in the odds of acquiring a smoking friend by grade 7. Significant [$\sigma^2_{\mu 0} = 0.297$ (0.089), p<.001] between school random variation was identified.

Model 2 examined the influence of senior student smoking prevalence on the odds of acquiring a smoking friend by grade 7, controlling for school size, board, and intervention condition. Senior student smoking prevalence was significantly related to the odds of acquiring a smoking friend by grade 7 ($\hat{\beta} = 0.020$, p<.05).

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[3] The school board variable was excluded from this model to allow for convergence.

Table 8: Multilevel Analysis of Variables Related to the Odds of Acquiring a Smoking Friend by Grade 7 among Students who had No Smoking Friends in Grade 6

Parameter		Model 1	Model 2	Model 3
		**Model Estimates (Standard Error)**		
Fixed	Intercept	-1.334 (0.085)	-1.693 (0.412)	-2.452 (0.389)
STUDENT-LEVEL				
Gender				0.431 (0.108)
Parent Smoking				0.143 (0.109)
Older Sibling Smoking				0.017 (0.175)
Smoking by Grade 7				2.087 (0.149)
SCHOOL-LEVEL				
Senior Student Smoking Prevalence			0.020 (0.009)	0.019 (0.008)
Size of Student Population			0.002 (0.002)	0.003 (0.002)
School Board	A		0.436 (0.250)	0.526 (0.223)
	B		-0.218 (0.349)	-0.033 (0.324)
	C		0.075 (0.377)	0.202 (0.353)
	D		0.196 (0.376)	0.281 (0.354)
	E		-0.014 (0.362)	0.213 (0.335)
	F		-	-
Intervention Condition	1		-0.102 (0.247)	-0.080 (0.220)
	2		-0.173 (0.254)	-0.189 (0.228)
	3		-0.245 (0.244)	-0.329 (0.221)
	4		-0.413 (0.252)	-0.401 (0.227)
(control)	5		-	-
Random *School-Level Random Variance* $\sigma^2_{\mu 0}$		0.297 (0.089)	0.215 (0.088)	0.117 (0.073)

Model 3 examined both the influence of senior student smoking prevalence and the influence of student-level social models on the odds of acquiring a smoking friend by grade 7. Senior student smoking prevalence remained significant after controlling for individual student characteristics ($\hat{\beta} = 0.019$, p<.05). Table 9 presents the estimated odds ratios for this model.

Table 9: Estimated Odds Ratios for Acquiring a Smoking Friend by Grade 7 among Students who had No Smoking Friends in Grade 6

		Odds Ratio (95% CI)	
STUDENT-LEVEL			
Gender		1.54 (1.24-1.90)	**
Parent Smoking		1.15 (0.93-1.43)	
Older Sibling Smoking		1.02 (0.72-1.43)	
Smoking by Grade 7		8.06 (6.02-10.81)	**
SCHOOL-LEVEL			
Senior Student Smoking Prevalence (5% interval)		1.10 (1.02-1.22)	*
Size of Student Population		1.00 (0.99-1.01)	
School Board	A	1.69 (1.09, 2.62)	*
	B	0.97 (0.51, 1.83)	
	C	1.22 (0.61, 2.45)	
	D	1.32 (0.66, 2.65)	
	E	1.24 (0.64, 2.39)	
	F	-	
Intervention Condition	1	0.92 (0.60, 1.42)	
	2	0.82 (0.53, 1.29)	
	3	0.72 (0.47, 1.11)	
	4	0.67 (0.43, 1.04)	
(control)	5	-	
*=p<.05, **=p<.0001		CI = Confidence Interval	

