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Two-year predictors of smoking initiation among elementary schoolchildren in multiethnic, low-income, inner-city neighborhoods

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A thesis submitted to the Faculty of Graduate Studies and Research
in partial fulfillment of the requirements for a Master of Science

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August 1999

Abstract

The objective of this study was to determine the two-year predictors of current smoking (smoked one or more times in the past year) and of ever smoking (lifetime use of cigarettes) among grade 4 students in multiethnic, low-income, inner-city neighborhoods in Montreal. Baseline and two-year follow-up data were collected from 501 children (54.3% girls) who, at baseline, were never-smokers. At the two-year follow-up, 22.0% reported ever smoking, including 7.6% who were current smokers. Gender-specific multivariate logistic regression analyses identified friends smoking (odds ratio (OR)=3.0 95% confidence interval (1.2-7.1)) and sibling smoking (OR=6.6 (1.7-22.2)) as independent predictors of ever smoking among boys. Friends' smoking (OR=4.7 (2.0-10.7)) and school were predictors of ever smoking among girls. Parental smoking also predicted ever smoking (OR=4.3 (1.6-11.9)) among girls born in Canada only. The only predictor of current smoking among boys was friends' smoking. Predictors of current smoking among girls included Canadian family origin.

Résumé

Cette étude visait à identifier les déterminants de la consommation de cigarettes actuelle (consommation durant la dernière année) et de la consommation à vie parmi des élèves de quatrième année suivi pendant deux années et résidant dans des quartiers multiethniques et économiquement défavorisés du centre-ville de Montréal. Les données ont été recueillies au début de l'étude et deux ans plus tard auprès de 501 enfants (filles = 54.3%) qui, au départ, n'avaient jamais fumé. Après deux années de suivi, 22.0 % des enfants rapportaient avoir fumé dont 7.6% durant la dernière année. Des analyses de régression logistique réalisées séparément pour chaque sexe ont identifié les déterminants de la consommation de cigarettes à vie suivant: la consommation de cigarettes par les amis (ratio de cotes (RC) = 3.0 (interval de confiance de 95%) (1.2 à 7.1)) et par la fratrie (RC = 6.6 (1.7 à 22.2)) chez les garçons et la consommation de cigarettes par les amis (RC = 4.7 (2.0 à 10.7)) et l'école frequentée chez les filles. La consommation de cigarettes par les parents est un déterminant additionnel de la consommation à vie (RC = 4.3, (1.6 à 11.9)) mais seulement chez les filles nées au Canada. Les déterminants de la consommation actuelle de cigarettes sont la consommation par les amis chez les garçons et l'origine familiale canadienne chez les filles.

Acknowledgements

I wish to express my sincere gratitude to my thesis supervisor, Dr. Jennifer O'Loughlin, for her thoughtful advice, incessant encouragement, and patience. This thesis could not have been successfully completed without her tireless help. I thank Dr. Gilles Paradis, for his precious insight; I thank Dr. Robert Platt, for his statistical guidance and helpful advice. I am grateful to the members of research and data collection team, principals, and teachers, as well as all students and parents who participated in this study and provided invaluable information.

I am indebted to Garbis Meshefedjian and Nancy Henri for the data preparation and data processing, and to Nancy Hanusaik for her proof reading. I also thank my other friends, including Aline Drapeau, Christine Dubiniecki, and Judith Shapiro. Finally, I thank my husband, Masayuki Numata, for his understanding and support.

This thesis is dedicated to the memory of Tsune Hori.

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List of Abbreviations

Af-Am	=	African-American
Anglo-Am	=	Anglo-American
BMI	=	body mass index
CI	=	confidence interval
CO	=	carbon monoxide
HMO	=	health maintenance organization
LOTE	=	language other than English
n/a	=	not applicable
OR	=	odds ratio
Ref.	=	reference
SD	=	standard deviation
SES	=	socioeconomic status
TV	=	television
USDHH	=	US Department of Health and Human Services
WHO	=	World Health Organization

1. Introduction

Cigarette smoking and exposure to environmental tobacco smoke are major preventable causes of premature deaths worldwide. In spite of a substantial decrease in overall smoking prevalence, more than 41,000 deaths in Canada, in 1991, were estimated to be directly attributable to tobacco use (Illing & Kaiserman, 1995) and smoking accounted for 56% and 48% of premature mortality among male and female smokers in Canada, respectively (Ellison, Morrison, & de Groh, 1999). Smoking is considered to be responsible for 30% of both cardiovascular deaths and cancer deaths, 90% of lung cancer deaths, and 85% of emphysema cases (Joseph, 1989). Smokers are also known to have higher risks for a variety of other diseases including influenza, pneumonia, peptic ulcers, abdominal aortic aneurysm, and cataracts (US Centers for Disease Control, 1993).

Adverse health consequences of active and passive smoking among children are also well documented. Apart from the impact of passive smoking, active smoking among children, similar to adults, causes increased respiratory symptoms, reductions in pulmonary function (Gold et al., 1996; Smeets, Brunekreef, Dijkstra, & Houthuijs, 1990). It has been reported that men who begin to smoke before age 15 have a substantially higher risk of developing lung cancer in comparison to men who begin smoking when older (Peto, 1986). The mechanism suggested was that young smokers may be markedly susceptible to DNA adduct formation, which is related to carcinogenesis, and have higher adduct burdens after they quit smoking than those who started smoking later in life (Wiencke et al., 1999). Furthermore, studies have demonstrated that smoking is associated with other risk-taking behaviors such as marijuana and other illicit drug use, binge drinking, and aggressive or violent behavior (DuRant, Smith, Kreiter, & Krowchuk, 1999; Escobedo, Reddy, & DuRant, 1997). Smoking in early adolescence might not cause illegal drug use, but could provide the foundation for participating in other risk-taking behaviors. Or it may be that smoking and risk-taking behaviors share a common underlying pathway. Thus, the consequences of early smoking among youth burden society in many ways.

According to the February 1995 Survey on Smoking in Canada, the smoking prevalence among persons aged 15 or older was 27% (Canadian Center on Substance Abuse, 1997). Overall, a 25% reduction of smoking prevalence has been observed over the last three decades. However, the prevalence of regular smoking among youth has declined less than that among adults over this period and even reversal in the downward trend was observed during 1989-1995 (Health Canada, 1996). According to the 1992-1993 Quebec Health and Social Survey, 30.4% of Quebecers who were 15 years or over reported smoking cigarettes on a daily basis. This prevalence was the highest among Canadian provinces. Among youth aged 15 to 17 years, 19.5% of males and 22.3% of females were reported to be regular smokers (Santé Québec, 1994). Furthermore, for youth aged 10 to 14 years, the overall prevalence of current smoking was 11% in Quebec, which was the highest prevalence among all provinces in Canada (Health Canada, 1994). Considering the disturbing fact that tobacco companies specifically target children and adolescents as new consumers, strengthening smoking prevention measures among youth, especially in Quebec, is truly an urgent issue.

Once smoking is initiated, it is likely to be a long-term addiction. One study indicated that adolescent smokers, on average, continue to smoke for 16 years before quitting (Pierce & Gilpin, 1996b). The probability of cessation, among adults, is correlated to the age at which smoking started (US Department of Health and Human Services [USDHH], 1994). Children who begin smoking by age 12 are more likely to be regular and heavy smokers and are less likely to quit smoking, than those who begin at older ages (Breslau & Peterson, 1996; Chen & Millar, 1998; Escobedo, Marcus, Holtzman, & Giovino, 1993). Nonetheless, in the United States, between 14.2% and 25.2% of children have their first puff by age 12 (USDHH, 1994), and in Canada, 16% of 21 to 39 year-olds who had ever smoked daily reported that they had started smoking at age 13 or younger (Chen & Millar, 1998). These facts leave no room for doubt that research and interventions for smoking prevention should target not only adolescents but also younger, elementary schoolchildren.

Despite consensus on the need for early intervention, the number of longitudinal surveys of smoking among children under 12 years of age is still limited. In addition, although information from high-risk populations is essential to develop effective interventions, some potential high-risk populations remain understudied. For example, it is well documented that the prevalence of smoking among adolescents is related to low socioeconomic status (SES) (Conrad et al., 1992, Glendinning, Shucksmith, & Hendry, 1994, USDHH, 1994). However, few studies have focused on low SES groups of children. Also, few studies focus on multiethnic populations, which often comprise high proportions of families of low SES, and in which unique cultural factors may influence smoking behavior. In general, foreign-born Canadian residents, Canadians whose first language is neither English nor French, and Canadians who report ethnic origins other than French or British, have relatively low smoking prevalence (Health Canada, 1995c). However, these groups are included among the priority groups for anti-smoking campaigns by Health Canada because of limited access to culturally appropriate programs and services (Health Canada, 1995a). Recent studies have reported that the predictors of smoking onset among adolescents differ by ethnic group and by the level of acculturation, the process of learning the values, beliefs, norms, and traditions of a new culture (Bettes, Dusenbury, Kerner, James-Ortiz, & Botvin, 1990; Epstein, Botvin, & Diaz, 1998b; Marin, 1992; USDHH, 1998). To date, little information on risk factors for smoking onset among children with diverse ethnicity living in low SES environments is available. For effective primary prevention, understanding predictors of smoking initiation among those who have never smoked helps tailor future intervention programs for multiethnic communities, which are becoming the norm in metropolitan areas including Montreal.

A school-based heart health promotion program, "Coeur en Santé St Louis du Parc", was conducted to evaluate the effectiveness of a multifactorial intervention program to reduce risk factors for cardiovascular disease among elementary schoolchildren in underprivileged neighborhoods in Montreal. As part of the evaluation, data were collected on changes in smoking behavior over two years from children who served as comparison subjects in this quasi-experimental study. Correlates of ever

smoking among study subjects in 1993 and one-year predictors of ever smoking among grade 4 and 5 children from 1993 to 1995 have been previously reported (O'Loughlin, Paradis, Renaud, & Sanchez Gomez, 1998a; O'Loughlin, Renaud, Paradis, Meshefedjian, & Zhou, 1998b). Since the process of progressing from first trying a cigarette to regular smoking usually takes about 2-3 years (Emmanuel, Ho, & Chen, 1991; World Health Organization [WHO], 1998), a two-year follow-up might also be a reasonable time frame for the investigation of smoking initiation. In addition, whether or not the findings from this study with a longer follow-up period would corroborate the findings from previous studies among the same study population is of interest. Thus, the main objective of this study is to identify two-year predictors of current and ever smoking among elementary schoolchildren originally in grade 4 (with no intervention) in multiethnic, low income, inner-city neighborhoods.

2. A review of the literature

2.1 Objectives of this review

The objectives of this literature review are:

(1) to present the commonly used measures of smoking behavior among children,

(2) to address issues related to the measurement of smoking behavior among children,

(3) to describe the prevalence of smoking among elementary school children using recent studies, and

(4) to summarize the reported predictors of smoking among children based on recent prospective and cross-sectional studies.

2.2 Definitions

Children: In this review, "children" are defined as individuals, aged 12 years or younger, or enrolled in elementary schools at baseline surveys. The reasons for this restriction are as follows; (1) Forty percent of adolescents start smoking by age 14 (USDHH, 1994), and the earliest stage of smoking, the preparation stage, is considered to begin before actual smoking takes place. Thus, childhood is a critical period for smoking

onset and it has been suggested targeting the preadolescent age group for smoking prevention, rather than adolescents. (2) It has not been determined whether risk factors for smoking onset change as children grow. Previous research has suggested that the relative importance of several factors may differ depending on smoking stage as well as age (Choi, Pierce, Gilpin, Farkas, & Berry, 1997; Jackson, Henriksen, Dickinson, Messer, & Robertson, 1998; Stanton, Lowe, & Silva, 1995; Stanton, Mahalski, McGee, & Silva, 1993). For example, several studies suggest that parental influence might be stronger when children are younger (Jackson, Henriksen, Dickinson, & Levine, 1997b) and be surpassed by the influence of smoking by friends later in their life (Conrad, Flay, & Hill, 1992; Presson et al., 1984). This suggests that findings from studies targeting preadolescent children may differ from those of adolescents. Also, studies that grouped subjects into broad age groups may obscure the causal association between smoking initiation and potential predictors, which could differ by age or developmental stage. (3) Those at highest risk for early smoking are more likely to drop out of school and are often already excluded from school-based studies among older age groups. (4) Our study focused on smoking initiation among elementary school children.

Smoking: "Smoking" refers to any experience of cigarette smoking including initiation, experimentation, and maintenance. Any stage of smoking was accepted in this review. However, outcomes related to smoking cessation or quitting were excluded.

2.3 Measurement of smoking behavior

2.3.1 Measurement of smoking behavior among children

Children's patterns of smoking differ from that of adults. This is characterized by the process of initiation, which consists of infrequent smoking. The transition from never smoking to established smoking is generally conceptualized into several developmental stages: preparation, initiation, experimentation, regular smoking, and addiction (USDHH, 1994). However, the levels of smoking and their definitions vary from study to study. Even though the same terminology is used, definitions are not necessarily consistent.

Furthermore, although it has been well known that responses are, in general, influenced by the phrasing of questions and the order in which questions are asked, precise information about questions themselves were often not reported in published articles. Some investigators described patterns of transition using several stages of smoking onset, then dichotomized those categories for further analysis. Even after the dichotomization of original categories, the similarity of outcome variables is limited.

Table 1 summarizes terms and definitions used in the literature reviewed.

Table 1 ***Categories and Definitions of Early Smoking Stages***

Number of Levels	Levels of behavior	Definition	References
2	Never smokers/ Never triers	Those who never tried cigarettes.	Epstein et al.,1998, Griesler et al., 1998, Gritz et al., 1998, O'Loughlin et al., 1998b, Greenlund et al.,1997, Pederson et al., 1997, Iannotti et al., 1996, Abernathy et.al., 1995, Bowen et al., 1991
	Ever smokers/ Lifetime smoking	Those who ever smoked. (Most were reduced to a binary variable of "ever" and "never" from the original polytomous measure.)	
2	Smoking onset : No	Those who consistently reported values indicating nonuse or inconsistent reporters.	Jackson et al., 1997, 1998
	Yes	Those who consistently reported values indicating some level of use.	
2	Never smoking	Those who had never smoked.	Griesler et al., 1998
	Current smoking	Those who had smoked in the past 3 months.	
2	Smoking less than once a month	Those who do not smoke once a month or more. (including never smokers, past smokers)	Epstein et al., 1998
	Current smoking	Those who smoked at least once a month.	
2	Non-established smokers	Among the experimenters, those who are not satisfied with the criterion for "current established smokers".	Choi et al., 1997
	Current established smokers	Those who smoked at least 100 cigarettes in their lifetime and smoked in the last 30 days.	
2	Never smokers	Those who did not agreed with the item "I have started to smoke a little"	Elder et al., 1996
	Ever smokers	Those who agreed with the above item.	

Table 1 (continued)

Number of Levels	Levels of behavior	Definition	References
2	Non-smokers	Those who had not smoked one or more cigarettes in the past month.	Doherty et al., 1994
	Smokers	Those who had smoked one or more cigarettes in the past month.	
2	Non-smokers	Those who had not smoked in the past year including never smokers.	Headen et al., 1991
	Smokers	Those who smoked at least a few times in the past year.	
3	Never smokers	Those who report non use or inconsistently report cigarette smoking.	Jackson et al.,1997b
	Initiation	Consistent reports for having tried smoking such as "one or two puffs" and "most or all of one cigarette" for lifetime use.	
	Experimentation	Consistent reports for having tried smoking and having smoked 2 to 5 packs of cigarettes in lifetime.	
	Current smokers	Anyone who has smoked during the past 30 days (including daily smokers and occasional smokers). =30 days prevalence	
3	Never smoked	Those who had never taken a single puff of a cigarette.	Bertrand & Abernathy, 1993
	Tried but no longer smoke	Those who had tried smoking at least once but who no longer smoke.	
	Currently smoke	Those who continued to use tobacco at the time of testing.	
3	(at grade 3-4) Non smokers	Those who never smoked a whole cigarette	Harrell et al., 1998
	Experimental smoking	From the questions " Have you ever smoked a whole cigarette in your life?" and "Do you smoke now?" Details of categorization were not available.	
	Current smoking		
3	(at grade 4-5) Non smokers	Those who never smoked a whole cigarette.	
	Experimental smoking	From the questions " Have you ever smoked 10 cigarettes in your life?" and "Do you smoke now?" Details of categorization were not available.	
	Current smoking		
3	Never smokers	Those who had never smoked.	Meijer et al., 1996
	Experimental smokers	Those who had smoked at least once but had not smoked within the last 2 weeks.	
	Current smokers	Those who smoked within the last 2 weeks.	

Table 1 (continued)

Number of Levels	Levels of behavior	Definition	References
4	Never smokers	Those who have never smoked.	Gritz et al., 1998
	Experimenters	Those who (1) had one or more puffs but not a whole cigarette, (2) smoked between 1 and 10 cigarettes in lifetime, (3) smoked fewer than 12 times in the past 12 months.	
	Current smokers	Those who (1) smoke once a month, (2) smoke a few cigarettes each week, (3) smoke a few cigarettes most days, (4) smoke about half a pack each day, (5) smoke a pack or more each day.	
	Former smokers	Those who used to smoke but quit in the past 12 months, or used to smoke but quit more than 12 months ago.	
4	Abstainer	Those who were abstinent at baseline, one-year follow-up, and two-year follow-up.	Jackson, 1998
	Current smokers	Those who (1) smoke once a month, (2) smoke a few cigarettes each week, (3) smoke a few cigarettes most days, (4) smoke about half a pack each day, (5) smoke a pack or more each day.	
	Former smokers	Those who used to smoke but quit in the past 12 months, or used to smoke but quit more than 12 months ago.	
	Smoker	Those who were smokers at two-year follow-up regardless of status at baseline (abstinent or initiation)	
4	Never smokers	Those who reported no smoking at all.	O'Loughlin et al., 1998
	Past smokers	Those who had smoked but not at all in the past year.	
	Trying smoking	Those who had smoked 1-2 times in the past year.	
	Current smokers (Experimenters/ regular smokers)	Experimenters: those who had smoked 3 or more times in the past year but not on a regular basis. Regular smokers: those who smoked a couple of times each month or each week and those who reported smoking every day.	
Continuous smoking index	11-point smoking index	In response to the question, "How often do you currently smoke?", categories varied according to responses, such as "I have never smoked." (1) to "A pack or more each day" (11).	Epstein et al., 1998

As Table 1 illustrates, terminology and categorization of smoking status varied widely across studies. There was a lack of consistency in the definition of "current smokers" and "former (past) smokers" among children at elementary school ages. Although the term "experimenters" was often used to describe irregular childhood smoking behavior, this category also did not have a common definition. The most consistent categorization was a dichotomization into "never smokers" versus "ever smokers/life time smoking".