Each 5% increase in the smoking rate among senior students at baseline increased the odds that a grade 6 student with no smoking friends would acquire a smoking friend by grade 7 (^OR 1.10). Figure 6 illustrates this relationship. Females were more likely than males to gain a smoking friend (^OR 1.54). Students who smoked more than once by grade 7 were more likely to have acquired a smoking friend compared to those who remained non-smokers (^OR 8.06). The odds of a student acquiring a smoking friend by grade 7 were not affected by having a parent or older sibling who smoked in grade 6, or the size of the student population at the student's school.
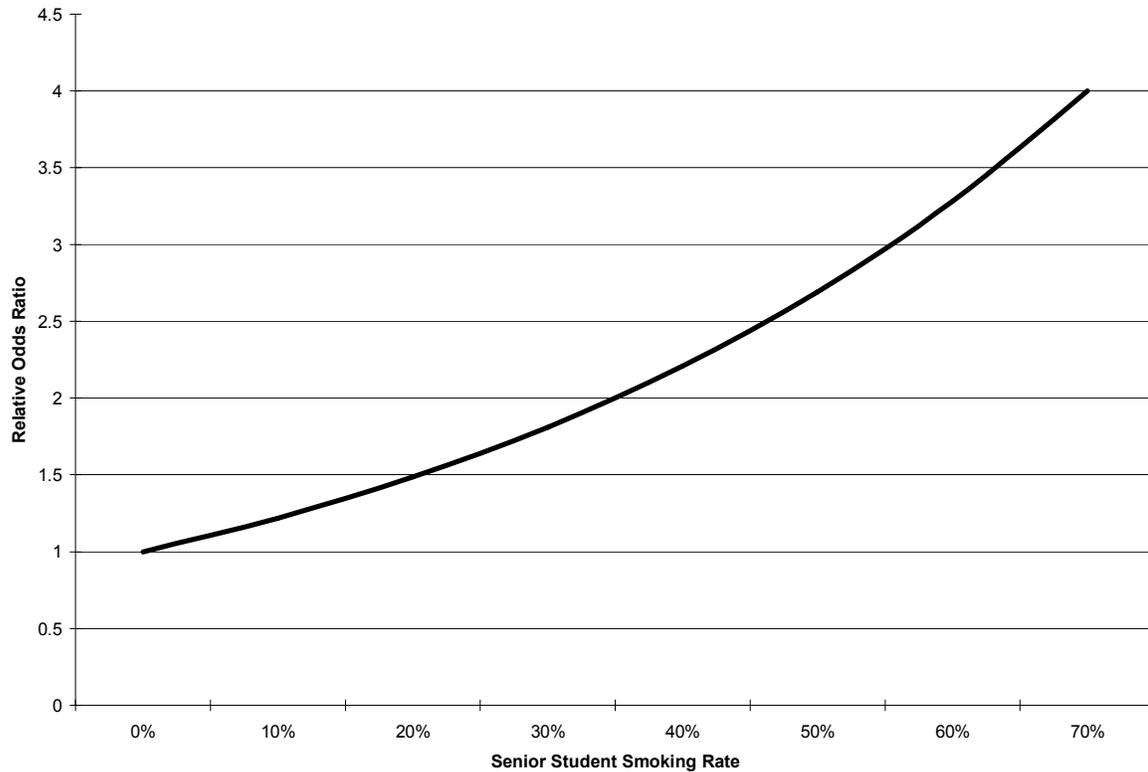
**Figure 6: Estimated Odds Ratio for Acquiring a Close Friend who Smokes by Grade 7
as a Function of the Senior Student Smoking Rate at a School among
Students who had No Smoking Friends in Grade 6**

6.5 *Research Question 3:* Effect of Friend Selection on Smoking Initiation

A sub-sample of the study cohort (students with no smoking friends in grade 6 who remained non-smokers in grade 7) was used to address Research Question 3. Table 10 compares baseline characteristics of students with no smoking friends in grade 6 by their smoking status in grade 7.

Table 10: Comparison of Baseline Characteristics by Smoking Status in Grade 7 among Students who had No Smoking Friends in Grade 6

		Grade 7 Non-Smoker		Grade 7 Smoker	
Characteristic		%	(N)	%	(N)
Gender	Female	89.7	1138	10.3	131
	Male	88.9	1032	11.1	129
Parent Smoking	None	60.4	1310	40.8	106
	One or More	39.4	860	59.2	154
Older Sibling Smoking	None	91.7	1989	78.5	204
	One or More	8.3	181	21.5	56

A multilevel logistic regression model was constructed to compare students who had smoked more than once by grade 7 and those who had not. All of these students were without smoking friends at baseline. Students with a parent (p<.0001) or an older sibling (p<.0001) who smoked at baseline were more likely to have tried smoking more than once by grade 7 and be excluded from the sub-sample used to investigate Research Question 3. No significant differences were seen by gender, senior student smoking rate, or size of student population, controlling for assigned intervention condition and school board.

Table 11 presents the combined results of the multilevel logistic regression models examining the contribution of school and student level characteristics to smoking initiation outcomes in grade 8 among students who remained non-smokers in grade 7.

Model 1 examined school-level differences in the odds of smoking initiation by grade 8 in students who had no smoking friends at baseline and remained non-smokers until the end of grade 7. Significant [$\sigma^2_{\mu 0} = 0.203$ (0.080), p<.01] between school random variation was identified.

Table 11: Multilevel Analysis of Variables Related to the Odds of Smoking Initiation by Grade 8 among Students with No Smoking Friends at Baseline who Remained Non-Smokers in Grade 7

Parameter		Model Estimates (Standard Error)		
		Model 1	Model 2	Model 3
Fixed	Intercept	-1.440 (0.079)	-1.676 (0.393)	-2.171 (0.412)
STUDENT-LEVEL				
Gender				0.052 (0.115)
Parent Smoking				0.428 (0.115)
Older Sibling Smoking				0.800 (0.175)
Smoking Friend in Grade 7				1.461 (0.123)
SCHOOL-LEVEL				
Senior Student Smoking Prevalence			0.017 (0.008)	0.013 (0.009)
Size of Student Population			0.0003 (0.002)	-0.0006(0.002)
School Board	A		0.600 (0.229)	0.420 (0.237)
	B		-0.008 (0.327)	-0.013 (0.337)
	C		0.066 (0.365)	-0.014 (0.375)
	D		0.395 (0.358)	0.275 (0.370)
	E		-0.256 (0.353)	-0.355 (0.364)
	F		-	-
Intervention Condition	1		0.120 (0.220)	0.137 (0.228)
	2		-0.342 (0.235)	-0.369 (0.243)
	3		-0.358 (0.225)	-0.292 (0.233
	4		-0.510 (0.232)	-0.459 (0.240)
(control)	5		-	-
Random				
School-Level Random Variance	$\sigma^2_{\mu0}$	0.203 (0.080)	0.126 (0.072)	0.128 (0.074)

Model 2 examined the influence of senior student smoking prevalence on the odds of smoking initiation by grade 8 in students who had no smoking friends at baseline and remained non-smokers until the end of grade 7, controlling for school size, board, and intervention condition. Senior student smoking prevalence at baseline was significantly related to the odds of a student who remained a non smoker in grade 7 smoking more than once by grade 8 ($\hat{\beta} = 0.017$, p<.05).

Model 3 examined both the influence of senior student smoking prevalence and the influence of student-level social models on the odds of a grade 7 non-smoker trying more

than one cigarette by grade 8. Senior student smoking prevalence did not remain significant

after controlling for individual student characteristics ($\hat{\beta} = 0.013$, p>.10). A student who

gained a smoking friend in grade 7 was significantly more likely to initiate smoking by grade

8 ($\hat{\beta} = 1.461$, p<.0.001). Table 12 presents the estimated odds ratios for this model.

Table 12: Estimated Odds Ratios for Smoking Initiation by Grade 8 among Students with No Smoking Friends in Grade 6 who Remained Non-Smokers in Grade 7

		Odds Ratio (95% CI)	
STUDENT-LEVEL			
Gender		1.05 (0.84-1.32)	
Parent Smoking		1.53 (1.23-1.92)	*
Older Sibling Smoking		2.23 (1.58-3.14)	**
Smoking Friend in Grade 7		4.31 (3.39-5.48)	**
SCHOOL-LEVEL			
Senior Student Smoking Prevalence (5% interval)		1.05 (0.95-1.15)	
Size of Student Population		0.99 (0.99-1.00)	
School Board	A	1.52 (0.96, 2.42)	
	B	0.99 (0.51, 1.91)	
	C	0.99 (0.47, 2.06)	
	D	1.32 (0.64, 2.72)	
	E	0.70 (0.34, 1.43)	
	F	-	
Intervention Condition	1	1.15 (0.73, 1.79)	
	2	0.69 (0.43, 1.11)	
	3	0.75 (0.47, 1.18)	
	4	0.63 (0.40, 1.01)	
(control)	5	-	
*=p<.001, **=p<.0001		CI = Confidence Interval	

Senior student smoking rates measured when the study sample was in grade 6 had no

direct effect on the odds of smoking initiation from grade 7 to grade 8 when controlling for

individual exposure to family and friend smoking. Students who were non smokers in both

grade 6 and 7 but gained a smoking friend by grade 7 were more likely to try smoking more

than once by grade 8 (^OR 4.31) compared to non-smoking students who did not acquire a

smoking friend by grade 7. Students who had a parent (ˆOR 1.53) or older sibling (ˆOR 2.23) who smoked at baseline were more likely to try a cigarette more than once by grade 8 than those without smokers in their family, regardless of whether or not they gained a smoking friend by grade 7. No significant relationship was seen between smoking initiation and gender or size of the student population in a school.

7.0 Discussion

A growing body of literature has recognized the need to identify which elements in the school environment have the potential to affect student health behaviours (Aveyard et al., 2004). This study advances previous cross-sectional findings (Leatherdale et al., 2005; in press; Leatherdale & Manske, 2005) by providing methodologically stronger evidence suggesting a positive relationship between the rate of senior student smoking at a school and smoking initiation among younger students. As the proportion of senior students who smoked increased, so did the likelihood that non-smoking grade 6 students would smoke more than once by the time they became senior students, regardless of exposure to smoking behaviour in their family or close friends. These results extend the longitudinal findings of Santi and colleagues (1991) demonstrating that the prevalence of smoking in grade 8 students at elementary schools appears to predict future smoking among younger grade 6 students, controlling for the presence of social models for smoking in immediate family and close friendship groups.