2.3.2 Validity of measurement

Possible biases in measurements of children's smoking status

All studies reviewed relied on self-reported smoking status. In the majority of studies, self-administered questionnaires were used as the most practical approach to obtain information on smoking behavior among children; this method is relatively cheap, allows for larger samples, can assure privacy, and can avoid interviewer bias (WHO, 1998). The World Health Organization (WHO) (1998) recommends that smoking status of adolescents not be assessed by proxy reports since parents, who are likely to provide answers, are not always aware of their children's behavior. The validity of self-reports on smoking among youth is, however, questionable because of two fundamental sources of respondent error: nondeliberate error in recall and deliberate misreporting. The former is more common in responses to questions about age of first cigarette use or frequency of smoking, than about current smoking status (WHO, 1998). The use of age-of-onset measures produces substantial errors in estimation of smoking behavior among adolescents and has low predictive values for recent smoking (Engels, Knibbe, & Drop, 1997). In addition, recall greater than one year for young children has been reported unreliable in research on children's substance use (Stanton & Silva, 1993). Deliberate misreporting of one's smoking behavior is probably related to "faking good" which is an attempt to create a false positive impression or "faking bad" which is an attempt to create a false negative impression (Streiner & Norman, 1995). Misreporting could also result from "social desirability", a tendency to put one's best foot forward without being aware

of this tendency (Edwards, 1957). Adolescent smokers are more likely than adult smokers to misclassify themselves as non-smokers (WHO, 1998). A high false negative rate (approximately 40%) has been reported in a study of nine year-old children (Fergusson & Horwood, 1989). Children may be reluctant to disclose their behavior to adults when those behaviors are considered socially undesirable.

Several studies included biochemical measurements, such as exhaled air carbon monoxide (CO) or saliva thiocyanate (SCN), to assess smoking among children. Since these biological markers are not sensitive enough to detect infrequent smoking and since they can be influenced by exposure to environmental tobacco smoke, they have been used primarily as a way to increase the accuracy of self-reported smoking status. Based on the premise that "subjects prefer providing accurate information about undesirable behavior to giving false information that would be validated by another measure" (Bauman & Dent, 1982), it has been hypothesized that the use of an objective measure would motivate children to answer more accurately. Thus, the "bogus pipeline method", in which subjects are informed that their self-reports can be verified by investigators through a procedure, such as biochemical measure, was first reported by Jones & Sigall (Jones & Sigall, 1971), and the method has been implemented in other studies. Earlier studies, that tested the efficacy of this approach in the measurement of adolescent smoking, supported the use of this method (Evans, Hansen, & Mittelmark, 1977; Murray, O'Connell, Schmid, & Perry, 1987a). Its usefulness, however, has become somewhat controversial (Campanelli, Dielman, & Shope, 1987; Murray et al., 1987a; Murray & Perry, 1987b; Werch, Gorman, Marty, Forbess, & Brown, 1987). Use of the bogus pipeline procedure to increase the validity of self-assessments among children needs to be further investigated.

In addition to bias due to response error, another information bias might occur because of categorization of study subjects by smoking status based on responses to multiple questions. In order to assure consistency of reporting, many studies determined children's smoking status through algorithms of multiple self-reported questionnaire items. This procedure has been recommended to obtain truthful answers from individuals

who are reluctant to report their smoking (Brittingham, Tourangeau, & Kay, 1998). However, the decision to eliminate or include subjects who report inconsistent smoking status varies from study to study. Some investigators exclude subjects whose reports of smoking status are inconsistent, while other investigators categorize them as "ever smokers". These inconsistencies between studies highlight the difficulties of measuring smoking status among children. It is possible that the younger the study subjects are, the higher the proportion of inconsistent reports, which contribute to response error. Such misclassification could attenuate the effect of potential predictors toward the null, resulting in negative findings for weak positive predictors.

Other factors related to the validity of self-reports among youth

The following four factors have been investigated in relation to the validity of self-reports of smoking behavior among adolescents. First, underreporting might be more frequent in household surveys than in school-based surveys because confidentiality is more difficult to achieve in the former setting (WHO, 1998). Secondly, the validity of self-reported smoking status did not differ by age group (Presson et al., 1984). Thirdly, it does differ depending on smoking patterns; occasional smokers tended to misclassify themselves as nonsmokers while the accuracy of self-reports among regular smokers and nonsmokers was high (95%) among adolescents aged 10 to 16 (Fergusson & Horwood, 1995). Finally, according to a study conducted among urban adolescents in North Carolina, sensitivity of self-reports, computed comparing self-reported smoking and exhaled carbon monoxide level, was high (83-99%) and did not change appreciably by ethnicity (i.e., African-American, Hispanic, or Whites) (Wills & Cleary, 1997).

Additionally, several methods have been used to increase the validity of self-reports among youth in school-based surveys. These include the use of anonymous questionnaires, use of individual envelopes to return completed questionnaires, requesting teachers leave the classroom or stay at their desks during completion of the survey, and use of individual booths to complete the questionnaire. The usefulness of these methods to increase the validity, however, has not been evaluated.

2.3 Prevalence of smoking among children

Many studies have been conducted in the last decade to describe smoking among children. Table 2 summarizes recent studies that report the prevalence of smoking among elementary school children or children of approximately age 12. Rather than presenting overall prevalence, some studies reported the prevalence in specific subgroups of subjects, such as by gender or ethnicity. Location of the study, year(s) of survey, study design, age/grade, the proportion of female subjects, ethnicity/race, SES, and the measure of smoking used in the study were described for each study. Detailed definitions of smoking used in these studies are reported in Table 1 by the first author's name and the year of publication.

Table 2 ***Summary of Reports Describing Prevalence of Smoking among Children***

Authors, Year of publication, Name of the survey or project	Population 1. Location 2. Year(s) of survey 3. Study design 4. Number of subjects 5. Grade/Age 6. % Female[1] 7. Ethnicity/race 8. SES	Measurements of smoking	Categories of smoking	Prevalence of ever-smokers /smoking in lifetime	Prevalence of current smokers
Epstein et al., 1998	1. New York City, USA 2. not available 3. baseline[a] 4. n=2,312 5. grade 6-7 / 12.6±0.9 years old 6. Female 52% 7. Asian 7%, Black 22%, Hispanic 56%, White 15%. Other excluded. 8. Majority came from low-income families.	An anonymous in-class self-administered questionnaire with CO measurement as "Bogus pipeline" method. (Data were also collected from the absentee.)	Never smoked; Ever-smoking; Current-smoking (30-day prevalence).	Ever-smoking Asian 12.9% Black 17.8% Hispanic 20.2% White 22.3%	Current-smoking Asian 1.3% Black 3.4% Hispanic 3.8% White 4.0% Gender difference exists.
Griesler et al., 1998 The 1992 National Longitudinal Survey of Youth	1. USA national sample 2. 1992 3. cross-sectional 4. n=1,773 5. 12.4±1.9 years old 6. not available 7. Af-Am 41.7% Hispanic 23.7% White 34.6% 8. 25.7% of the family lived in poverty.	A self-administered in-class questionnaire.	Never smoked; Life time smoking; Current smoking (last 3 months).	Life time smoking 24.1% Male 23.9% Female 24.2%	Current smoking 10.0% Male 9.4% Female 10.6%

Note. CO = carbon monoxide. Af-Am = African-American. [a] Baseline survey from a longitudinal study.

Table 2 (continued)

Authors, Year of Publication	Population	Measurements of smoking	Categories of smoking	Prevalence of ever-smokers	Prevalence of current smokers
Gritz et al., 1998	1. Houston, USA 2. not available 3. cross-sectional 4. n=641 5. grade 5 6. Female 55.5% 7. White 37.8%, Af-Am 27.9%, Hispanic 22.8%, Other 11.5% 8. parental education: less than high school 36%	A self-administered in-class questionnaire with saliva collection; "Bogus pipeline" method	Never smokers; Ever smokers (Experimenters; Current smokers; Former smokers.)	Ever smokers 15.6%	Current smokers 0.6%
O'Loughlin, et al., 1998b Coeur en Santé St Louis du Parc	1. Montreal, Canada 2. 1993-1995 3. cross-sectional 4. n=2,268 5. 9-12 years old 6. Female 50.0 % 7. multiethnic, low-income, inner-city neighborhoods	A self-administered in-class questionnaire	Never smokers; Ever smokers (past smokers + experimenters/regular smokers).	Ever smokers Male 28.7% Female 20.3%	Experimental/ regular smokers Male 4.9% Female 3.9%
O'Loughlin, et al., 1998a Coeur en Santé St Louis du Parc	1. Montreal, Canada 2. 1993-1994 3. baseline[a] 4. n=1,824 5. 9-12 years old 6. Female 50.0% 7. multiethnic, low-income neighborhoods	A self-administered in-class questionnaire	Never smokers; Ever smokers (past smokers + experimenters/regular smokers).	Ever smokers 21.1% Male 25.1% Female 17.1%	Currently trying/Experimental/ regular smokers 5.7%

Note. Af-Am = African-American.

[a] Baseline survey from a longitudinal study.

Table 2 (continued)

Investigators, Publication year	Population	Measurement of smoking	Categories of smoking	Prevalence of ever smokers	Prevalence of current smokers
Hu et al., 1998 The 1990 California Youth Tobacco Survey	1. California, USA 2. 1990 3. cross-sectional 4. n=1,708 5. 12-13 years old 6. (Female 49.5% among 12-17 years old sample as a whole.) [a] 7. (White 69.4% Asian 8.7% Black 6.2%, Other 9.3%)[a] 8. income < $20,000 28.8%	A random-digit-dialing telephone interview.	Non-smokers =never smokers; Current smokers (smoking within 30 days); Former smokers.	Former smokers & current smokers 10.83%	Current smokers 3.16%
Jackson, 1998	1. North Carolina, USA 2. 1994 3. baseline[a] 4. n=913 5. grade 3 and 5 6. Female 51% 7. White 83%	A self-administered in-class questionnaire.	Never tried; Initiation of smoking.	Initiation of smoking 14 %	not available
Choi et al., 1997 Teenage Attitudes and Practice Survey (TAPS)	1. USA national sample 2. 1989 3. baseline[a] 4. n=503 5. 12-13 years old 6. Female 38.6 % 7. White 78.6% Af-Am 12.1% Hispanic 6.6% Asian/other 2.8% 8. high / low SES	A telephone interview or a mail questionnaire.	Never smokers; Experimenters; Established smokers (former/current).	Experimenters Male 25.4 % Female 18.4 %	Established Male 0.7 % Female 0.9 %

Note. . Af-Am = African-American; SES = socioeconomic status.

[a] Baseline survey from a longitudinal study.

Table 2 (continued)

Authors, Year of Publication	Population	Measurement of smoking	Categories of smoking	Prevalence of ever smokers	Prevalence of current smokers
Jackson & Henriksen, 1997a	1. North Carolina, USA 2. 1994-1996 3. cross-sectional 4. n=1,213 5. grade 3 and 5 6. Female 51% 7. White 82% Black 16% Other 2%	A self-administered in-class questionnaire (Teachers were present but stayed at their desks.)	Never tried; Onset of smoking.	Onset of smoking 15% grade 3 10% grade 5 21% Male 19% Female 12%	not available
Jackson et al., 1997b	1. North Carolina, USA 2. not available 3. cross-sectional 4. n=1,272 5. grade 4 and 6 6. Female 51% 7. White 83%	A self-administered in-class questionnaire.	Abstinence; Initiation; Experimentation.	Initiation & experimentation 27.4 % grade 4 17.8 % grade 6 37.2 % Female 24.5 % Male 30.5 % White 24.7 % Black 40.2 %	Experimentation 9.3 % grade 4 3.5 % grade 6 15.3% Female 6.7 % Male 12.1 % White 9.5 % Black 8.7 %
Greenlund et al., 1997 Bogalusa Heart Study	1. Louisiana, USA 2. 1993-1994 3. cross-sectional 4. n=913 5. grade 3-6 6. Female 49.8% 7. White 59.6%	A self-administered questionnaire (Private booths were provided.)	Never tried cigarettes; Ever tried cigarettes; Regular smokers.	Ever tried cigarettes 14.8 % White 20.8% Black 8.6%	Regularly smoked at least once a week 1.2%
Iannotti et al., 1996 Bush & Iannotti, 1992	1. Washington D.C., USA 2. 1988-1989 3. baseline[a] 4. n=2,078 5. 8.9 ± 0.9 years old 6. Female 51% 7. Af-Am 90 % Anglo-Am 2 % Hispanic 3 % Asian 1% Other 4% 8. High / low SES	An anonymous self-administered in-class questionnaire	Nonuse; Prior use (had previously smoked).	Had previously smoked 18.5 %	not available

Note. Af-Am = African-American; Anglo-Am = Anglo-American; SES = socioeconomic status. [a] Baseline survey from a longitudinal study.

Table 2 (continued)

Investigators, Publication year	Population	Measurement of smoking	Categories of smoking	Prevalence of ever smokers	Prevalence of current smokers
Meijer et al., 1996	1. Jerusalem, Israel 2. 1993 3. cross-sectional 4. n=155 5. grade 6 6. Female 53% in original sample 7. not available	An anonymous self-administered in-class questionnaire.	Experimental; Current (smoked within the last 2 weeks).	Experimental + current 15 %	Current 1 %
Pederson et al., 1997	1. Scarborough, Canada 2. 1992-1993 3. cross-sectional 4. n=1,552 5. grade 6 6. Female 51.2% 7. not available	A self-administered in-class questionnaire provided with a sealed envelope.	Never smoked; Ever smoked; Current regular.	Ever smoked 16.7% (Experimental 10.0% Ex-smokers 5.2% Current regular 1.1%) Male 18.9% Female 14.7%	Current regular smokers 1.1%
Rowe et al., 1996	1. Indiana, USA 2. 1980-1983 3. baseline[a] 4. not available 5. grade 6 6. Female≈Male 7. predominantly white	A group-administered questionnaire organized by classroom groups.	Nonsmokers; Triers; Regular smokers; Ex-smokers.	Trier + Regular smokers with Non-smoking parents: Male 19% Female 11% with Smoking parents: Male 32% Female 26%	Regular smokers with Non-smoking parents: Male 0% Female 0% with Smoking parents: Male 3% Female 2%
Elder et al., 1996 The Child and Adolescent Trial for Cardiovascular Health (CATCH)	1. USA 2. 1994 3. baseline[a] 4. n=6,527 5. grade 6 6. Female 50.6% 7. not available	Self-report in-class questionnaires	Non smokers; Ever smokers ("started to smoke a little").	Agreeing with " I have started to smoke a little." 4.8 %	not available

Note. [a] Baseline survey from a longitudinal study.

Table 2 (continued)

Authors, Year of Publication	Population	Measurement of smoking	Categories of smoking	Prevalence of ever smokers	Prevalence of current smokers
Abernathy et al., 1995 Canada Health Attitude Survey	1. Calgary, Canada 2. 1988 3. baseline[a] 4. n=1,243 5. grade 6 6. Female 49.6% 7. not available	An anonymous self-report questionnaire administered during health class by classroom teachers.	Nonsmokers; Smokers (ever smoked).	Smokers Male 30.0 % Female 21.6 %	not available
Øygard et al., 1995 The Oslo Youth Study	1. Oslo, Norway 2. 1979 3. baseline[a] 4. n=570 (1979) 5. grade 5-7 6. Female 50.4% in 1979 7. not available 8. 55-56% of parents had less than high school education.	An anonymous, self-report in-class questionnaires.	Never smokers; Experimental; Regular.	Experimental + Regular Male 13.6% Female 13.9%	Regular Male 4.3% Female 5.7%
Doherty & Allen, 1994	1. A Midwestern city, USA 2. 1982 3. baseline[a] 4. n=402 5. 11-13 years old 6. Female 50.7%[b] 7. Caucasian 96%[b] 8. middle to upper middle class.	A self-report questionnaire completed in the home.	Current smokers or not (Smoked one or more cigarettes in the past month Yes / No)	not available	Current smoker at time 1 22.4%

Note. [a] Baseline survey from a longitudinal study. [b]A percentage in the original sample.

Table 2 (continued)

Investigators, Publication	Population	Measurement of smoking	Categories of smoking	Prevalence of ever-smokers	Prevalence of current smokers
Emery et al., 1994	1. Florida, USA 2. not available 3. cross-sectional 4. n=411 5. grade 6 6. Female 48.2 % 7. White 82.7 % Hispanic 6.8% Af-Am 5.6 % Others 4.9 %	An anonymous, self-report in-class questionnaire with teachers' absence.	Never users; Past users (at least once in the past); Recent users (having used within the past 30 days).	Ever users 33.7% Past users 24.2 % Recent users 9.5 %	Recent users 9.5 %
Abernathy et al., 1992 Bertrand et al. 1993	1. Calgary, Canada 2. 1988 3. cross-sectional 4. Male n=4,095, Female n=3,969 5. grade 6 6. Female 50.8% 7. not available	A self-administered questionnaire during the health class by class teachers.	Never smoked; Ever smokers (Tried /quit & Current smokers).	Ever smokers Male 34.1 % (Tried/quit 27.8 %) Female 30.0 % (Tried/quit 24.3 %)	Current smokers Male 6.3 % Female 5.6 %
Abernathy, 1992 Bertrand et al. 1993	1. Calgary, Canada 2. 1988-1991 3. baseline[a] 4. n=3,566 5. grade 6 (11-12 years old) 6. Female 54.7% 7. not available	A self-administered questionnaire during the health class by class teachers.	Never smoked; Ever smokers (Tried /quit & Current smokers).	Ever smokers Male 31.0 % (tried/quit 26.3 %) Female 27.1 % (tried/quit 22.8 %)	Current smokers Male 4.7 % Female 4.3 %
Bowen et al., 1991 Hutchinson Smoking Prevention Project	1. Washington state, USA 2. 1986 3. cross-sectional 4. n=1,663 5. grade 5 6. not available 7. primarily white, working-, and middle-class communities	A self-administered in-class questionnaire with "bogus pipeline method".	Never-triers (never tried a cigarette); Triers (tried one or more cigarettes).	Had tried one cigarette 22.7% Had tried more than one 7.1% (Male 9.8% Female 5.1%) Ever smoked Male 36.1% Female 26.6%	not available

Note. Af-Am = African-American. [a] Baseline survey from a longitudinal study.