In this study, there was no significant association found between senior student smoking prevalence and smoking initiation by grade 8 among students who had no smoking friends in grade 6 and remained non-smokers in grade 7. However, a student who had no smoking friends in grade 6 and remained a non-smoker in grade 7 was more likely (OR 1.10)

to gain a smoking friend than a similar student attending a school where fewer senior

students smoked. Students who gained a smoking friend by grade 7 were four times more

likely to initiate smoking by grade 8 than students who did not gain a smoking friend.

Although it is widely recognized that adolescents with smoking friends are more likely to

become smokers themselves (Avenevoli & Merikangas, 2003; Flay et al., 1994; Santi et al.,

1991; Simons-Morton, 2002; 2004; Urberg et al., 1997; Vitaro et al., 2004; Wang, 2001), the

association between senior student smoking prevalence and the acquisition of smoking

friends is an important new finding and suggests one of the pathways by which school

context may affect smoking behaviour in elementary school students. This is of particular

concern since the social environment of an elementary school is not typically chosen by the

student and may inadvertently affect their risk for smoking above and beyond what parents

can control.

Social Cognitive Theory (Bandura, 1986) offers one explanation for these findings.

SCT suggests that by observing older students smoking, younger students may perceive this

action to produce favourable results and become more likely to try smoking themselves.

Students who attend schools with a high percentage of senior students who smoke may be

more likely to observe smoking activity on or off school property, although the occurrence of

this is probably less likely in elementary schools than in high schools. A high prevalence of

smoking among senior students may also make smoking seem more normative and

acceptable (Chang, 2004; Kumar, O'Malley, Johnston, Schulenberg & Bachman, 2002).

Since students commonly report that their reasons for smoking are for immediate social gain

or to belong (Baille, Lovato, Johnson & Kalaw, 2005) and adolescents are known to increase

desirable behaviours that receive approval in peer group in order to be well liked and

accepted (Allen, Porter, McFarland, Marsh and Boykin McElhaney, 2005), it is important to minimize both the prevalence and acceptability of smoking in the school environment.

While the observational learning component of SCT provides a rationale for the observed findings, the strength of the above inferences are restricted by the limited availability of data addressing the complete range of SCT constructs and potential confounders. An ideal study would include measures of perceived senior student smoking rates by the younger cohort, including expected outcomes of smoking with regard to peer relationships within schools (Kiesner, Poulin & Nicotra, 2003), as well as the availability of cigarettes and frequency of opportunities to smoke (Forster, Chen, Blain, Perry, & Toomey, 2003). Knowledge of additional contextual factors such as school smoking policies and enforcement procedures (Leatherdale & Manske, 2005; Novak & Clayton, 2001; Reitsma & Manske, 2004), school connectedness (Battistich & Hom, 1997; Bonny, Britto, Klosterman, Hornung & Slap, 2000; Nutbeam & Aaro, 1991) and the level of acceptance of and exposure to smoking in the surrounding neighbourhood (Cook, 2003; Leatherdale, Brown, Cameron & McDonald, in press; Wilcox, 2003) would also help specify the exact the relationship between senior student smoking and smoking initiation among younger students. Although the findings from this study are indicative of direct relationships between senior student smoking and smoking initiation, and senior student smoking and the acquisition of a close friend who smokes, the possibility that other factors are contributing to these findings cannot be ruled out.

Senior student smoking has now been found to be predictive of younger student initiation in three separate databases,[4] although all of these findings were based on data

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[4] The three databases include the School Smoking Profile Project (Leatherdale et al., 2005; in press; Leatherdale & Manske, 2005), Waterloo Smoking Prevention Project 2 (Santi et al., 1991), and WSSP3 (the present study).

collected from Ontario students, primarily in the Southern region. This limits the extent to which accumulated evidence, and specifically the findings from this study, can be applied to other geographic regions. The link between senior student smoking and smoking initiation in younger elementary school students does show some consistency over time however.

Santi et al. (1991) report on elementary school data collected from 1983-1986, during which time rates of smoking among Ontario youth in grade 7 declined from approximately 15% to 10% (Adlaf & Paglia, 2003). Data for the present study were collected from 1989-1992, when rates held fairly steady at around 7%. Data collection for the present study occurred prior to the implementation of the Tobacco Control Act in Ontario which banned smoking on school property and the sale of cigarettes to minors under age 19, and the concurrent cigarette tax reduction which sparked a huge increase of youth smoking in the late 90s, imitating rates observed in the early 80s. Youth smoking prevalence then fell quite dramatically, so when the elementary school data used by Leatherdale and Manske (2005) were collected in 2002, smoking rates among grade 7 students in Ontario were even lower (approximately 5%) than those occurring during data collection for the present study. Although provincial levels of youth smoking varied during these study periods, significant variation in school smoking rates remained. No matter what the overall average level of smoking in the larger population may be, some students appear to be placed at higher risk for smoking initiation depending on what school they attend.