Table 2 (continued)

Authors, Year of Publication	Population	Measurement of smoking	Categories of smoking	Prevalence of ever-smokers	Prevalence of current smokers
Headen et al., 1991	1. Southeastern US 2. 1985 3. baseline[a] 4. n=392 5. 12 years old 6. Female 50.8 % 7. White 69.6 %	A self-report questionnaire in subjects' home.	Non-smokers; Smokers (at least a few times in the past year).	not available	Smokers 19.9 % Male 21.1 % Female 18.7 % White 24.9 % Black 8.9 %

Note. [a] Baseline survey from a longitudinal study.

Summary of studies on the prevalence of smoking among elementary school children

The target populations in these studies were diverse, and measures of smoking were widely variable, so that estimates of prevalence of "ever smokers" among children ranged from 10.8% to 40.2%. The following patterns were observed. First, the prevalence of smoking among children increases monotonically by age. Second, with respect to gender differences in smoking, the recent trend that smoking has become more common among young females than males in several western industrialized countries (Botvin & Botvin, 1992; Chollat-Traquet, 1992; Patton et al., 1998; Santé Québec, 1994; Stanton, Oei, & Silva, 1994; Wald & Nicolaides-Bouman, 1991; Waldron, Lye, & Brandon, 1991) was not apparent among elementary school children or children of approximately age 12 years. The prevalence of smoking among boys was equal to or higher than among girls. Finally, congruent with findings from recent studies that focused on potential differences in smoking prevalence by race/ethnicity (USDHH, 1998), a consistent pattern emerged that white children smoked more frequently than African-American/black, Hispanic, or Asian children. There was only one study which reported that black children initiated smoking more frequently than white children did (Jackson et al., 1997b). However, progressing to the experimentation stage was similar by ethnicity in that study.

2.4 Predictors and correlates of smoking initiation among children

2.4.1 Eligibility of studies included in this review

The following criteria delineate the reasons why publications were excluded from this review: (1) The initial age of study subjects was greater than 13 years (middle school/junior high school); (2) smoking was investigated as a risk factor for other dependent variables; (3) the publication language was not English; (4) the location of the study was not in Canada, the United States, western Europe, or Australia. In addition, because the prevalence of smoking, anti-smoking legislation, and the social norms toward smoking have evolved over time, findings from studies conducted more than 20 years ago might not be comparable to those of the 1980s or 1990s. Therefore, only studies that analyzed data collected in the past 20 years were reviewed.

2.4.2 Description of studies

Tables 3 and 4 summarize key features of studies that investigate predictors or correlates of smoking among children. Each study is described according to the following characteristics: location of the study, year(s) of baseline survey, year(s) that the outcome was assessed, study population (age, % female, ethnicity, SES, etc.), response rate at baseline, duration of follow-up, follow-up rates, methods of assessing smoking status, outcome variables, baseline prevalence, outcome rates, whether the "bogus pipeline" method was used, theory or hypothesis driving the research, analytical method for attrition analysis, analytical methods for the main analyses, and any other relevant information.

Table 3 ***Study Description (Longitudinal Studies)***

Authors, Year of publication, Name of the survey	Survey 1. Location 2. Type of study 3. Year(s) of recruitment 4. Year(s) of outcome assessed	Subjects 1. Number of non-smokers 2. Age/Grade 3. % Female 4. Ethnicity 5. SES	Follow-up 1. Response rate at baseline 2. Follow-up rate 3. Duration 4. Method for minimizing attrition	Measurement 1. Methods 2. Categories of outcome 3. Baseline prevalence 4. Incidence rate 5. "Bogus pipeline" method	Hypothesis	Analytic methods 1. Attrition analysis 2. Main analysis	Notes
Harrell et al., 1998 CHIC I-II (Cardiovascular Health in Children Study)	1. North Carolina, USA 2. School-based 3. not available 4. not available	1. n=1,970 2. 8-11 year-olds 3 Female 50.4% 4. White 79.8% Af-Am 20.2% 5. Half of schools were in rural areas and half in urban areas.	1. not available 2. attrition rates 7.4% - 41.7% 3. six years 4. not available	1. self-report in-class questionnaires, a parental questionnaire 2. Never smoked vs. experimental smoking or current smoking 3. experimental smoking 4% at grade 3-4 4. experimental smoking 42% at grade 8-9 5. none	Demographic and/or puberty level predict smoking initiation.	1. description with no analytical information. 2. χ^2tests, generalized estimating equations with a logistic link function, multiple logistic regression, survival analysis, Cox proportional hazard model with time dependent variable	Other racial minorities were excluded. Af-Am, urban subjects were more likely to be lost to follow-up over time.
Jackson, 1998	1. North Carolina, USA 2. School-based 3. 1994 4. 1996	1. n=788 abstinent at baseline 2. grade 3 and 5 3. Female 53% 4. White 83% 5. not available	1. not available 2. 62% 3. two years 4. not available	1. self-reports in-class 2. Abstinent vs. Smoking initiation 3. At baseline, 14% initiated smoking. 4. At year 3, 35% initiated smoking. 5. none	Susceptibility to smoke predicts smoking onset.	1. χ^2test for difference 2. hierarchical logistic regression analysis	Non-participants were more likely to be white, female, fifth grade. Those who were inconsistent in reporting smoking status were coded as abstinent.

Note. Af-Am = African-American.

Table 3 (continued)

Authors, Year of Publication	Survey	Subjects	Follow-up	Measurement	Hypothesis	Analytic methods	Notes
Jackson et al., 1998	1. North Carolina 2. School-based 3. 1994 4. 1995, 1996	1. n=401; (n=233 for starter vs. abstinent. n=258 for trier vs. abstinent. n=234 for smoker vs. abstinent.) 2. grade 5 3. Female 51% 4. White 84% Af-Am 15% other 1 %	1. 95% 2. wave 2 81% wave 3 65% 3. two years 4. not available	1. A self-report in-class questionnaire 2. patterns of smoking: abstinent through Year 3; starter; trier; smoker; 3. not available 4. starter 16.0% trier 22.4% smoker 15.7% 5. none	Susceptibility of smoking predicts smoking initiation.	1. χ^2test, t-test 2. hierarchical logistic regression analysis, stepwise forward selection	Those who were inconsistent in reporting smoking, had a learning disability, or spoke English as a second language were excluded.
O'Loughlin et al., 1998a Coeur en Santé St Louis du Parc	1. Montreal, Canada 2. School-based 3. 1993-1994 4. 1994-1995	1. n=1824 2. grade 4 and 5 3. Female 50.0% 4. Family origin % Europe 22.5 Central Am 21.7 Canada 20.8 Asia 14.7 Arabic 5.2 South Am 4.6 Other 10.6 5. Low-income neighborhoods	1. not available 2. 66.8% 3. one year 4. not available	1. A self-report in-class questionnaire 2. Never smoked; Ever smoked 3. Ever smoked at baseline: Male 24.3% Female 15.8% 4. Ever smoked at 1-year follow-up: Male 32.6% Female 25.3% 5. none	Exploratory investigation in multiethnic, low-income, inner-city neighborhoods	1. χ^2test 2. univariate and multivariate logistic regression analysis	"Family origin" is based on countries of birth of subjects and their parents, and languages spoken by the subject. Those who were inconsistent in reporting smoking were considered non-smokers.
Epstein et al., 1998	1. New York 2. School-based 3. 1994 4. 1996	1. n=1,295 2. grade 6 and 7 (mean. 12.66 years) 3. Female 54% 4. self-identified Hispanic or Latino	1. more than 90% 2. 79.8% 3. one year 4. At least one return data collection for absentees	1. A self-report in-class questionnaire and CO sampling 2. 11-point index assessed smoking 3. not available 4. not available 5. none	Linguistic acculturation predicts smoking. There is a moderating effect of gender.	1. a simple description in characteristics of sample for the two survey assessments 2. multivariate linear regression	

Note. Af-Am = African-American; Central Am = Central America; South Am = South America.

Table 3 (continued)

Authors, Year of Publication	Survey	Subjects	Follow-up	Measurement	Hypothesis	Analytic methods	Notes
Choi et al., 1997 Teenage Attitude and Practice Study (TAPS I, II)	1. USA 2. National survey 3. 1989 4. 1993	1. n=503 2. 12-13 year-old experimenters. 3. Female 38.6% 4. Caucasian 78.6% Af-Am 12.1% Hispanic 6.6% Asian/Other 2.8% 5. Household income was asked and included as a covariate.	1. (82% of original sample of 12,097) 2. (87% of original cohorts) The information specific to this study was not available. 3. four years 4. not available	1. Interviewed by telephone or mail questionnaires 2. Never smokers; Experimenters; Former/Current established. 3. Experimenter: Male 25.4 % Female 18.4% Established smoker: Male 0.7% Female 0.9% 4. Established smoker Male 31.7% Female 32.2% 5. none	Psychosocial factors predict established smoking among experimenters .	1. not available 2. multiple logistic regression analysis for each age group	All percentages were weighted and adjusted for sampling design and non-response.
Øygard et al., 1995 The Oslo Youth Study	1. Oslo, Norway 2. Initially school-based 3. 1979, 1981 4. 1989	1. n=570 (1979 cohort), n=530 (1981 cohort) 2. grade 5, 6, and 7 3. Female 50.4% (1979) 51.6% (1981) 4. not available 5. 55-56% of parent's education <high school.	1. 79.5% in 1979 66.5% in 1981 2. 1979 68.9% 1981 74.0% 3. 8 years / 10 years 4. Tried to contact non-responders as many as three times by mail.	1. A self-report in-class at baseline; a mailed questionnaire at follow-up. 2. Non-smokers; experimental; regular smokers 3. Experimental: Male 9.3% Female 8.2% Regular: Male 5.7% Female 4.3% 4. Daily smokers Male 39.9% Female 50.7% 5. none	Impact of family and peer models during the early adolescent years on smoking onset and subsequent daily smoking among young adults.	1. Cross-tabulation and logistic regression analysis 2. χ^2test, multivariate logistic regression analysis	Parents/guardians were provided separate questionnaires at baseline surveys. Includes baseline smokers (= a panel study design).

Note. Af-Am = African-American.

Table 3 (continued)

Authors, Year of Publication	Survey	Subjects	Follow-up	Measurement	Hypothesis	Analytic methods	Notes
Elder et al., 1996 Child and Adolescent Trial for Cardiovascular Health (CATCH)	1. U.S.A. 2. School-based 3. 1991 4. 1994	1. n=6,527 2. grade 3 3. Female 50.6% 4. Caucasians 70.6% 5. not available	1. not available 2. not available 3. three years 4. not available	1. self-report in-class questionnaire 2. life time use of cigarettes 3. not available 4. at grade 5 4.8%	Socioenviron-mental factors and organizational change influence smoking.	1. not available 2. logistic regression analysis	Smoking experience at grade 3 was not measured. Intervention schools were included.
Doherty & Allen, 1994	1. A Midwestern city, U.S.A. 2. Community-based 3. 1982 4. 1988	1. n=312 nonsmokers 2. 11-13 years old 3. Female 50.7% 4. Caucasians 96% 5. Middle to upper-middle class, members of an HMO, two-parent family 89%	1. 42% of families 2. 89% of families 3. six years 4. not available	1. A self-report questionnaire filled in the home 2. One or more cigarettes smoked in the past month 3. At baseline: 22.3% 4. At time 2: 30% became smokers. 5. none	Family functioning, parental smoking, and adolescent psychosocial adjustment predict smoking initiation.	1. not available 2. χ^2test, multivariate logistic regression analysis	
Bertrand & Abernathy, 1993 Peer Assisted Learning program (PAL)	1. Calgary, Canada 2. School-based 3. 1988 4. 1989, 1990, 1991	1. n=2,459 never smoker 2. grade 6 3. Female 56.1% 4. not available	1. not available 2. wave 2 71.5% wave 3 80.4% wave 4 82.7%. 3. three years 4. not available	1. An anonymous self-report in-class questionnaire 2. Never smokers, Triers/Quitters, Current smokers. 3. at grade 6: Male 4.6% Female 4.3% 4. at grade 9: Male 19.7% Female 27.0% 5. none	Exploratory investigation	1. not available 2. one-way between subjects multivariate analysis of variance, stepwise discriminant function analysis	Children who repeated the same grade were excluded. Children who were exposed to the PAL program were included.

Note. HMO = Health Maintenance Organization

Table 4 ***Study Description (Cross-sectional Studies)***

Authors, Year of publication, Name of the survey	Survey 1. Location 2. Type of study 3. Year(s) of survey	Subjects 1. Total number 2. Age/Grade 3. % of Female 4. Ethnicity 5. SES	Participation	Measurement 1. Methods 2. Categories 3. Prevalence 4. "Bogus pipeline" method	Hypothesis	Analytic methods (Main analysis)	Notes
O'Loughlin et al., 1998b Coeur en Santé St Louis du Parc	1. Montreal, Canada 2. School-based 3. 1993	1. n=2,285 2. grades 4-6 3. Female 50.0% 4. Family origin % Canada 21.0 Europe 23.2 Central America 20.1 Asia 15.8 Arabic-speaking countries 5.1 South America 5.4 Other 9.5 5. Low-income neighborhoods	1. 80.5% of eligible students 2. 99.3% were eligible for analysis	1. A self-report in-class questionnaire 2. Never smoked; Ever smoked 3. Ever smoked: boys 28.7% girls 20.3% 4. Experimenter/regular smoker: boys 4.9% girls 3.9%	Psychosocial factors predict smoking initiation/ continued smoking among children in multiethnic, low-income, inner-city neighbor-hoods.	univariate and multivariate logistic regression analysis	"Family origin" is based on countries of birth of subjects and their parent(s) and languages spoken by the subjects.
Pederson et al., 1997	1. Scarborough, Canada 2. School-based 3. 1992-1993 academic year	1. n=1,552 2. grade 6 3. Female 51.2 % 4. One fifth of the target population was recent immigrant.	1. 43.1 % of eligible students 2. 91.7% were eligible for analysis	1. A self-report in-class questionnaire 2. Ever smokers;. never smokers 3. Ever smoker 16.7% Male 18.9% Female 14.7%	Psychosocial factors are related to smoking in grade 6 children.	Pearson's χ^2 test, Student's t-test	

2.4.3 Findings

Table 5 summarizes the results from each study. A meta-analytic approach could not be applied because of the limited number of articles (ten longitudinal and two cross-sectional studies) as well as the heterogeneity of study populations, methods of outcomes measured and potential predictors, differing lengths of follow-up, and differing analytical methods. Potential predictors were categorized into three groups: (1) sociodemographic factors, (2) environmental and interpersonal socialization factors, and (3) psychological/ intrapersonal and behavioral factors. Statistically significant findings are discussed for each predictor, but the direction of the effect was not reported since the measures and scales were not always consistent among studies reviewed. Recent studies among adolescents were not presented in the following table. However, relevant findings from those studies are discussed in the following section.

Table 5 ***Study Variables and Findings (Studies of Predictors of Smoking Initiation among Children)***

First author, year of publication	Analysis	Outcome	Variables																															
			Sociodemographic								Environmental										Psychological/behavioral													Others
											Smoking							Parental																
			Age/grade	Gender	Ethnicity/race	Acculturation	Family structure	SES (parental education)	SES (household income)	Locale (urban/rural)	Parents	Father	Mother	Sibling(s)	Household smoker	Friends	Accessibility	negative response	communication	monitoring	School performance	Intentions	Mastery	Life events	Psychological distress	Mental health	Self-esteem	Self-control	Mental coping	Susceptibility	BMI (Overweight)	Physical activity	Puberty level	
Harrell, 1998	GEE	Experimental smoker		M	M			M		M																							M	
		Current smoker		M	M			M		m																							M	
	MLR	Grade 3-4 to Grade 4-5		M	m			M		m																								
		Grade 4-5 to Grade 5-6		M	M			M		M																								
	SA	Experimenter		U	U			U		U																								
	Cox R	Experimenter		M	M			M		M																								
Jackson, 1998	HLR	Becoming a starter		u m	u m		u m				U M					u m	u m	u m	u	u	U M						u	U m		u				
		Becoming a trier		u m	U M		U m				U M					U M	U	u	u	U	U M						u	U M		u				
		Becoming a smoker		u m	U m		U M				U M					U M	U M	U M	u	U M	U M						U m	U M		U M				
	ST	Abstinent, starter, trier, smoker.																				U												
Jackson, 1998	HLR	Smoking initiation	U M	u m	U M										U M	U m					U m									U M				

Note. GEE = generalized estimating equations with a logistic link function; MLR = multivariate logistic regression analysis; SA = survival analysis; Cox R = Cox regression analysis; HLR = hierarchical logistic regression analysis; ST = Scheffe's tests for pairwise comparisons of the group means; SES = socioeconomic status.

U represents a significant variable in a univariate model; u represents a non-significant variable in a univariate model. M represents a significant variable in a multivariate model; m represents a non-significant variable in the same model. A blank signifies that the variable was not investigated in the study.