At the student-level, results from this study were consistent with existing evidence indicating that adolescents are more likely to initiate smoking behaviour if they have a parent, older sibling, or close friend who smokes (Avenevoli & Merikangas, 2003; Tyas & Pederson, 1998). No gender differences were observed for smoking initiation by grade 8,

35

however, significant gender differences did exist in the odds of selecting a smoking friend by grade 7. Females were more likely than males to acquire a smoking friend (OR 1.54), controlling for any change to smoking status in grade 7.

This finding is somewhat surprising considering that females are more likely to have intimate and reciprocal friendships at school than males, who tend to have a less integrated and more diverse group of friends (Urberg, Degirmencioglu, Tolson & Halliday-Scher, 1995). One would expect males to be more likely to acquire smoking friends in higher prevalence schools, simply by engaging in friendships with a wider range of school peers. It may be that females are more likely than males to view smokers as socially desirable friends (Michell & Amos, 1997). The gender differences observed in this study may have been affected by the fact that males were more likely to be excluded from the study cohort than females, although there were no gender differences found in the likelihood of having zero smoking friends at baseline. Future research is needed to clarify the association between gender, senior student smoking and the acquisition of smoking friends to determine whether smoking initiation among males and females may be influenced by different pathways.

Contrary to existing evidence (Chassin et al.,1998; Engels et al., 2004; Melby et al.,1993), no significant relationship was observed between parental smoking and selection of a close friend who smoked among non-smoking students who had no smoking friends at baseline. However, students who reported having a close friend who smoked in grade 6 were more likely to have had a smoking parent than students who did not have a close friend who smoked in grade 6. It is possible that the effects of parental smoking may be strongest prior to grade 6, especially since parental smoking is more likely to influence initiation at younger ages (Vitaro et al., 2004). Parenting styles and levels of monitoring may also be related to

peer selection (Mounts, 2002; Simons-Morton, 2002). Future research addressing possible interactions between parental involvement, peer selection and school context may provide new insight and identify methods of interrupting the potential influence of senior student smoking on friend selection and future smoking behaviour.

The findings from this study indicate that variables in the school context may affect smoking behaviour and selection of smoking friends independent of immediate family and friend influences. Senior student smoking may influence younger students directly, or it may be a signal that other factors in the environment are increasing the risk of smoking and socializing with smokers at certain schools. Further research is needed to clarify the role of senior student smoking in youth initiation, and investigate other factors in the school climate which may also affect smoking initiation. Knowledge of these pathways would help to tailor the content of anti-smoking interventions and modify factors in the school environment which increase risk.

In the meantime, the smoking prevalence rate among senior students may be one way to flag schools where students are at increased risk of smoking. Cameron and colleagues (1999) suggest that smoking prevention programs may be most effective in elementary schools where 20% of senior students smoke. Leatherdale and colleagues (2005) concluded that students attending high schools where 30% of seniors smoke may be at substantial risk for smoking onset. One approach is to target these 'high-risk' schools with more intensive interventions than those used in 'lower-risk' schools. This targeted approach would mean that essentially the same population level impact could be achieved at a lower cost than a universal dissemination approach.

7.1 Implications for Research

It is well-recognized that variations in smoking behaviour may be due to the school, the composition of individuals within a school, or a combination of both factors (Aveyard et al., 2004; Frolich, Potvin, Gauvin & Chabot, 2002). Longitudinal designs and multilevel analysis are recommended to establish causal pathways and separate school-related factors from student-related factors (Diez-Roux, 2000; Duncan et al., 1996). This study employed these methodologies, and advanced existing evidence suggesting that between-school variance in smoking rates is not due solely to pupil composition (Aveyard et al., 2005).

In this study, senior student smoking prevalence predicted future smoking and acquisition of smoking friends by younger students, however, much more research is required to clarify the precise mechanisms by which senior student smoking may affect these outcomes as well as identify additional aspects of school context which may also be influential. The positive associations found between smoking initiation and student-related risk factors (parent, sibling and friend smoking) were congruent with most published evidence. Future studies could extend the findings of this study by examining interactions between individual- and school-level variables to reveal whether certain sub-populations of students are placed at more or less risk for smoking in different environments. Following students as they change schools to determine how an increase or decrease in senior student smoking rates affects smoking initiation and affiliation with smoking friends, may help to identifying protective factors in the school context which inhibit either smoking initiation or the selection of smoking friends. Understanding the characteristics of students who acquire smoking friends and attend a school where many senior students smoke but do not initiate smoking may provide valuable insight as to how to increase protective factors among those students who are being affected by school context.

Understanding the complex relationship between school risk factors and individual risk factors is a challenging task. Studies that incorporate multiple levels of context such as individual, schools, school boards, neighbourhoods, provinces and countries would add much needed insight to the area of school smoking prevention, although the logistics of such studies present difficulties (Cook, 2003). Findings from this study indicate that school context is an important factor in smoking behaviour and further research is warranted to determine how potential negative influences in the school environment can be harnessed or modified to deter the progression of smoking behaviours among youth.

7.2   Implications for Practice

There has been recent debate over whether or not school-based anti-smoking interventions are effective (Glantz & Mandel, 2005; Wiehe et al., 2005). Some argue that program content and delivery methods simply need to be redesigned. Aveyard and colleagues (2005) have suggested that if influential school contextual factors could be utilized to elicit change, school smoking prevalence rates could be reduced by at least 25%. Tailoring interventions to meet the unique needs of schools has been recommended to maximize program effectiveness (Cameron et al., 1999; Chassin et al., 1984), yet further evaluation is required to determine the impact of such an approach.

This study takes one step towards determining how to accomplish the task of incorporating school context into future anti-smoking practices. It adds to the growing evidence that student smoking behaviours are affected by school environment. Students who may not normally acquire smoking friends appear more likely to do so in schools with a higher proportion of senior students who smoke. Public health decision makers should take this into consideration when deciding what anti-smoking programs to implement where, and

use this information to help mobilize parents and other concerned individuals into action. Youth involvement in the implementation and decision-making processes could further increase the success of these programs (Glantz & Mandel, 2005; Lantz et al., 2000).

7.3   Limitations

The longitudinal study design, multilevel analytic techniques and large number of students and schools participating are strengths of this study, but limitations do still exist. Significant differences existed between retained students and those lost to follow up. Males, students with parents and close friends who smoked, and students attending schools where more seniors students smoked were less likely to be retained. Rates of smoking initiation by grade 8 are therefore likely underestimated in the study cohort, since, with the exception of gender, these characteristics were all predictive of smoking initiation among students who were retained.

The study relied on self-reported data, although this method has been shown to provide valid estimates of substance-use behaviour when biochemical validation (Patrick et al., 1994) and measures to ensure confidentiality are employed (Dolcini, Adler & Ginsberg, 1996), as they were during WSPP3 data collection procedures. Secondary analysis of an existing data set limited the availability of additional student- and school-level variables which may be related to the observed outcomes. In particular, perceived smoking among peers has been strongly related to adolescent smoking behaviour (Iannotti & Bush, 1992). Even though actual rates of smoking in schools have been shown to influence perceived rates (Unger & Rohrbach, 2002), knowing the estimated prevalence of senior student smoking among the younger study cohort would have strengthened the findings of the present study.

The study was also limited in its measure of close friend smoking. Although the findings reveal that students in schools with high senior student smoking prevalence are more likely to select smoking friends, the source of those friendships cannot be determined. It remains unclear whether the smoking friends selected were the same age or older, or attended the same school or not. Future research using social network analyses could help clarify this issue (Ennett & Bauman, 1993).

The operational definition of smoking initiation used in this study was deliberately chosen to enable direct comparisons with the research of Santi and colleagues (1991), which used trying a cigarette more than once as the outcome measure for smoking. This definition seemed to provide a conservative estimate of smoking initiation, and enable a more nuanced understanding of the association between senior student smoking prevalence and future smoking behaviour than using ever-smoking as an outcome variable. However, use of this definition hinders the assumptions that can be made about the influence of schools on the selection of smoking friends. Even though an overwhelming majority of tried-once smokers do not consider themselves to be smokers (Leatherdale, 2004), certain exceptions do occur and these students may be more likely to deliberately seek out friendships with smokers (Ennett & Bauman, 1994).

8.0   Conclusions

This investigation extends the findings of several recent studies to demonstrate that the prevalence of senior student smoking is significantly related to a) the likelihood that a younger elementary school student will smoke more than once by the end of elementary school and b) the likelihood that a younger elementary school student will acquire one or more smoking friends within a year, increasing the likelihood that they will smoke more than

once by the end of elementary school. The longitudinal design enables control for prior smoking behaviour, and the multilevel models used allow student composition to be separated from school context.

Further research is warranted to determine the precise mechanisms by which high rates of senior student smoking affect younger students to improve the content and delivery of anti-smoking interventions. The increased risk of smoking initiation among students attending schools with high senior student smoking prevalence signals the need for immediate attention to reduce future morbidity and mortality among today's youth.