Table 5 (continued)

First author, year of publication	Analysis	Outcome	Age/grade	Gender	Ethnicity/race	Acculturation	Family structure	SES (parental education)	SES (household income)	Locale (urban or rural)	Parents	Father	Mother	Sibling(s)	Family member(s)	Friends	Accessibility	Father/Mother's encouragement on Non-smoking		Family cohesion	School performance	Social conformity	Mastery	Life events	Psychological distress	Mental health/depression	Self-esteem	Coping/ Problem solving	Mental coping	Susceptibility	BMI (Overweight)	Physical activity	TV programs/day	Others
			Sociodemographic								Environmental (Smoking: Parents – Friends)										Psychosocial/behavioral													Others
O'Loughlin 1998	MLR	Becoming an ever-smoker	U M	U M	U	u	U	u	u		M	U	U	U M		U M		u	u												u	U	u	High fat/junk food consumption = U, M
		Continued smoking Boys	U M		u	u	U	u	u			u	u	U		U M		u	u												u m	u	u	Baseline smoking =U, M
		Girls	U M		u	u	u	u	u			u	u	u		U M		u	u												U M	u	u	Baseline smoking =U, m
Elder, 1996	MLR	Ever smoking		u M	u m							U m	U m	U M	U M	U M																		Intervention = u, m
Choi, 1997	MLR	Establishing smoking		u M	U M			U M	u m							U m-M					U m													Level of experimentation =U,M
Øygard, 1995	MLR	Daily smoking 1979 cohort						m				m	M	m		m																		Baseline smoking (regular vs. non smokers) = M
		Male only						U				u	U	u		U																		Baseline smoking =U
		Female only						u				u	U	u		u																		Baseline smoking =u
		Daily smoking 1981 cohort						m				m	M	m		M																		Baseline smoking (regular vs. non smokers) = M
		Male only						U				u	u	u		U																		Baseline smoking =U
		Female only						u				U	U	U		U																		Baseline smoking =U

Note. MLR = multivariate logistic regression analysis. U represents a significant variable in a univariate model; u represents a non-significant variable in a univariate model. M represents a significant variable in a multivariate model; m represents a non-significant variable in the same model. A blank signifies that the variable was not investigated in the study.

Table 5 (continued)

First author, year of publication	Analysis	Outcome	Variables																																	
			Sociodemographic								Environmental											Psychosocial/behavioral														Others
											Smoking																									
			Age/grade	Gender	Ethnicity/race	Acculturation	Family structure	SES (Parental education)	SES Household income	Locale (urban or rural)	Parents	Father	Mother	Brother/Sister smokes	Family member smokes	Friends	Accessibility	Approval of mother	Parent/child relationship	Family cohesion	Social support	Social conformity	Mastery	Life events	Psychological distress	Mental health/depression	Self-esteem	Coping/ Problem solving	Mental coping	Rebelliousness	BMI	Physical activity	TV programs/day	Leisure time activities	High fat/junk food consumption	
Doherty, 1994	HLR	Current Smoking									u M									U M					V		V									Family cohesion is an effect modifier of parental smoking.
Bertrand, 1993	DFA	Discriminate Never-smokers, Triers/quitters, Current smokers at Grade 7[a]																																		
															3	1			2							V	V							4		
		Discriminate Never smokers, Triers/quitters, Current smokers at Grade 8[a]																																		
															2	4			1							5	V							3		
Univariate and/or Cross-sectional analyses																																				
Epstein, 1998	GLM	Smoking inde		U		U																														
		Male only				u																														
		Female only				U																														
O'Loughlin, 1998b	LR	Ever smoking P < 0.10	U	U	u		u	u	u			u	U	U		U															u	u	U		U	Mother encourage non-smoking = u
	MLR	Ever smoking Boys	U				u m	u	u			U	U	U		U															U	U	U m		M	Mother encourage non-smoking = u
	MLR	Ever smoking Girls	U				U	u	u			u m	U	U		U															u	u	U		m	Mother encourage non-smoking = U
Pederson, 1997	χ^2test	Ever smoking										U	U	U		U		U			U	U	U	U		U	u	u	u	U						Substance abuse = u, Destructive behavior = u

Note. HLR = hierarchical logistic regression analysis; DFA = discriminant function analysis; GLM= general linear model analysis. (M) LR= (multivariate) logistic regression analysis. U represents a significant variable in a univariate model; u represents a non-significant variable in a univariate model. M represents a significant variable in a multivariate model; m represents a non-significant variable in the same model. V represents a variable investigated in the study and not retained for multivariate analysis (Results from univariate analysis were not available). A blank signifies that the variable was not investigated in the study.

[a] The number represents the order in which they are entered in the equation, which provides an index of the relative importance of the variables.

Sociodemographic factors

Age/Grade: Age and grade are well-established predictors of smoking initiation among adolescents. When the age/grade range of the study sample is wide, age/grade emerges as a significant predictor for smoking onset among children as well. Choi et al. (1997) found that several predictors of becoming an established smoker differed and were modified by age.

Gender: Recent studies from western societies show that higher smoking prevalence has been observed among female than male adolescents (Botvin & Botvin, 1992; McGee & Stanton, 1993; Stanton et al., 1994). The gender difference among preadolescents remains controversial. Female gender predicted smoking initiation in two studies (Bertrand & Abernathy, 1993; Øygard, Klepp, Tell, & Vellar, 1995), while other studies found the opposite (Elder et al., 1996; Harrell, Bangdiwala, Deng, Webb, & Bradley, 1998; O'Loughlin et al., 1998b). The percentage of established smoking or continued smoking were equal for both genders in two studies (Choi et al., 1997, O'Loughlin et al., 1998a). It has been suggested that there are different mechanisms underlying smoking adoption between genders in both adolescents and adults. Nevertheless, little is known about whether or not there are gender differences in predictors of smoking initiation among younger children. Epstein et al. (1998) indicated that a factor such as linguistic acculturation might affect boys and girls differently, and O'Loughlin et al. (1998a) suggested that weight issues may be associated with maintaining the smoking habit among preadolescent girls, but not among same-aged boys.

Ethnicity/Race: Current categorizations of race/ethnicity in many studies on smoking are based on political/legal categories developed by the federal government in the United States, including designations such as "White", "Black", "Hispanic", "Asian", or "Other". Most researchers have used these ethnic categories or more simplified categorizations such as "White" versus "Black/Non-white". Although the validity and meaning of these labels have been questioned (Collins, 1996), it has been well documented that smoking prevalence differs by ethnic group; African-American and

Asian adolescents are less likely to smoke than White or Hispanic adolescents and young adults (Flint, Yamada, & Novotny, 1998; Greenlund et al., 1996; Najem, Batuman, Smith, & Feuerman, 1997; Najem, Batuman, Smith, & Feuerman, 1997). In addition, ethnicity has been regarded as a moderating factor that influences adolescent smoking initiation (Griesler & Kandel, 1998; Sussman, Dent, Flay, Hansen, & Johnson, 1987). Three studies reported ethnicity/race as an independent predictor of smoking initiation among children after controlling for possible confounding factors such as SES, and family members' smoking (Choi et al., 1997; Harrell et al., 1998; Jackson, 1998). On the other hand, it was not always a significant predictor in Jackson's study, in which each pattern of smoking onset was compared separately to abstainers (Jackson et al., 1998). O'Loughlin et al. (1998a) examined a "family origin" variable created based on language(s) spoken and country(ies) of birth of the parents and subject. Although this variable was a significant one-year predictor of ever smoking in univariate analysis, it was not retained in multivariate analysis. Also, it was not predictive of continuing smoking one year later.

Acculturation: The influence of acculturation on smoking, which has been studied among adolescent immigrants or adolescents with different cultural background and living in western countries, is not clear. Differences in study populations, methods of measurement, smoking prevalence in subjects' countries of origin, and analytical methods all contribute to inconsistent results between studies (Dusenbery, Epstein, Botvin, & Diaz, 1994; Klonoff & Landrine, 1996). Epstein et al. (1998) hypothesized that acculturation, measured by use of the languages of the host county and the country of ethnic origin (linguistic acculturation), predict smoking among Hispanic/Latino youths. They found that more acculturated Hispanic girls smoke more than their less acculturated counterparts, although this relation was not evident among boys. Since these analyses did not control for environmental and psychological factors, the results need to be confirmed in multivariate analyses that include major confounders. O'Loughlin et al. (1998a) studied subject's birth country in a multiethnic population as a proxy for acculturation. However, foreign-born children did not appear to be different from Canadian-born children with respect to smoking initiation and continuation in this one-year follow-up study.

Family structure: Single-parent family status is a predictor of smoking initiation among adolescents (USDHH, 1994). Two-parent family status is protective for early smoking onset (Conrad et al., 1992; Isohanni, Moilanen, & Rantakallio, 1991). Nevertheless, this variable has not always been found to be significant in studies among children (Jackson et al., 1998; O'Loughlin et al., 1998a, 1998b). It is possible that risk factors for smoking tend to be clustered among children who do not live in a two-parent family so that once other factors, such as SES, family functioning, parental smoking, or other psychosocial factors related to family structure, are taken into account, family structure itself does not remain predictive.

SES: It is well established that low SES is associated with smoking among adults and many studies support that adolescents living in less advantaged milieus start smoking early. (Conrad et al., 1992; Van Teijlingen ER, Friend, & Twine, 1996) Although parental education, as a proxy of SES, was investigated in three studies, findings were not consistent. Harrell et al. reported protective effects of higher parental education in their study conducted in North Carolina (1998), while Choi et al. (1997) found the opposite effect based on a national US sample of 12-13 year-olds. In their long follow-up study (8 and 10 years) in Norway, Øygard et al. (1995) found that parental education level was predictive of future smoking only among females in univariate analysis. Such inconsistent results may be due in part to lack of an appropriate or comprehensive measure for SES and/or to wide variability in study populations and designs.

Locale: The reported influences of location of the residence (urban versus rural) on smoking initiation are inconsistent among adolescents. Harrell et al. (1998) investigated the residence of children as a predictor of smoking initiation and reported that children living in rural areas started smoking earlier than children in urban areas. Taking into account potential confounders including availability of cigarettes among minors, the effect of area of residence needs to be confirmed in future research.

Environmental and interpersonal factors

Parental smoking: Parental smoking was found to be a significant predictor in five studies. Øygard et al. (1995) reported that, after adjusting for SES, father's, friends', and sibling smoking, only mother's smoking predicted subjects' smoking status 8 or 10 years later. Doherty and Allen (1994) reported that the effect of parental smoking was modified by subjects' family cohesion level, the degree of emotional bonding in the family. Parental smoking was predictive of smoking behavior six years later only among children with low family cohesion. Parental smoking was an independent two-year predictor of smoking initiation, even after controlling for friends' smoking (Jackson et. al., 1998). On the other hand, in an analysis of predictors of continued smoking by O'Loughlin et al. (1998a), parental smoking was not a significant one-year predictor in multivariate analysis.

Sibling smoking: The influence of sibling smoking on adolescent smoking is well documented (Chassin, Presson, Sherman, Montello, & McGrew, 1986; Hunter et al., 1986). Among the studies reviewed, O'Loughlin et al. (1998a) reported that sibling smoking was an independent one-year predictor of smoking initiation. Øygard et al. (1995) found a significant effect of sibling smoking only among boys in univariate analysis. Some studies were unable to examine this variable probably because of the small number of observations in the category or because of the use of this variable to create another variable, such as smokers at home or family members' smoking.

Family members' smoking: Since health-related behaviors including smoking are likely to be clustered in families and thus the effect of each family member's behavior is decreased by interrelations among them in multivariate model, it seems reasonable that some studies preferred to use the variable, family members' smoking or smoking in household. Bertrand and Abernathy (1993) found that family members' smoking was a significant predictor and its relative importance appeared to increase as the follow-up period increased. Two other studies also reported its significance in both multivariate and univariate analyses (Elder et al., 1996; Jackson, 1998).

Friends' smoking: Despite differing definitions used for "friends", the influence of friends' smoking on adolescents' smoking initiation has been repeatedly documented in previous studies (Ary & Biglan, 1988; Chassin, Presson, Sherman, Montello, & McGrew, 1986; Conrad et al., 1992; Wang, Fitzhugh, Westerfield, & Eddy, 1995). However, three studies among children reviewed here (Jackson, 1998; Jackson et al., 1998; Øygard et al., 1995) reported negative findings of friends' smoking in their multivariate analyses. There are two possible reasons for these non-significant findings. First, friends' smoking status is likely to change over time. It is possible that a measure of "friend smoking", obtained at one point in time in the past, would not remain predictive after a 10-year follow-up period as in the case of the study by Øygard (1995). Similarly, in Bertrand and Abernathy 's study (1993), a decrease in the relative importance of friends' smoking was observed when the time interval between two surveys increased by one year. By studying subjects according to patterns of smoking onset during two years of follow-up, Jackson et al. (1998) found that friends' smoking was a significant predictor of becoming a smoker or a trier, but not of becoming a starter, who remains abstinent until one year follow-up and starts smoking before the two year follow-up. Changes in friends' smoking status after one year follow-up (from "no" to "yes"), which was not measured in that study, is possible. It may indicate that the changes in subjects' smoking status follow shortly after acquiring friends who smoke. In other words, if investigators had had data on friends' smoking status less than two years before the assessment of the outcome, friends' smoking may have been identified as a significant predictor even among those starters. Second, if friends' smoking was strongly related to other variables in the multivariate model, such as age, ethnicity/race, susceptibility, and so forth, friends' smoking may not remain as an independent predictor. Depending on the characteristics of study population, the relative importance of friends' smoking can vary, and this is the case of another study (Jackson et al., 1998).

Additionally, although the relative importance of friends' smoking and parental smoking is not clear, Choi et al. (1997) reported that experimenters who had smokers among their family members were not at risk for becoming established smokers, whereas

children who had smokers among their best friends were about 2.5 times more likely to establish smoking compared to children with minimal exposure to smokers. Stanton and Silva (1993) reported that friends who smoke, but not parents who smoke, had an influence on children's initiation of smoking, while both non-smoking friends and non-smoking parents were influential in terms of non-smoking behavior (Stanton & Silva, 1993).

Accessibility to cigarettes: Among older adolescents, accessibility was not a predictor of smoking initiation after adjusting for other variables (McGee & Stanton, 1993). It is possible, however, that accessibility or availability of cigarettes is more important for younger children. One study suggests the method by which children obtain cigarettes shifts with age, such that young children tend to obtain cigarettes from friends or family members while older adolescents tend to purchase them (Forster, Wolfson, Murray, Wagenaar, & Claxton, 1997). It is possible that smokers at home trigger children's smoking onset, not only through role modeling, but also by providing easy access to cigarettes. Two studies examined accessibility. Jackson et al. (1998a, 1998b) reported that accessibility was an independent predictor of becoming a smoker, but not of becoming a starter or trier. Elder et al. (1996) also found accessibility to be significant in predicting ever smoking, after adjusting for sociodemographic and smoking-related environmental factors.

Parental communication, child/parent relationship, parent/adolescent strain, family cohesion, parental monitoring: Social relationships within family members have been hypothesized to be important predictors or modifiers of other predictors of adolescent smoking (Distefan, Gilpin, Choi, & Pierce, 1998; Reimers, Pomrehn, Becker, & Lauer, 1990; Williams & Covington, 1997). The general relationship between children and parents appeared to play an important role with respect to smoking initiation also among children. Family functioning, the quality of family relationships was investigated in a study, and Doherty and Allen (1994) found that low family cohesion predicted subsequent adolescent smoking and that the influence of parental smoking was modified by family cohesion level. Bertrand and Abernathy (1993) found that the parent/child

relationship was the strongest predictor amongst all variables investigated in their two-year follow-up study. On the other hand, Jackson et al. (1998) reported that, amongst smoking-specific socialization factors, parental monitoring, but not parental communication, was predictive of becoming a smoker. On the other hand, O'Loughlin et al. reported that perceived parental encouragement of non-smoking, which was asked if parent(s) talked about dangers of smoking, was not a predictor of either smoking initiation or continuing smoking (1998a).

Psychological and behavioral factors

Investigation of psychological or intra-personal factors among children is limited, possibly because of difficulties measuring psychosocial factors among younger children whose cognitive level is not fully developed, or because of the lack of established measures.

School performance: Three studies (Choi et al., 1997; Jackson, 1998; Jackson et al., 1998) examined this predictor of smoking initiation in adolescents and all found positive associations at least in univariate analyses. Children with low academic achievement were more likely to start or establish smoking compared to children with high academic achievement. However, after adjustment for other variables in multivariate models, two studies reported that school performance was no longer significant, suggesting that it may not be an independent predictor of smoking initiation (Jackson, 1998) or established smoking (Choi, 1997).

Self-esteem: Early studies have demonstrated an association between low-self esteem and smoking among adolescents and children (Botvin et al., 1993; Crump, Lillie-Blanton, & Anthony, 1997; Botvin et al., 1993). Nevertheless, only one of the three prospective studies reviewed here reported statistical significance, and only in univariate analysis (Jackson et al., 1998).

Mental health, psychological distress: Studies involving adolescents have suggested an association between smoking and stress (Byrne, Byrne, & Reinhart, 1995;

Covey & Tam, 1990; Weinrich, Hardin, Valois, & Gleaton, 1996). Psychological well-being during childhood was investigated in three studies (Bertrand & Abernathy, 1993; Doherty & Allen, 1994; Pederson, Koval, & O'Connor, 1997). Although a significant association was found cross-sectionally (Pederson et al., 1997) and prospectively (Bertrand & Abernathy, 1993), another found psychological well-being to be non-predictive (Doherty & Allen, 1994).

Intention to smoke: Intention to smoke has been found to be predictive of smoking onset among adolescents. One study examined short- and long-term intentions to smoke among the subgroups of different smoking patterns (Jackson et al., 1998). Intention to smoke could differentiate each group of abstainers, starters, triers, and smokers from the rest of subjects.

Susceptibility: Recently, several researchers reported that susceptibility to smoking (i.e., lack of a firm commitment not to smoke) was a strong independent predictor of smoking initiation among adolescents (Pierce, Choi, Gilpin, Farkas, & Merritt, 1996a; Unger, Johnson, Stoddard, Nezami, & Chou, 1997). Individuals who remained abstinent but susceptible to smoking were more frequent among younger children and could benefit from prevention programs. Jackson et al. (1998) also reported that susceptibility was a strong independent predictor of smoking initiation among children. Susceptibility could represent the first step of smoking onset, comparable to the preparation stage described in the Surgeon General's Report (USDHH, 1994). Identifying the predictors of this variable, in addition to the predictors of actual smoking onset, could be important for structuring comprehensive intervention programs.