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Appendix A

Lifestyle Questionnaire
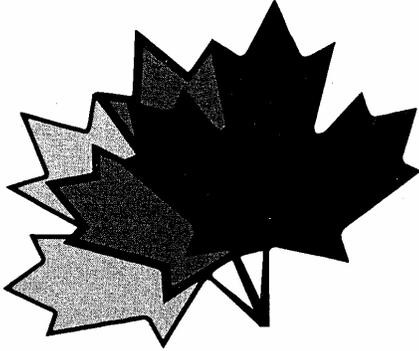
LIFESTYLE QUESTIONNAIRE

Department of Health Studies

University of Waterloo

Winter, 1990

This questionnaire is about the development of lifestyles by young people. Please answer all the questions as well as you can. Be completely honest. Nobody will see your answers except the researchers at the University of Waterloo. Your teachers, parents or friends will not see or hear about your responses.

These questions are about you. Please read each question carefully, and answer all the questions as honestly as you can. Remember, nobody will see your answers except the researchers at the University of Waterloo.

1. How old are you?

    _____

2. What is your BIRTH DATE? _____ _____ _____
    day   month   year

For these questions, put a check mark (√) on the line next to the answer you choose. Check only one answer per question.

3. Which are you:

    1. _____ male

    2. _____ female

4. Have you ever smoked? This means even one puff of one cigarette.

    1. _____ Yes.

    2. _____ No.

5. Have you ever smoked again since the first time you tried a cigarette?

    1. _____ Yes.

    2. _____ No.

    3. _____ I have never smoked.

6. Do you usually smoke every week? (Even if it is only one puff of one cigarette.)

    1. _____ Yes.

    2. _____ No, I don't smoke that often.

    3. _____ No, I have only tried once.

    4. _____ No, I have quit.

    5. _____ I have never smoked.

The following question concerns your recent smoking. Again put a check mark (√) on the line next to the answer you choose. Check only one answer per question.

7. **How much do you currently smoke?**

    1. _____ I have never smoked.

    2. _____ Not at all in the last 12 months.

    3. _____ A few times in the last 12 months.

    4. _____ Usually once a month.

    5. _____ A few times each month.

    6. _____ Usually once a week.

    7. _____ A few times each week.

    8. _____ A few times most days.

    9. _____ About half a pack each day.

    10. _____ A pack or more each day.

For the following three questions, write your answer on the line beside each question.

8. **Since this time yesterday, how many cigarettes have you smoked?**

    If you have not smoked any
    cigarettes, write 0 on the line. _____

9. **Since this day last week, how many cigarettes have you smoked?**

    If you have not smoked any
    cigarettes, write 0 on the line. _____

10. **Since this day last month, how many cigarettes have you smoked?**

    If you have not smoked any
    cigarettes, write 0 on the line. _____

11. **Have you quit smoking?**

    1. _____ Yes.

    2. _____ No.

    3. _____ I have never smoked.

12. **Do you think you will smoke cigarettes in the future?**

    1. _____ I definitely will not smoke cigarettes.

    2. _____ I probably won't smoke cigarettes.

    3. _____ I might smoke cigarettes or I might not smoke cigarettes.

    4. _____ I probably will smoke cigarettes.

    5. _____ I definitely will smoke cigarettes.

13. **How many times have you tried chewing tobacco or snuff in your whole life?**

    1. _____ Never.

    2. _____ 1 time.

    3. _____ 2 to 5 times.

    4. _____ 6 to 10 times.

    5. _____ 11 to 20 times.

    6. _____ more than 20 times.

14. **How many times have you used chewing tobacco or snuff in the last 7 days?**

Write the number. If you have
not used chewing tobacco or snuff,
write 0 on the line.

These are questions about smoking in your family. Please read each question carefully and try to answer as honestly as you can.

15. Does your father (or stepfather or foster father) smoke cigarettes? Think about the father you see the most. Put a check mark on the line next to the <u>one</u> answer you choose.

      1. _____ I have no father.

      2. _____ No, he has never smoked.

      3. _____ No, he has stopped smoking.

      4. _____ Yes, he smokes cigarettes, cigars or a pipe.

      5. _____ I don't know.

16. Does your mother (or stepmother or foster mother) smoke cigarettes? Think about the mother you see the most. Put a check mark on the line next to the <u>one</u> answer you choose.

      1. _____ I have no mother.

      2. _____ No, she has never smoked.

      3. _____ No, she has stopped smoking.

      4. _____ Yes, she smokes cigarettes, cigars or a pipe.

      5. _____ I don't know.

17. Do any of your older brothers smoke cigarettes?

      1. _____ Yes.

      2. _____ No.

      3. _____ I don't know.

      4. _____ I don't have any older brothers.

18. Do any of your older sisters smoke cigarettes?

      1. _____ Yes.