Body mass index (BMI): Concerns about weight have been recognized as one reason that females smoke and find it difficult to quit. Consistent with findings among adolescent girls (French, Perry, Leon, & Fulkerson, 1994), an association between smoking and weight status has been reported in pre-adolescent girls (O'Loughlin et al., 1998a). Overweight girls who had tried smoking were more likely than their non-

overweight counterparts to continue smoking. This association was not found among boys.

Physical activity: One study has suggested that gender difference (female smoke more than male) observed among youth may be related with low participation in sports among females (Waldron et al., 1991). Among white Male high school students, higher levels of physical activity were reported to be inversely associated with cigarette smoking (Winnail, Valois, McKeown, Saunders, & Pate, 1995). Another study reported that smoking initiation over three years was significantly lower among females aged 12 to 16 years with high leisure-time physical activity level (LTPA) (Aaron et al., 1995). In univariate analysis, high physical activity predicted smoking initiation among boys aged 9 to 12 (O'Loughlin et al., 1998a).

Dietary behaviors: Among adolescent girls, food consumption, as well as eating disorders, have been reported to be associated with smoking onset (Brunswick & Messeri, 1983). Although dietary behaviors may reflect family eating habits more than children's preferences, frequent consumption of high fat/junk food was reported to be an independent predictor of smoking initiation among boys but not among girls (O'Loughlin et al., 1998a). It is not clear if unhealthy lifestyle behaviors are causally related to smoking onset or if unhealthy behaviors tend to cluster in certain familial environments.

Other factors

Pubertal stage: Pubertal development level was examined in one study only (Harrell et al., 1998). A positive association was observed between entering puberty and smoking initiation. This finding is consistent with other studies suggesting that smoking initiation relates to earlier maturation (Swan, Creeser, & Murray, 1990; Tschann et al., 1994; Wilson et al., 1994). Another study reported that saliva testosterone level was associated with smoking initiation among 12-14 year-old adolescents (Bauman, Foshee, & Haley, 1992), suggesting that biological aspects of smoking initiation may be important as well.

Baseline smoking: Panel studies, which include study subjects who have outcome (i.e., ever smokers) at the outset of the study. conducted among adolescents have documented that baseline smoking is a strong predictor of future smoking behavior (Ary & Biglan, 1988). After stratifying by gender, one study failed to find significance of this variable in the multivariate analysis among girls (O'Loughlin et al., 1998a), and another also could not find significance in univariate analysis among females (Øygard et al., 1995). However, it is unclear as to whether this indicated either effect modification by gender or lack of statistical power (i.e., baseline smoking prevalence among girls was lower than that among boys).

2.5 Limitations of the review

Only published studies were included in this review. Difficulties in reviewing this literature include lack of standardization in definitions of smoking and use of selected study populations, which might have limited external generalizability.

2.6 Summary

Prevalence of smoking among children

The reported prevalence of current smoking among elementary school children was generally low. However, the prevalence of ever smoking was markedly high (10.8%-40.2%). Both current and ever smoking increased with age. Prevalence among boys was somewhat higher than among girls at this age (approximately 12 years old), and the prevalence of smoking among Whites was higher than among children of other races, including African-American/Blacks, Hispanics, and Asians.

Predictors of smoking initiation, and of continued smoking among children

Among sociodemographic factors, increased age was a universally important predictor. Gender might be a predictor, but might be more important as an effect modifier than an independent predictor. Ethnicity/race, acculturation, family structure, and SES could be important predictors or potential confounders/effect modifiers of other

predictors. Consequently, information on these factors needs to be collected and carefully examined.

Among social-environmental factors, smoking by friends was a consistent and strong predictor of smoking. Parental smoking, sibling smoking, and family members' smoking was also predictive. Although family functioning (e.g., the quality of family relationships) and accessibility to cigarettes have been reported to be predictive in recent studies, the "causal" mechanisms underlying these socialization/environmental factors on smoking onset (i.e., role modeling, easy access, shared attitudes, social norms etc.) have not yet been fully explored.

Among the limited number of psychological/behavioral factors investigated to date, none have been consistently identified as an independent predictor, except for school performance. Several factors are predictive among adolescents but have not yet been examined in children. In addition to the difficulty in establishing reliable measures of psychological factors among children, potential interrelations between variables, as well as the time-variant nature of such variables, could impede investigations.

Weight issues may be important in the smoking onset process among preadolescent girls (similar to adolescent and adult females) (O'Loughlin et al.,1998a). Another study reported that pubertal level were predictive of smoking initiation (Harrell et al., 1998). The influences of biological/physiological changes, such as hormone levels, on smoking initiation warrant further investigation.

Using baseline values measured at the outset of the study and examining the predictability of factors after relatively long follow-up periods would have resulted in negative findings. Thus following up cohorts over shorter time intervals and applying appropriate analytical methods, such as survival analysis, generalized estimated equation models with updated covariates, or proportional hazard analysis, in which time-dependent variables are accommodated over time, may help find weak associations in future studies.

3. Methods

3.1 Background

Coeur en Santé St Louis du Parc was a school-based heart health promotion program for elementary school children in grades 4 to 6 in St-Louis du Parc, a multiethnic, low-income, inner-city area in Montreal. To evaluate the impact of this multi-factorial cardiovascular disease prevention intervention, a quasi-experimental study was conducted by a local Public Health Department in Montreal, as part of the Canadian Heart Health Initiative. Eight elementary schools located in St-Louis du Parc were designated intervention schools, and two comparison schools, matched for ethnicity (based on the mother tongue of students in the school as compiled by) and poverty, were selected for each intervention school, from within the Montreal Catholic School Commission (MCSC) and the Protestant School Board of Greater Montreal (PSBGM). A school-specific poverty index (Conseil scolaire de l'île de Montréal, 1993) and the mother tongue of the students in the schools, compiled by the Department of Intercultural Affaires of the Montreal Catholic School Commission, were used to match intervention and comparison schools. The poverty index of all schools included in the study was in the lowest quartile, indicating that the schools were drawn from underprivileged areas in Montreal. Of 16 comparison schools, two dropped out over the course of this five-year study. Therefore, data for study subjects from 14 comparison schools (i.e., which were not exposed to the intervention program) in the original study were available for a secondary analysis and were used for the observational study reported in this thesis.

Data on behavioral risk factors for cardiovascular disease including smoking, physical activity, and dietary habits, as well as sociodemographic characteristics were collected in repeated cross-sectional surveys from 1993 through 1997 using self-reported questionnaires in a classroom setting. All students aged 9 to 12 in grade 4, including special education and learning impaired students, were included in the survey. The original study was approved by a standing ethics committee at the Department of Public Health of the Montreal General Hospital.

3.2 Study design

Figure 1 illustrates the study design. Three cohorts of grade 4 children (one with baseline data collected in 1993, one with baseline data collected in 1994, and one with baseline data collected in 1995) from the 14 comparison schools was identified for analyses. Students with both baseline and two-year follow-up data were identified from among all participants using a unique personal identification number for each student. Children who participated in the survey at baseline but did not participate in the two-year follow-up survey as well as those participated in baseline and one-year follow-up surveys only were lost to follow-up; their data were used in the attrition analysis only.

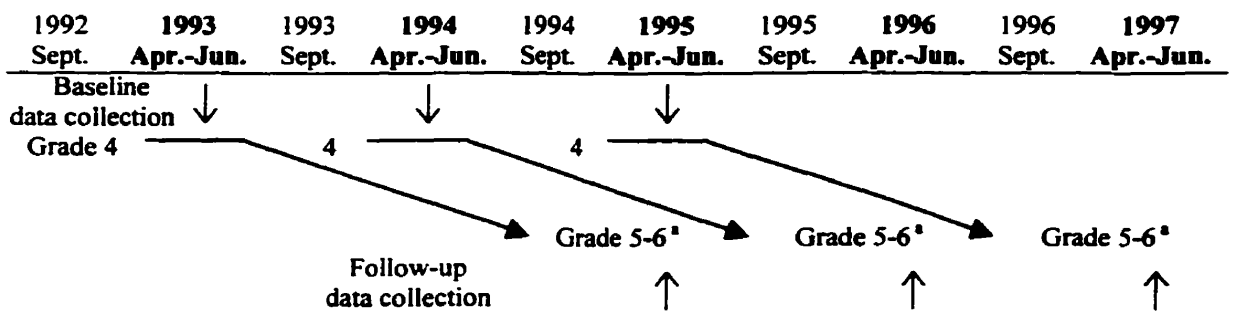

Figure 1. **Description of the study cohort and timing of data collection, 1993-1997, Montreal, Canada.**

Note. Sept. = September. Apr. = April. Jun. = June. Arrows = times of data collection.

[a] Includes children who repeated grade 4 or 5 and participated in the baseline and two-year follow-up surveys.

3.3 Data collection procedures

Baseline data for the three cohorts were collected in two visits to each of the 14 schools in April-June 1993, 1994, and 1995. Two-year follow-up data were collected in 1995, 1996, and 1997 using the same methods of data collection. During the first visit, anthropometric measurements of height and weight were collected by lay interviewers who had been trained according to a standardized protocol (Evers & Hooper, 1995). During the second visit to each school, data on student sociodemographic characteristics, lifestyle behaviors (smoking, level of physical activity, dietary habits), and psychosocial variables were collected. Two trained interviewers administered the questionnaires according to an Interviewer's Manual of Instructions (Heart Health Program, 1995). One interviewer, standing at the front of the classroom, carefully read each question. A second interviewer circulated in the classroom to answer questions from students and to verify that students were following instructions. The interviewers emphasized repeatedly the importance of truthful responses and they assured confidentiality. The questionnaire, which took 30-45 minutes to complete, was administered in French or English according to the official language of the school.

Bilingual (English/French) letters explaining the objectives and procedures of the study and consent forms for participation were distributed to all students three weeks before the survey team visited the school. There were two types of parental consent: "active" consent which required participating children to return a slip with signed approval from a parent, and "passive" consent in which the signed slip required to be returned only if parents refused consent. Either active or passive parental consent for children's participation was obtained according to the stated preference or school policies as directed by the school principal.

3.4 Description of study variables

Table 6 shows the list of the variables investigated in this study.

Table 6 ***List of Variables Investigated in This Study***

Dependent variable	• Becoming a current smoker (currently trying/experimenter/regular smoker at follow-up). • Becoming an ever smoker (including even one puff).
Independent Variables	
Sociodemographic characteristics	• Gender • Age • Family structure • Country of birth • Family origin • Parental unemployment
Smoking-related Environments	• Parental smoking • Sibling smoking • Friends' smoking • Parental encouragement of non-smoking
Variables related to children's BMI or lifestyle	• Overweight (greater than 90th percentile of BMI based on the age- and gender-specific percentiles) • Number of TV programs watched/day • Physical inactivity • Participation in sports activities/lessons
Other	• Baseline year • School

Note. BMI = body mass index; TV = television.

A copy of the questionnaire used in 1993 is included in Appendix I.

3.4.1 Dependent variables

Current smoking and Ever smoking The dependent variables investigated in this study were (1) whether the subject was a current smoker (i.e., smoked one or more times in the past year), and (2) whether the subject had ever smoked (including even just a puff) at the two-year follow-up . Not all children who try cigarettes at this age become regular

smokers, rather, the majority of experimenters are considered neither committed nonsmokers nor committed smokers. Lifetime experience of smoking may, therefore, not the best outcome to be targeted by smoking prevention programs. Furthermore, because the subgroup at risk of established smoking during preadolescence might differ from those who do not go on to become established smokers, the outcome of becoming a current smoker at follow-up was examined. Since studies have suggested that transition to later smoking stages accelerates as age increases and since the development of smoking behavior is largely a one-way process (Fergusson & Horwood, 1995), we included "currently trying" children in the "current smokers" category.

On the other hand, recent studies demonstrate early experimentation with cigarettes to be a predictor of later use. Children who start smoking at age 12 or younger were more likely to be regular and heavy smokers than children who start smoking at older ages (Escobedo et al., 1993). In addition, despite the lack of consensus on the definitions of early stages of childhood smoking, ever smoking is the most common outcome studied in research of this field, including the recent study of one-year predictors conducted using the same data base (O'Loughlin et al., 1998a). Thus, we also investigated predictors of ever smoking, whether or not the subjects tried smoking (even just a puff) during the two-year follow-up.

Student smoking status was determined based on responses to two different items: 1) "*Have you ever smoked a cigarette, even just a puff?*" with response categories being *No; Yes, 1 or 2 times; Yes, 3 to 10 times*; and 2) "*Check off one box below which describes you best, You have never smoked; You have smoked, but not at all in the past year; You smoked once or a couple of times in the past year; You smoke a couple of times each month; You smoke a couple of times each week; and You smoke every day*" (Flynn et al., 1992). "Current smokers" included those "trying smoking" (having smoked 1-2 times in the past year), "experimenters" (those who had smoked 3 or more times in the past year but not on a regular basis), and "regular smokers" (students who smoked a couple of times each month or more). "Ever smokers" included both "current smokers" and "past smokers".

3.4.2 Potential predictors investigated

Potential predictors were selected from the items in the original questionnaires based on published or suspected associations with children's smoking. Detailed descriptions are provided for only variables that are not self-explanatory.

Socio-demographic characteristics

Data on sociodemographic characteristics collected in the student questionnaires included gender, age, country of birth of child (born in Canada yes or no), family structure (two-parent family, single-parent family, others), country of birth of the father and mother, language(s) spoken, and employment status of parents.

Age: The self-reported age of children at baseline was a continuous variable in the original data, with a mean of 10.0 years and standard deviation (*SD*) of 0.8. Age ranged from 9 to 12 years. There was no linear association between age and the logit of the probability of becoming lost to follow-up or becoming a current or ever smoker. Children aged 11 or 12 years in grade 4 often include immigrant children with low language proficiency in English or French or children with learning difficulties or behavioral disorders. For example, 64.6% of 11 and 12 year-olds and only 38.7% of 9 and 10 year-olds were born outside of Canada. This difference was statistically significant ($\chi^2(1, n = 1152) = 54.84$, $p < .001$), suggesting that older children had somewhat different characteristics from grade 4 children who are aged 9 or 10. Children aged 9 or 10 years, therefore, formed the reference category.

Family structure: Family structure was categorized into "two-parent", "single-parent", or "other" in original data set. The category "other" represented only 5.2% of the sample. Therefore, we grouped "other" with "single-parent family". Two-parent family status represented 72.9% of the sample and was chosen as the reference category.

Country of birth: Children who reported that they were born in Canada ("born in Canada" -yes) represented 55.5% of the sample and were chosen as the reference

category. Children who reported that they were born in countries other than Canada were grouped ("born in Canada" -no).

Family origin: A variable had been created in the original data set to study the possible influence of cultural factors and ethnicity on smoking. For the composition of a "family origin" variable, country(ies) of birth of each child, the mother, and father, and language(s) spoken were used. When there were too few students for meaningful analyses in a single category, family origins were grouped into categories based on language similarity and/or geographic proximity. Children whose family origin could not be determined were categorized as "other/unclassified". Categories included Canada, Europe, Asia, Arabic-speaking countries, South America, Central America/Caribbean, and Other (including 43 countries). For analysis, six dummy variables were created with Canada chosen as the reference category. However, none of the boys in the "other" category and none of the girls in "Asian" category reported current smoking, resulting in zero cell counts. Hence, the family origin variable with seven categories could not be investigated in multivariate analysis. A dichotomous family origin variable, "Canadian family origin" (yes, no) was, therefore, created. Since the family origin of 83.3% of study subjects was "outside Canada", "outside Canada" was chosen as the reference category. The categorizations used for the "family origin variable" are presented in Appendix II.

Parental unemployment: To identify a subgroup possibly experiencing relatively more financial difficulty, children who reported that their parents were not employed or whose parent was not employed, in single-parent families were categorized as "exposed" ("parent(s) unemployed" -yes). Children who answered that they did not know parental employment status were also grouped with "exposed". When at least one of parents was reported to be employed, their status was chosen as "unexposed" ("parents(s) unemployment" -no), the reference category.

Environmental characteristics with respect to smoking

Parental smoking: Children's perception of the smoking status of parents was obtained by asking, "*Does your mother smoke cigarettes?*" (yes, no, not applicable) and

"*Does your father smoke cigarettes?*" (yes, no, not applicable). Agreement between children's report of parents' smoking status and parents' self-reports was high among a sample from the same study base; Kappa = .82 for mothers and .72 for fathers. (Barnett, O'Loughlin, Paradis, & Renaud, 1997). The Spearman rank correlation coefficient between mother's smoking and father's smoking was .33 (p = .0001) among 213 boys; .37 (p = .0001) among 258 girls. We created a single variable, "(either/both) parent(s) smoke(s)" (yes, no) for analysis. Children who did not report that "either/both parent(s) smoke(s)" formed the reference category. Children were categorized depending on whether they had at least one smoking parent or not, regardless of the family structure (two-parent family or not).

Sibling smoking: Children were asked about the smoking status of their siblings by having them fill in the correct number in the box: "*You have brothers who smoke. You have sisters who smoke.*" Children who answered one or more to either question were coded "brother(s) smoke(s)" (yes/no) or "sister(s) smoke(s)" (yes/no). Although the correlation between these two variables was not very strong (r = .10; p = .02) among 498 study subjects, the proportions of subjects who reported that brother/sister smoked were small (4.2% for "brother(s) smoke(s)", 2.2% for "sister(s) smoke(s)"). We created a single variable "sibling(s) smoke(s)" (yes, no/not applicable), for analysis. The reference category for this variable was having no brother(s) or sister(s) who smoke(s).

Friends' smoking: Children's perception of the smoking status of their friends was measured by the question; "*How many of your friends smoke cigarettes?*" (none, a few, most, don't know). Response to this variable, "friends smoke", was dichotomized into "friends smoke" -yes (a few/most) or -no (none/don't know). Those who reported that none of their friends smoked or who reported that they did not know if their friends smoked formed the reference group.

Parental encouragement of non-smoking: Data were obtained on perception of parental encouragement of non-smoking according to the following questions: "*Does your father talk to you about the danger of smoking?*" (yes, no, not applicable) and "*Does*

your mother talk to you about the danger of smoking?" (yes, no, not applicable). No and not applicable were combined in the original data. Mother's and father's encouragement was correlated with $r = .38$; $p = .0001$ among 463 study subjects. We combined these two variables and created a single variable, "either/both parents encourage non-smoking" (yes, no/not applicable). Children were categorized depending on whether they had at least one parent who encouraged non-smoking, regardless of their family structure (two-parent family or not). Children who reported that "either/both parents encouraged non-smoking" were chosen as the reference group.

Variables related to children's BMI or lifestyle

Overweight: BMI was calculated as weight (kg)/height $(m)^2$. Children were categorized into five groups according to the age- and gender-specific BMI percentiles using the National Health and Nutrition Examination Surveys (NHANES) II standards (Frisancho, 1990). "Thin" was defined as less than the age- and gender-specific 15^{th} percentile. "normal" was defined as between the 15^{th} and 85^{th} age- and gender-specific percentile. "heavy" included children between the 85^{th} and 90^{th}. "Overweight" included children between the 90^{th} and 95^{th}; "obese" included children greater than the 95^{th} age- and gender-specific percentile (Rolland-Cachera et al., 1982). Since the association between these five categories and log-odds of becoming a current/ever smoker did not suggest a linear association, the first three categories were grouped as "not overweight" which became the reference category and the forth and fifth categories were grouped as "overweight".

Number of TV programs watched per day: The number of TV programs watched on an average weekday was asked in the question, "*On schooldays, you usually watch.... 6 or more TV programs a day, 4 or 5 programs a day, 2 or 3 programs a day, 1 program a day, you don't watch TV on schooldays.*" No log-linear association with the dependent variables was observed. Although the advertisement of cigarettes on TV was banned in Canada, the smoking-related images are still viewable in many TV programs, such as movies or TV dramas. Those who reported the highest level of TV watching were

categorized as "exposed", and those who reported less than 6 programs per day were grouped as "unexposed", the reference category.

Physical inactivity: Children completed a self-report Weekly Activity Checklist (Sallis, Buono, Roby, Micale, & Nelson, 1993). For each of the preceding seven days, students checked in which physical activities they had participated. The list of activities for this study was determined based on extensive pre-testing and included the 28 activities most frequently engaged in by this age group during the spring season. Children were instructed to check those activities in which they had been engaged for 15 minutes or more. The association between quartile of the physical activity score and the log odds (risk) of becoming a current or an ever smoker did not demonstrate linearity. Thus, we defined physical inactivity to be a score of six or less based on recent recommendations advocating daily moderate to vigorous physical activity (USDHH, 1996). Children participating in less than one activity per day on average (score of six or less), were defined to be physically inactive. Children who reported six or more physical activities per week were chosen to represent the reference category.

Participation in sports activities/lessons: Data were collected on participation, during the past year, in sports teams at school, outside school, and sports/dance lessons. "Participation in sports activities or sports lessons" was dichotomized into yes or no. Those who reported participation in any organized sports activities (at school, outside school) or reported that they took any sports/dance lessons formed the reference category.

Other variables

Baseline year: This variable represented one of the three cohorts in which children were followed, namely, 1993 to 1995, 1994 to 1996, or 1995 to 1997. Two dummy variables were created and the cohort of baseline year 1993 was chosen as the reference.

School: The prevalence of smoking, as well as attrition, varied by school. Although this variable could not be investigated in the analysis of current smokers, due to

zero cell counts in the outcome category in several schools, and although calculating the odds ratio for each school was not our primary interest, the importance of controlling this variable was justified as follows. First, there might have been clustering of smoking behavior within schools. It has been suggested that the smoking initiation process could be explained, in part, by an "epidemic model" (Rowe et al., 1992), i.e., smoking among schoolmates could influence the behavior of children attending the same school. Secondly, several potential predictors were found to be correlated with the school variable in this study sample, including age, baseline year, family origin, country of birth, parental smoking, and sibling smoking. Finally, controlling for school can control for other unmeasured confounders. One such factor may be the availability of cigarettes within each school district. For example, cigarettes could have been purchased more easily in some school districts than others, depending on local situations such as the existence of corner stores where children could easily obtain cigarettes. Consequently, thirteen dummy variables were created for the 14 schools, allowing for control of this variable in the analysis conducted to identify predictors of becoming an ever smoker. As previously mentioned, the prevalence of current smoking was low creating zero cell counts in several schools, such that school could not be controlled in the analysis of current smoking.

4. Data Analysis

4.1 Preparation of the data set

Children who had missing values for age or gender at baseline, and for smoking status either at baseline or at follow-up, were excluded from the study subjects. Since two schools, in 1994 as well as 1995, temporarily dropped out from the survey because of the refusal of extra curricular programs by the teachers' union, children who enrolled to those dropped out schools at the two-year follow-up survey were eliminated from the eligible children.

4.1.1 Coding

All dichotomous variables were coded 1 or 0 (reference). Dummy variables were created for variables with more than two categories and nominal variables.

4.1.2 Missing data

Observations with missing data were assigned to be "unexposed" category for the following variables; parental unemployment, parental encouragement of non-smoking, and participation in sports activities/sports lessons. Subjects with missing data on other variables were deleted both in univariate and multivariate analyses. Categories of response coded and the number of missing data for each variable are presented in Appendix III.

4.2 Statistical methods

4.2.1 Attrition analysis

Attrition analyses were conducted to examine possible bias resulting from differential attrition. Children who remained in the study were compared to children lost to follow-up using the baseline characteristics. The p values by the χ^2 test for difference as well as by the log likelihood ratio χ^2 test were computed for each variable and independent predictors of lost to follow-up were identified using multivariate logistic regression analyses.

4.2.2 Main analysis

Two-year predictors of current/ever smoking among never smokers at baseline were identified in multivariate logistic regression analysis. The dependent variables were whether baseline never smokers became current smokers or whether they became ever smokers during the two-year follow-up. The prevalence of current smoking or ever smoking in each category of all potential predictors was first examined univariately. All exposures associated with the dependent variable with p value $< .25$ by the log likelihood ratio χ^2 test were retained for the stepwise selection procedure. The purpose of the analysis was to obtain a valid exposure-outcome estimate rather than a good predictive

model, and the use of standard computer algorithms including stepwise selection procedure is not, in general, recommended for this goal since confounders and effect modifiers must be given special attention. However, as long as the analyst understands the limitations of the methods, such mechanical selection procedure can serve as a useful tool in the model building process by screening a large number of variables and by simultaneously fitting a number of logistic regression equations in much less time (Hosmer & Lemeshow, 1989). Thus, we applied this procedure for the model building. In the analyses of predictors of ever smoking, the procedure was modified. Potential confounding variables, identified as predictors of ever smoking in previous research, were included in the model as control variables before stepwise selection procedures were undertaken. In forward selection procedures, we chose .15 for the "alpha" level to judge the importance of variables (Hosmer and Lemeshow, 1989). Subsequently, backward selection procedures were conducted for confirmation. All other variables, not retained, were entered into the model individually in order to check for confounding. After selection of the main effect variables, candidate interaction terms from the combinations of main effect variables were investigated during the model building. Main analyses were completed for boys and girls separately.

Goodness of fit was assessed using the Hosmer and Lemeshow Test, in which discrepancies between observed and expected numbers of observations in groups are summarized using the χ^2 statistic, with (number of groups minus 2) degrees of freedom. This test is recommended for models with a dichotomous outcome and a large number of covariate patterns (Hosmer & Lemeshow, 1989). Lack of statistical significance indicates good fit.

All analyses were conducted using the SAS statistical package (SAS Institute inc., 1988) except for stepwise logistic regression analyses, which were done by the BMDP statistical package (BMDP Statistical Software, 1988). In this report, results were considered statistically significant when the p values were less than .05.

5. Results

5.1 Response

5.1.1 Baseline participation response

Of 1,851 grade 4 children who were enrolled in the 14 participating schools in 1993, the 12 schools in 1994, and the 12 schools in 1995 at the time of baseline survey, data were collected from 1,431 subjects (77.3%). The percentage of baseline participation differed by baseline year with marginal statistical significance (χ^2 (2, N=1,851) = 5.55, p = .06). The proportions of baseline participation were 76.3% in 1993, 72.2% in 1994, and 77.2% in 1995.

5.1.2 Follow-up proportion

Of 1,165 grade 4 children who had never smoked at baseline, two-year follow-up data were collected from 516 subjects (44.3%). Ninety-six out of 1,165 (8.2%) participated in the baseline and two-year follow-up surveys only, and 420 of 1,165 (36.1%) participated in all three surveys (baseline, one-year, and two-year follow-up). Excluding children who had missing values on smoking status at follow-up (n = 15) resulted in 501 study subjects (43.0% of eligible cohort). Figure 2 illustrates the response in the study population.

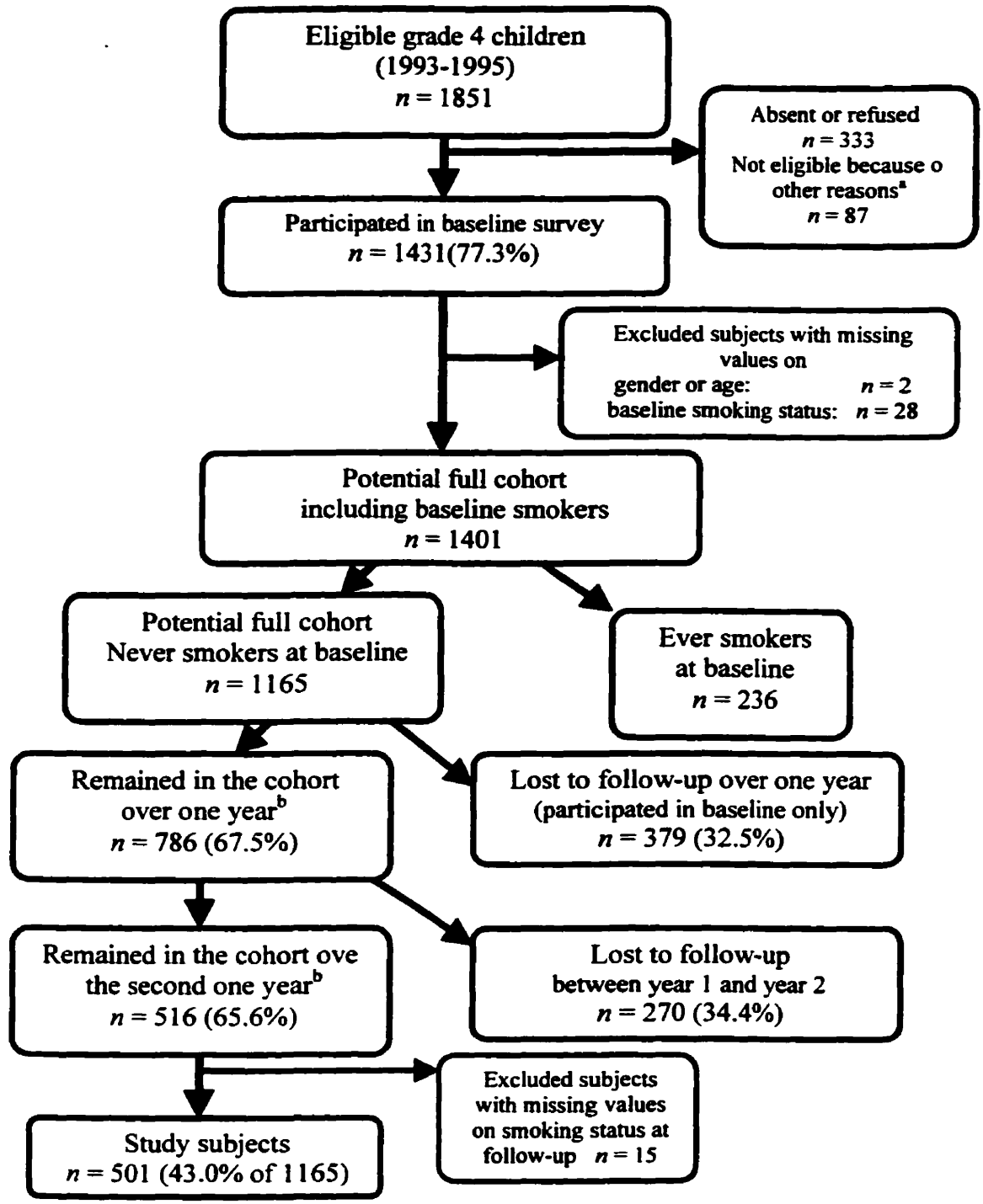

Figure 2. **Description of response in study population.**

Note. [a] Children who were 8 year-old or younger or 13 year-old or older at baseline; those who had missing value on their grade were excluded from the data set. [b] Includes children with both baseline and two-year follow-up data but without one-year follow-up data ($n = 96$).

The proportion of subjects followed differed significantly by baseline year (χ^2 (2, N=1,165) = 20.29, $p < .001$), with losses to follow-up were higher in the later years. Figure 3 shows the number and proportion of subjects with two-year follow-up data, according to the baseline year of data collection.

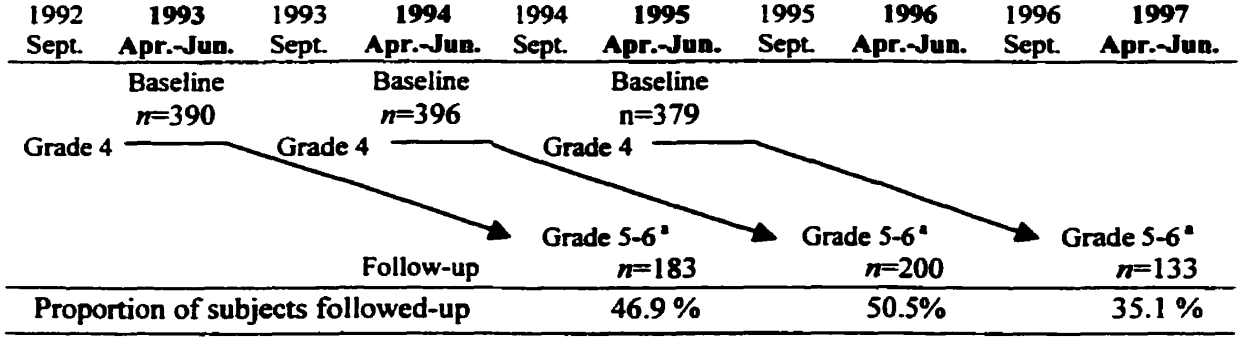

Figure 3. **Proportion of subjects with two-year follow-up data, by baseline year.**

Note. [a] Included children who repeated grade 4 or 5.

5.2 Attrition analysis

Overall, 56.3% of boys and 55.2% of girls who never smoked at baseline were lost to follow-up over two years. The percentage of subjects lost to follow-up did not differ by gender (χ^2 (1, N = 1,165) = 0.13, p = .72). To investigate possible bias related to attrition, selected variables including sociodemographic characteristics of children who remained in the study were compared to those of children lost to follow-up (Table 7). Based on the χ^2 tests for difference by category, children lost to follow-up differed significantly from those followed up with respect to baseline year, age, school, country of birth, family origin, and parental encouragement of non-smoking.

Table 7 ***Comparison of Baseline Characteristics of Elementary Schoolchildren Followed-up and Those Lost to Follow-up, Montreal, Canada, 1993-1997***

Variable		Cohort		Lost to follow-up		
		n[a]	%	*n*[a]	%	
All		516	n/a	649	n/a	
Gender	Male	241	46.7	310	47.8	
	Female	275	53.3	339	52.2	
Baseline year	1993	183	35.5	207	31.9	****
	1994	200	38.8	196	30.2	
	1995	133	25.8	246	37.9	
Age (years)	9-10	436	84.5	462	71.2	****
	11-12	80	15.5	187	28.8	
School	1	60	11.6	66	10.2	***
	2	45	8.7	85	13.1	
	3	21	4.1	26	4.0	
	4	40	7.8	66	10.2	
	5	8	1.6	6	0.9	
	6	28	5.4	30	4.6	
	7	35	6.8	32	4.9	
	8	55	10.7	59	9.1	
	9	28	5.4	67	10.3	
	10	36	7.0	58	8.9	
	11	45	8.7	34	5.2	
	12	21	4.1	30	4.6	
	13	50	9.7	40	6.2	
	14	44	8.5	50	7.7	
Family structure	Two-parent	388	75.2	461	71.0	*
	Single-parent/Other	128	24.8	188	29.0	
Born in Canada	Yes	317	61.4	322	50.6	****
	No	199	38.6	314	49.4	
Family origin	Canada	92	17.8	109	16.8	**
	Europe	96	18.6	88	13.6	
	Asia	73	14.2	139	21.4	
	Arabic-speaking countries	27	5.2	47	7.2	
	South America	26	5.0	25	3.7	
	Central America/Caribbean	132	25.6	144	22.2	
	Other	70	13.6	85	15.0	
Parent(s) unemployed	No	453	87.8	553	85.2	
	Yes/Don't know	63	12.2	96	14.8	
Friends smoke	None/Don't know	428	82.9	522	80.4	
	A few/Most	88	17.1	127	19.6	

Table 7 (continued)

Variable		Cohort		Lost to follow-up		
		n[a]	%	*n*[a]	%	
Parent(s) smokes	No[b]	276	53.6	314	48.5	*
	Yes	239	46.6	334	51.5	
Sibling(s) smoke(s)	No[b]	480	93.6	595	92.8	
	Yes	33	6.4	46	7.2	
Parent(s) encourage(s) non-smoking	Yes	457	88.6	550	84.8	*
	No[b]	59	11.4	99	15.3	

Note. [a] Totals differ because of missing data. [b] Category includes "not applicable".
*$p < .25$. **$p < .05$. ***$p < .01$. ****$p < .001$, by the χ^2 test for difference by category.

Based on the results from univariate logistic analyses, a multivariate analysis was conducted to identify independent predictors of loss to follow-up. Table 8 shows the unadjusted and adjusted odds ratios for the predictors of loss to follow-up.