      2. _____ No.

      3. _____ I don't know.

      4. _____ I don't have any older sisters.

The following question is about your closest friends. Your closest friends are the friends you like to spend the most time with.

19. How many of your 5 closest friends smoke cigarettes?

1. _____ None.   4. _____ 3 of them.

2. _____ 1 of them.   5. _____ 4 of them.

3. _____ 2 of them.   6. _____ All of them.

Appendix B

Table 3: Operational Definitions and Variable Coding Procedures
for Social Models and Covariates

Table 3: Operational Definitions and Variable Coding Procedures for Social Models and Covariates

Variable Name	Operational Definition	Variable Coding

Family and Friend Smoking

Variable Name	Operational Definition	Variable Coding
Smoking Father	Student has a father or stepfather or foster father who smokes cigarettes, cigars or a pipe	**1 = Smoking Father** Q 15 (yes) **0= Non-Smoking Father** Q 15 (no father, never smoked, stopped smoking or I don't know)
Smoking Mother	Student has a mother or stepmother or foster mother who smokes cigarettes, cigars or a pipe	**1 = Smoking Mother** Q 16 (yes) **0 = Non-smoking Mother** Q 16 (no mother, never smoked, stopped smoking or I don't know)
Smoking Older Brother	Student has an older brother who smokes cigarettes	**1 = Smoking Brother** Q 17 (yes) **0= Non-Smoking Brother** Q 17 (no, I don't know, don't have older brother)
Smoking Older Sister	Student has an older sister who smokes cigarettes	**1 = Smoking sister** Q 18 (yes) **0= Non-smoking sister** Q 18 (no, I don't know, don't have older sister)
Number of Smoking Friends	Student has 0-5 friends who smoke cigarettes	**Q19** (0 -5)

Covariates

Variable Name	Operational Definition	Variable Coding
School Board	School board to which study school belongs	A = 15 schools B = 15 schools C = 14 schools D = 15 schools E = 10 schools F = 15 schools

Intervention Condition	Circumstances by which the intervention was delivered (or not delivered)	1 = teacher self-preparation 2 = teacher workshop 3 = nurse self-preparation 4 = nurse workshop 5 = control
Size of Student Population	Total number of students in grade 6 in each school at baseline	ratio variable (1 person increments)
Senior Student Smoking Prevalence	Percentage of grade 8 students classified as experimental or regular smokers at baseline	ratio variable (0-100) reported in 5% increments
Gender	Sex that participant reports being	**1 = Female** Q3 (response 2) **0= Male** Q3 (response 1)

Appendix C

Figure 2: Two-Level Model of Analysis

*Level 2* School

Level 1 Student

Measurement Times
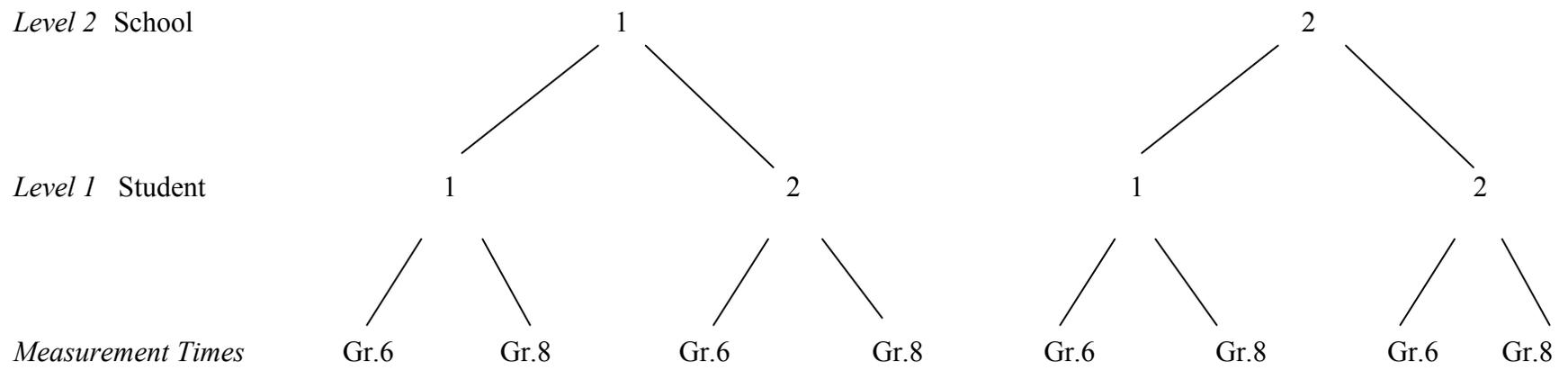
Figure 2: Two-Level Model of Analysis

Adapted from Duncan et al. (1996).