The results from multivariate analysis indicate that children lost to follow-up differed from those who remained in the study. After adjusting for school and family origin, children lost to follow-up were more likely to be in the cohort of the latest baseline year (1995), 11-12 years old, not living in a two-parent family, born outside Canada, and not having parent(s) who encourage(s) non-smoking. The odds of becoming lost to follow-up among children of Asian origin were significantly higher than that of Canadians in univariate analysis. Although adding the family origin variable with six dummy variables improved the model (assessed by the log likelihood ratio χ^2 test; $\chi^2(6, N=1,152) = 12.3$, $p = .06$), none of the individual categories were significant in the final model when Canadian origin was used as the reference category. Since family origin was significantly associated with other variables in the model (except for parental encouragement of non-smoking), it was retained in the final model. School, as a group, improved the model, with marginal significance, but was associated with all other variables except for parental encouragement. School was, therefore, included in the final model for adjustment. Goodness of fit was acceptable.

Table 8 ***Predictors of Loss to Follow-up among Elementary Schoolchildren who had Never Smoked in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1997***

Predictor	Unadjusted OR [a] (95%CI)	Adjusted OR [a] (95%CI)
Baseline year		
1993	Ref.	Ref.
1994	0.9 (0.7, 1.1)	1.0 (0.7, 1.3)
1995	1.6 (1.2, 2.2)	1.8 (1.3, 2.5)
Age (years)		
9-10	Ref.	Ref.
11-12	2.2 (1.6, 3.0)	1.9 (1.4, 2.6)
Family structure		
Two-parent	Ref.	Ref.
Single-parent/Other	1.6 (1.2, 2.2)	1.4 (1.0, 2.0)
Family origin		
Canada	Ref.	Ref.
Europe	0.8 (0.5, 1.1)	0.7 (0.5, 1.2)
Asia	1.5 (1.0, 2.2)	1.1 (0.7, 1.8)
Arabic-speaking countries	1.4 (0.8, 2.5)	1.0 (0.7, 1.8)
South America	0.7 (0.4, 1.4)	0.6 (0.3, 1.1)
Central America/Caribbean	0.9 (0.6, 1.3)	0.7 (0.5, 1.1)
Other/Unclassified	0.9 (0.6, 1.4)	0.7 (0.5, 1.1)
Born in Canada		
Yes	Ref.	Ref.
No	1.6 (1.2, 2.0)	1.5 (1.1, 2.0)
Parent(s) encourage(s) non-smoking		
Yes	Ref.	Ref.
No	1.4 (1.0, 2.0)	1.4 (1.0, 2.0)

Note. $n = 1152$. Excludes 13 subjects with missing values. Hosmer-Lemeshow Goodness of Fit statistic $\chi^2(8, N = 1152) = 13.05, p = .11$. OR = odds ratio; CI = confidence interval.

[a] Unadjusted OR obtained from univariate logistic regression analysis.

[b] Adjusted OR obtained from multivariate logistic regression analysis including school.

5.3 Prevalence of smoking and patterns of change in smoking status

5.3.1 Prevalence and pattern of smoking by gender

The proportions of current and past smokers at baseline are presented in Table 9. Differences in smoking status by gender were statistically significant.

Table 9 ***Smoking Status at Baseline, by Gender, among Elementary Schoolchildren in Multiethnic, Low-income Neighborhoods, Montreal, Canada, 1993-1995***

Gender	Total *n*	Baseline smoking status					
		Never smoker		Past smoker		Current smoker	
		%	95% CI	%	95% CI	%	95% CI
Boys	706	78.1	75.0 - 81.1	15.3	12.6 - 18.0	6.7	4.8 - 8.5
Girls	695	88.4	86.0 - 90.7	9.1	6.9 - 11.2	2.6	1.4 - 3.8
Total	1401	83.2	81.2 - 85.1	12.2	10.5 - 13.9	4.6	3.5 - 5.7

Note. The proportion of smokers differed significantly by gender (χ^2 (2, N = 1579) = 34.77, $p < .001$).

At the two-year follow-up, the proportion of current smoking was almost doubled compared to at baseline. Gender differences were no longer statistically significant (Table 10).

Table 10 ***Smoking Status at Follow-up, by Gender, among Elementary Schoolchildren in Multiethnic, Low-income Neighborhoods, Montreal, Canada, 1995-1997***

Gender	Total *n*	Follow-up smoking status					
		Never smoker		Past smoker		Current smoker	
		%	95% CI	%	95% CI	%	95% CI
Boys	300	67.2	62.0-72.6	20.0	15.5 -24.5	12.7	8.9 -16.4
Girls	304	71.7	66.6-76.8	19.1	14.7-23.5	9.2	6.0-12.5
Total	604	69.5	65.9-73.2	19.5	16.4-22.7	10.9	8.4 -13.4

Note. Includes subjects who were ever smokers at baseline. Smoking status did not significantly differ by gender (χ^2 (2, N = 604) = 2.13, p = .34).

5.3.2 Prevalence and pattern of smoking by baseline year

Among grade 4 children in 1993, the prevalence of ever smoking was 20.4% (Table 11). The proportion decreased in later years; 15.2% in 1994 and 14.6% in 1995. This association was statistically significant.

Table 11 ***Smoking Status at Baseline, by Baseline Year, among Elementary Schoolchildren in Multiethnic, Low-income Neighborhoods, Montreal, Canada, 1993-1995***

Baseline year	Total	Baseline smoking status			
		Never smoker		Ever smoker	
	n	%	95%CI	%	95%CI
1993	490	79.6	76.0 – 83.2	20.4	16.8 – 24.0
1994	467	84.8	81.5 – 88.1	15.2	11.9 – 18.5
1995	444	85.4	82.1 – 88.6	14.6	11.4 – 17.9
Total	1401	83.2	81.2 – 85.1	16.8	14.9 - 18.8

Note. The proportion of baseline ever smokers differed significantly by baseline year (χ^2 (2, N = 1,401) = 6.88, p = .03).

5.3.3 Other characteristics of study subjects that changed over time

Several characteristics of the study population changed over time due, in part, to the high mobility among the population. Our data suggest that country of birth, age, family origin, parental unemployment, and parental smoking differed significantly by baseline year among children who participated in the baseline survey. The proportion of children born outside Canada and that of parental unemployment increased; the proportion of older children, parental smoking decreased in later years. The ethnic mix also differed by baseline year. Among the boys followed-up, the proportions of older subjects, parental unemployment, and parental encouragement of non-smoking differed significantly by baseline year. Among the followed-up girls, those born in Canada and parental smoking decreased significantly over time. The distribution of family origins and schools also differed by baseline year in both genders. These changes in sociodemographic and smoking-related characteristics were taken into account during the model building process and will be discussed later.

5.3.4 Smoking status at follow-up according to baseline smoking status

Table 12 shows that baseline smoking status predicted smoking status two years later. Most never-smokers (78.0%) remained never-smokers. About half (47.4%) of children who had ever smoked, but who had not smoked in the past year at baseline, (i.e., past smokers), did not become current smokers. Depending on baseline smoking, 7.6% of never-smokers, 25.0% of past smokers, 31.3% of those trying to smoke, and 36.6% of experimental/regular smokers at baseline reported current smoking two years later.

As all data on smoking behavior were derived from children's self-report questionnaires, some misclassifications in smoking status were observed. Twenty-nine of 103 ever smokers at baseline (28.2%) reported never smoking in the two-year follow-up. These children were misclassified either at baseline or at follow-up.

Table 12 ***Smoking Status at Two-year Follow-up According to Baseline Smoking Status among Elementary Schoolchildren in Multiethnic, Low-income Neighborhoods, Montreal, Canada, 1993-1997***

Baseline smoking	Total n	Two-year follow-up smoking: Never- smoked %	95%CI	Past smoker %	95%CI	Currently trying %	95%CI	Current exp./reg.[a] %	95%CI
Never smoked	501	78.0	74.4 - 81.7	14.4	11.3 -17.4	1.8	0.6 - 3.0	5.8	3.7 - 7.8
Past smoker	76	27.6	18.5 - 39.3	47.4	35.6 -58.6	6.6	2.5 - 15.2	18.4	10.3 -28.3
Currently trying	16	31.3	11.1 - 57.8	37.5	15.3 -63.5	18.8	4.1 - 45.1	12.5	1.6 - 38.0
Current exp./reg.[a]	11	27.3	6.1 - 59.3	36.4	11.1- 67.1	0.0	0.0 - 23.5	36.7	11.1- 67.1
Total	604	69.4	65.7 - 73.1	19.4	16.3 -22.6	3.0	1.6 - 4.3	8.2	6.0 - 10.4

Note. Excludes subjects with missing values on smoking status either at baseline or at follow-up.

[a] Exp./reg. = experimental smokers or regular smokers.

5.3.5 Smoking status at follow-up among baseline never smokers

Over the two-year follow-up, 9.2% of boys who had never smoked at baseline and 6.3% of girls who had never smoked became current smokers; 21.8% of boys and 22.1% of girls became ever smokers (past smokers or current smokers). Among baseline never smokers, the pattern of change in smoking status among boys was similar to that among girls (Table 13).

Table 13 ***Smoking Status at Two-year Follow-up among Baseline Never Smokers in Multiethnic, Low-income Neighborhoods, Montreal, Canada, 1995-1997***

Gender	Total *n*	Smoking status at two-year follow-up					
		Never smoker		Past smoker		Current smoker	
		%	95% CI	%	95% CI	%	95% CI
Boys	229	78.1	72.8 - 83.5	12.7	8.4 - 17.0	9.2	5.4 - 12.9
Girls	272	77.9	73.0 - 82.9	15.8	11.5 - 20.1	6.3	3.4 - 9.1
Total	501	78.0	74.4 - 81.7	14.4	11.3 - 17.4	7.6	5.3 - 9.9

Note. The patterns of smoking did not differ between boys and girls (χ^2 (2, N = 501) = 2.25, p = .32).

5.4 Characteristics of study subjects

Table 14 describes the characteristics of the sample and the distribution of potential predictors by gender. Our sample was 45.7% male. The mean age was 9.9 years among both boys and girls at the time of baseline survey. One quarter of boys (25.1%) and 25.9% of girls did not live in a two-parent family. Table 14 highlights the ethnic diversity of the study subjects, the high smoking prevalence among fathers, and the low smoking prevalence among mothers.

Table 14 ***Distribution of Potential Predictors of Smoking, by Gender, in Multiethnic, Low-income, Inner-city Neighborhoods at Baseline, Montreal, Canada, 1993-1997***

Predictor			Boys		Girls	
			n[a]	%	*n*[a]	%
Baseline year		1993	84	36.7	95	34.9
		1994	86	37.6	107	39.3
		1995	59	25.8	70	25.7
Age (years)[c]		9	58	25.3	79	29.0
		10	134	58.5	154	56.6
		11	35	15.3	36	13.2
		12	2	0.9	3	1.1
School		1	26	11.4	32	11.8
		2	19	8.3	25	9.2
		3	9	3.9	11	4.0
		4	17	7.4	22	8.1
		5	4	1.7	4	1.5
		6	12	5.2	16	5.9
		7	20	8.7	13	4.8
		8	25	10.9	29	10.7
		9	13	5.7	15	5.5
		10	16	7.0	18	6.6
		11	17	7.4	27	9.9
		12	9	3.9	11	4.0
		13	24	10.5	24	8.8
		14	18	7.9	25	9.2
Family structure[c]	Two-parent family		173	75.5	203	74.6
	Single-parent family		47	20.5	55	20.2
	Other		9	3.9	14	5.1
Born in Canada		Yes	146	63.8	162	59.6
		No	83	36.2	110	40.4
Family origin		Canada	44	18.8	48	17.6
		Europe	37	16.2	57	21.0
		Asia	32	14.0	41	15.1
		Arabic-speaking countries	15	6.6	11	4.0
		South America	15	6.6	10	3.7
		Central America/Caribbean	53	23.1	72	26.5
		Other	34	14.8	33	12.1
Parent(s) unemployed		No	205	89.5	237	87.1
		Yes	24	10.5	35	12.9
Friends smoke		None	137	59.8	145	53.3
		Don't know	53	23.1	80	29.4
		A few	36	15.7	44	16.2
		Most	2	0.9	2	0.7
		Missing	1	0.4	1	0.4

Table 14 (continued)

Predictor		Boys		Girls	
		n[a]	%	*n*[b]	%
Father smokes	No[d]	130	56.8	148	54.4
	Yes	86	37.6	115	42.3
	Missing	15	6.6	9	3.3
Mother smokes	No[d]	183	79.9	203	74.6
	Yes	44	19.2	64	23.5
	Missing	3	1.3	5	1.8
Parent(s) smoke(s)	No[d]	129	56.6	138	50.7
	Yes	99	43.2	134	49.3
	Missing	1	0.4	0	0.0
Sibling(s) smoke(s)	No[d]	212	92.6	256	94.1
	Yes	16	7.0	14	5.1
	Missing	1	0.4	2	0.7
Father encourages non-smoking	Yes	146	63.8	184	67.6
	No[d]	63	27.5	73	26.8
	Missing	20	8.7	15	5.5
Mother encourages non-smoking	Yes	192	83.8	229	84.2
	No[d]	36	15.7	40	14.7
	Missing	1	0.4	3	1.1
Parent(s) encourage(s) non-smoking	Yes	203	88.6	241	88.9
	No	26	11.4	31	11.1
BMI[c]	Thin	16	7.0	17	6.3
	Normal	117	51.1	153	56.3
	Heavy	24	10.5	41	15.1
	Overweight	16	7.0	28	10.3
	Obese	56	24.5	33	12.1
Number of TV programs/day[c]	≥ 6	74	32.3	70	25.7
	4 -5	39	17.1	72	26.5
	2 -3	84	36.8	105	38.6
	0 -1	31	13.6	25	9.2
Physically inactive	No	187	81.7	209	76.8
	Yes	42	18.3	63	23.2
Participated in sports activities/lessons					
	Yes	215	93.9	255	93.8
	No	14	6.1	17	6.3

Note. [a]$n = 229$. [b]$n = 272$. [c] Distribution is shown in the original categories before collapsing.

[d] Category includes "not applicable".

5.6 Predictors of current smoking

5.6.1 Univariate analysis of predictors of current smoking

The proportion of current smokers according to selected potential predictors is presented for boys and girls separately in Table 15. The prevalence of current smoking at follow-up among boys and girls was 9.2% and 6.3%, respectively (Table 13).

Among boys, baseline year, friends' smoking, parental encouragement of non-smoking, and participation in sports activities/lessons had p values of less than .25, according to the log likelihood ratio χ^2 test. Only friends' smoking was statistically significant ($p = .03$). Boys, at baseline, who reported that their friends smoked were more likely to become current smokers.

Among girls, school, country of birth, family origin, parental smoking, sibling smoking, and physical inactivity had p values of less than .25 by the log likelihood ratio χ^2 test. Family origin ($p = .006$), parental smoking ($p = .04$), were significant, while baseline year was marginally significant ($p = .05$). Girls who reported that their parent(s) smoked were more likely to become current smokers. Fewer girls in later baseline years reported becoming current smokers. Family origin was associated with current smoking. None of the girls of the "other" family origin reported current smoking, while 18.8% of Canadian girls and 20.0% of girls of South American origin reported current smoking. In addition to the zero cell count in "other" family origin category, the numbers of subjects in Arabic-speaking countries and South American origin were too small to obtain stable estimates of odds ratios. Thus, in subsequent multivariate analyses, "family origin" was dichotomized (outside Canada or Canada) ($p = .001$). It is notable that friends' smoking was not significant in univariate analysis.

Table 15 ***Univariate Associations between Potential Predictors and Current Smoking in Elementary Schoolchildren in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1997***

Predictor		Boys			Girls		
		n[a]	Current smoking %		*n*[a]	Current smoking %	
All		229	9.2		272	6.3	
Baseline year	1993	84	13.1	*	95	11.6	**
	1994	86	9.3		107	3.7	
	1995	59	3.4		70	2.9	
Age (years)	9-10	192	8.3		233	6.8	
	11-12	37	13.5		39	2.6	
School	1	26	15.4		32	6.3	*[b]
	2	19	15.8		25	0.0	
	3	9	11.1		11	9.1	
	4	17	5.9		22	18.2	
	5	4	0.0		4	0.0	
	6	12	0.0		16	6.3	
	7	20	5.0		13	0.0	
	8	25	8.0		29	0.0	
	9	13	15.4		15	20.0	
	10	16	6.3		18	5.6	
	11	17	17.7		27	11.1	
	12	9	0.0		11	9.1	
	13	24	12.5		24	4.2	
	14	18	0.0		25	0.0	
Family structure	Two-parent family	173	9.3		203	5.9	
	Single-parent family/Other	56	8.9		69	7.3	
Born in Canada	Yes	147	8.2		162	8.0	*
	No	84	11.9		112	4.5	
Family origin	Canada	43	9.3		48	18.8	***[b]
	Europe	37	10.8		57	3.5	
	Asia	32	6.3		41	2.4	
	Arabic-speaking countries	15	20.0		11	9.1	
	South America	15	13.3		10	20.0	
	Central America/Caribbean	53	5.7		72	2.8	
	Other	34	8.8		33	0.0	
Family origin (dichotomized)							
	Outside Canada	186	9.1		224	3.6	****
	Canada	43	9.3		48	18.8	
Parent(s) unemployed	No	205	9.8		237	6.8	
	Yes/Don't know	24	4.2		35	2.9	

Table 15 (continued)

Predictor		Boys			Girls		
		n^a	Current smoking %		n^a	Current smoking %	
Friends smoke	None/Don't know	191	6.8	***	226	6.2	
	A few/Most	38	21.1		46	6.5	
Father smokes	No[c]	129	9.3		148	3.4	**
	Yes	86	9.3		115	10.4	
Mother smokes	No[c]	183	8.2	*	203	3.5	****
	Yes	43	14.0		64	15.6	
Parent(s) smoke(s)	No[c]	129	8.5		138	2.9	**
	Yes	99	10.1		134	9.7	
Sibling(s) smoke(s)	No[c]	212	9.0		256	6.6	*[b]
	Yes	16	12.5		14	0.0	
Parent(s) encourage(s) non-smoking	Yes	203	9.9	*	240	6.7	
	No[c]	26	3.9		31	3.2	
Overweight	No	157	7.6	*	211	5.7	
	Yes	72	12.5		61	8.2	
Number of TV programs/day	< 6	156	8.3		202	6.4	
	6	75	12.0		70	5.7	
Physically inactive	No	187	9.6		209	7.2	*
	Yes	42	7.1		63	3.2	
Participated in sports activities/lessons							
	Yes	215	9.8	*[b]	255	5.9	
	No	14	0.0		17	11.8	

Note. [a] Totals differ because of missing data. [b] *P* value was obtained based on the last maximum likelihood iteration because of a zero cell count in one of the categories. [c] Category includes "not applicable".

* $p < .25$. ** $p < .05$. *** $p < .01$. **** $p < .001$. by the likelihood ratio χ^2 test for each variable.

5.6.2 Multivariate analysis of predictors of current smoking

Independent predictors of current smoking at follow-up were identified using stepwise logistic regression. Based on the univariate analyses, variables which had *p* values of < .25 by the log-likelihood ratio χ^2 test were retained as potential predictors for multivariate analyses. Tables 16 and 17 present unadjusted and adjusted odds ratios of these predictors for each gender.

Among boys, friends' smoking was the only significant predictor in both univariate and multivariate analyses. Baseline year with two dummy variables was selected by the stepwise selection procedure with $p = 0.12$, but none of the individual categories were significant in the final model when 1993 was used as the reference category. When each of the other variables was added to the model to check for confounding effects, none of other variables changed the odds ratios of friends' smoking and baseline year appreciably (i.e., more than 10%). The odds of current smoking at follow-up were 3.5 times greater for boys who reported that their friends smoked at baseline than those who did not. Goodness of fit of the model was acceptable.

Table 16 ***Two-year Predictors of Current Smoking among Boys who had Never Smoked at Baseline, in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1997***

Predictor		Unadjusted OR[a] (95%CI)	Adjusted OR[b] (95%CI)
Baseline year			
	1993	Ref.	Ref.
	1994	0.7 (0.3, 1.8)	0.8 (0.3, 2.1)
	1995	0.2 (0.05, 1.1)	0.2 (0.05, 1.2)
Friends smoke			
	No/Don't know	Ref.	Ref.
	A few/Most	3.7 (1.4, 9.6)	3.5 (1.3, 9.4)

Note. $n = 229$. Hosmer-Lemeshow Goodness of Fit statistic $\chi^2(3, N = 229) = 4.00, p = .26$.

OR = odds ratio; CI = confidence interval; Ref. = reference.

[a] Unadjusted OR obtained from univariate logistic regression analysis. [b] Adjusted OR and 95% CI obtained from multivariate logistic regression analyses.

Among girls, baseline year and family origin, dichotomized into "Canada" and "outside Canada", were selected as significant predictors by the stepwise selection procedure. When the remaining variables were added, one by one, to check for confounding effects, parental smoking decreased the odds ratio of the (Canadian) family origin variable by 16% (from 7.0 to 5.9). On the other hand, adding country of birth increased the odds ratio of the family origin variable by 12% (from 7.0 to 7.9). Only parental smoking satisfied the usual criteria for being a confounder (i.e., it has been identified as a predictor of current smoking among children in previous studies (Doherty

et al.1994; Jackson et al., 1998) and it was significantly associated with the outcome and other predictors in the model in this study sample). The prevalence of parental smoking among Canadian girls was 79.2%, which was significantly higher than that of girls of non-Canadian family origin, 42.9% (χ^2 (1, N=272) = 20.85, p < .001). None of the Canadian girls having no parent(s) who smoked became current smokers, while 23.7% of Canadian girls who had at least one smoking parent became current smokers (χ^2 (1, N = 48) = 2.92, p = .09). On the other hand, no difference in the proportion of current smokers was observed by parental smoking among girls of non-Canadian family origin (χ^2 (1, N = 224) = 0.17, p = .68). Nevertheless, this possible effect modification of family origin on parental smoking could not be investigated because of the zero cell count and because of the lack of statistical power. Canadian girls were 5.9 times more likely to become current smokers compared to non-Canadian origin girls. Girls in the later baseline years of the cohort were less likely to become current smokers compared to girls whose baseline year was 1993. Parental smoking was not significant after adjusting for other variables in the model. Goodness of fit was acceptable.

Table 17 ***Two-year Predictors of Current Smoking among Girls who had Never Smoked at Baseline, in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1997***

Predictor		Unadjusted OR[a] (95%CI)	Adjusted OR[b] (95%CI)
Baseline year			
	1993	Ref.	Ref.
	1994	0.3 (0.09, 1.0)	0.3 (0.08, 1.0)
	1995	0.2 (0.05, 1.0)	0.2 (0.04, 1.1)
Family origin			
	Outside Canada	Ref.	Ref.
	Canada	6.2 (2.3, 17.1)	5.9 (1.9, 17.9)
Parent(s) smoke(s)			
	No	Ref.	Ref.
	Yes	3.6 (1.1, 11.3)	1.7 (0.5, 6.0)

Note. n=272. Hosmer-Lemeshow Goodness of Fit statistic χ^2 (6, N = 272) = 3.92, p = .67.

OR = odds ratio; CI = confidence interval; Ref. = reference.

[a] Unadjusted OR obtained from univariate logistic regression analysis. [b] Adjusted OR and 95% CI obtained from multivariate logistic regression analyses.

5.7 Predictors of ever smoking

5.7.1 Univariate analysis of predictors of ever smoking

The proportion of ever smokers according to selected potential predictors are presented for boys and girls separately in Table 18. Based on log likelihood ratio χ^2 tests, among boys, age, family structure, country of birth, friends' smoking, parental smoking, sibling smoking, parental encouragement of non-smoking, and physical inactivity had p values of less than .25. Among girls, baseline year, school, family origin, friends' smoking, parental smoking, overweight, and participation in sports activities/lessons were predictive of ever smoking with $p < .25$. Differences in the proportion of ever smoking by family origin were apparent; only 9.8% of Asian girls reported ever smoking compared to 50.0% of South American girls, and 29.2% of Canadian girls.

Table 18 ***Univariate Associations between Potential Predictors and Ever smoking in Elementary Schoolchildren, by Gender, Montreal, Canada, 1993-1997***

Predictor		Boys		Girls	
		n^a	Ever smoking %	n^a	Ever smoking %
All		229	21.8	272	22.3
Baseline year	1993	84	27.4	95	30.5 *
	1994	86	18.6	107	17.8
	1995	59	18.6	70	17.1
Age (years)	9-10	192	20.3 *	233	22.8
	11-12	37	29.7	39	18.0
School	1	26	38.5	32	21.9 ****[b]
	2	19	15.8	25	20.0
	3	9	44.4	11	27.3
	4	17	29.4	22	45.5
	5	4	0.0	4	0.0
	6	12	8.3	16	25.0
	7	20	20.0	13	23.1
	8	25	20.0	29	3.5
	9	13	23.1	15	60.0
	10	16	18.8	18	16.7
	11	17	17.7	27	14.8
	12	9	22.2	11	45.5
	13	24	20.8	24	12.5
	14	18	11.1	25	12.0
Family structure	Two-parent family	173	20.2 *	203	20.7
	Single-parent family/Other	56	26.8	69	26.1

Table 18 (continued)

Predictor		Boys			Girls		
		n[a]	Ever smoking %		*n*[a]	Ever smoking %	
Born in Canada	Yes	147	17.8	**	162	22.2	
	No	84	28.9		110	21.8	
Family origin	Canada	43	20.9		48	29.2	*
	Europe	37	24.3		57	22.8	
	Asia	32	31.3		41	9.8	
	Arabic-speaking countries	15	26.7		11	27.3	
	South America	15	20.0		10	50.0	
	Central America/Caribbean	53	13.2		72	20.8	
	Other	34	23.5		33	18.2	
Family origin[c]	Outside Canada	186	22.0		224	20.5	*
	Canada	43	20.9		48	29.2	
Parent(s) unemployed	No	205	22.0		237	22.4	
	Yes/Don't know	24	20.8		35	20.0	
Friends smoke	No/Don't know	191	18.9	**	226	17.3	****
	A few/Most	38	35.9		46	45.7	
Father smokes	No[d]	129	17.1	*	148	17.6	**
	Yes	86	27.9		115	28.7	
Mother smokes	No[d]	183	20.8	*	203	18.2	**
	Yes	43	27.9		64	32.8	
Parent(s) smokes	No[d]	129	17.8	*	138	15.9	**
	Yes	99	27.3		134	28.4	
Sibling(s) smoke(s)	No[d]	212	19.8	****	256	22.7	
	Yes	16	50.0		14	14.3	
Parent(s) encourage(s) non-smoking	Yes	203	23.7	*	240	22.1	
	No[d]	26	7.7		31	22.6	
Overweight	No	157	22.6		211	19.9	*
	Yes	72	20.3		61	29.5	
Number of TV programs/day	< 6	156	22.4		202	20.8	
	6	75	21.3		70	25.7	
Physically inactive	No	187	24.1	*	209	22.5	
	Yes	42	11.9		63	20.6	
Participated in sports activities/lessons							
	Yes	215	21.9		255	21.2	*
	No	14	21.4		17	35.3	

Note. [a] Totals differ because of missing data.. [b] *P* value was obtained based on the last maximum likelihood iteration because of 0 cell count in one of the categories. [c] Dichotomized family origin.

[d] Category includes "not applicable". * $p < .25$. ** $p < .05$. *** $p < .01$. **** $p < .001$. by the log likelihood ratio χ^2 test.

5.7.2 Multivariate analysis of predictors of ever smoking

Tables 19 and 20 present the odds ratios of ever smoking retained in the final models as well as the unadjusted odds ratios obtained from univariate analyses, for boys and girls separately. Since this outcome variable has been investigated in previous research, including the study of one-year predictors using the same study data base, previously identified predictors, including age, family structure, parental smoking, sibling smoking, friends' smoking, and school, were entered into the model as control variables before stepwise procedures were carried out. None of the children in a school, reported ever smoking at follow-up. Thus, eight children (four boys and four girls) were eliminated from the data set because a zero cell count in the category produces a large estimated coefficient and large estimated standard error. Older subjects, in this study sample, differed from younger subjects with respect to country of birth (χ^2 (1, $N = 229$) = 10.29, $p < .001$ among boys; χ^2 (1, $N = 272$) = 10.58, $p < .001$ among girls). Hence, country of birth was also included among the control variables. Among the candidate interaction terms from the combinations of main effect variables retained in the multivariate model, an interaction term was selected in the model for girls, but none was selected in the model for boys.

Among boys, sibling smoking and friends' smoking were significant independent predictors. Boys who reported that their sibling(s) smoked were 6.2 times more likely to initiate smoking than boys who reported that they did not have sibling(s) who smoked. Boys who reported that their friends smoked were 3.0 times more likely to initiate smoking than boys who did not report friends' smoking, after adjustment for other variables. School was not a significant predictor. Goodness of fit of the model was acceptable.

Table 19 ***Two-year Predictors of Ever Smoking among Elementary School Boys who had Never Smoked at Baseline, in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1997***

Predictor	Unadjusted OR[a] (95%CI)	Adjusted OR[b] (95%CI)
Age (years)		
9-10	Ref.	Ref.
11-12	1.7 (0.8, 3.7)	1.2 (0.5, 3.0)
Family structure		
Two-parent family	Ref.	Ref.
Single-parent family/Other	1.5 (0.7, 3.0)	1.6 (0.7, 3.6)
Born in Canada		
Yes	Ref.	Ref.
No	1.8 (1.0, 3.4)	1.9 (0.9, 4.0)
Parent(s) smoke(s)		
No	Ref.	Ref.
Yes	1.9 (1.0, 3.6)	1.8 (0.8, 3.8)
Sibling(s) smoke(s)		
No	Ref.	Ref.
Yes	4.6 (1.6, 13.3)	6.6 (1.7, 22.2)
Friends smoke		
None/Don't know	Ref.	Ref.
A few/Most	2.6 (1.2, 5.5)	3.0 (1.2, 7.1)

Note. $n = 225$. Excludes two subjects with missing values and four subjects in the school with no outcome. Hosmer-Lemeshow Goodness of Fit statistic $\chi^2(8, N = 225) = 7.52, p = .48$.
OR = odds ratio; CI = confidence interval; Ref. = reference.
[a] Unadjusted OR obtained from univariate logistic regression analysis. [b] Adjusted OR and 95% CI obtained from multivariate logistic regression analyses including schools.

Among girls, baseline year, school, sibling smoking, and friends' smoking were significant independent predictors. Parental smoking was also a significant predictor, but only among girls who were born in Canada. Girls who reported that their friends smoked were 4.7 times more likely to initiate smoking than those who did not report friends' smoking. Girls who reported that their sibling(s) smoked were less likely to initiate smoking than girls who did not report sibling smoking. Girls in the cohorts of later baseline years were less likely to initiate smoking compared to those in 1993. Among

girls born in Canada, those who reported that their parent(s) smoked were 4.3 times more likely to initiate smoking than those who did not report parental smoking. Parental smoking, however, did not predict smoking initiation among girls born outside Canada. School was a significant predictor. Goodness of fit of the model was acceptable.

Table 20 ***Two-year Predictors of Ever smoking among Elementary School Girls who had Never Smoked at Baseline, in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1997***

Predictor	Unadjusted OR[a] (95%CI)	Adjusted OR[b] (95%CI)
Baseline year		
1993	Ref.	Ref.
1994	0.5 (0.2, 0.9)	0.4 (0.2, 0.8)
1995	0.5 (0.2, 1.0)	0.4 (0.2, 1.1)
Age (years)		
9-10	Ref.	Ref.
11-12	0.7 (0.3, 1.7)	1.0 (0.4, 2.9)
Family structure		
Two-parent family	Ref.	Ref.
Single-parent family/Other	1.4 (0.7, 2.6)	1.1 (0.5, 2.5)
Sibling(s) smoke(s)		
No	Ref.	Ref
Yes	0.6 (0.1, 2.6)	0.09 (0.01, 0.6)
Friends smoke		
No/don't know	Ref.	Ref.
A few/most	3.9 (2.0, 7.7)	4.7 (2.0, 10.7)
Girls born in Canada		
Parent(s) smoke(s)		
No	Ref.	Ref.
Yes	4.3 (1.8, 10.3)[c]	4.3 (1.6, 11.9)
Girls born outside Canada		
Parent(s) smoke(s)		
No	Ref.	Ref.
Yes	0.8 (0.1, 2.3)[c]	0.7 (0.09, 4.8)

Note. $n = 266$. Excludes two subjects with missing values and four subjects in the school with no ever smokers. Hosmer-Lemeshow Goodness of Fit statistic χ^2 (8, $N = 266$) = 5.88, $p = .66$. OR = odds ratio; CI = confidence interval; Ref. = reference.

[a] Unadjusted OR obtained from univariate logistic regression analysis. [b] Adjusted OR and 95% CI obtained from multivariate logistic regression analyses including schools. [c] OR from the model including country of birth, parental smoking, and their interaction terms only.

5.8 Summary of findings

The following is a summary of the main findings of this study.

1. Attrition was high and did not occur at random. Children in the later baseline years, 11-12 year-olds compared to 9-10 year-olds, those not living in a two-parent family, those born outside Canada, and those lacking parental encouragement of non-smoking were more likely to be lost to follow-up.
2. The prevalence of current or ever smoking at baseline was higher among boys than girls (6.7% vs. 2.6% for current smoking; 21.9% vs. 12.6% for ever smoking). However, the pattern of progression from never smoking to current/ever smoking, was similar, by gender, over the two-year follow-up.
3. At baseline, the prevalence of current smoking among grade 4 elementary school children was 4.6% and that of ever smoking was 16.8%. At two-year follow-up, 10.9% reported current smoking and 30.5% reported having ever smoked (including past smokers and current smokers).
4. At the two-year follow-up, 9.2% of boys and 6.3% of girls who had never smoked at baseline reported current smoking. Predictors of current smoking differed by gender. Among boys, the only significant independent predictor of current smoking was friends' smoking (odds ratio (OR) (95% confidence interval) = 3.5 (1.3, 9.4)). Among girls, baseline year and family origin (Canada or not) were predictive. Girls in the later baseline years were less likely to become current smokers. Canadian girls were more likely to become current smokers than girls whose family origin was not Canada (OR = 5.9 (1.9, 17.9)).
5. At the two-year follow-up, 21.8% of boys and 22.1% of girls, who had never smoked at baseline, had initiated smoking. Independent two-year predictors of ever smoking among boys were sibling smoking (OR = 6.2 (1.7, 22.2)) and friends' smoking (OR = 3.0 (1.2, 7.1)). Among girls, baseline year (1994 compared to 1993: OR = 0.4, (0.2, 0.8)), friends' smoking (OR = 4.7 (2.0, 10.7)), and sibling smoking (OR = 0.09 (0.01, 0.6)) were independent predictors of ever smoking. The effect of parental smoking differed by country of birth; parental smoking was predictive of ever smoking only among girls born in Canada (OR = 4.3 (1.6, 11.9)).

6. Discussion

This investigation is one of the first to examine early smoking onset, longitudinally, in children living in multiethnic, low income, inner-city neighborhoods. In this section, we first discuss implications of the findings regarding attrition. Prevalence of smoking and two-year predictors of becoming a current/ever smoker are then discussed for boys and girls separately. Discussions on gender differences in predictors follow. Finally, limitations of this study are discussed.

6.1 Attrition analysis

Attrition was high - 55.6% of children eligible for follow-up were lost to follow-up over two years. Thirty-three per cent of the initial cohort who never smoked at baseline were lost over the first year of follow-up, and an additional 23% of the initial cohort (34% of those who remained in the cohort after one year) was lost in the subsequent year. These high attrition rates reflect the high mobility of the student population in these schools. According to the school board, approximately 30% of students move and/or change school each year. In addition to children changing schools, loss to follow-up, in this study, resulted from subjects being absent from school on the day of the survey and lack of parental consent for participation in the follow-up surveys. The high attrition observed in this study demonstrates the difficulty of conducting longitudinal studies in multiethnic, low-income, inner-city neighborhoods even at the elementary school level, where, by law, children cannot drop out of school.

The original quasi-experimental study employed a study design in which schools were assigned to treatment conditions, while observations were made on individual students. The primary objective of that study (i.e., evaluation of an intervention program) is achievable regardless of the relatively high attrition that occurred among cohort members. Nevertheless, the high attrition highlights the difficulty in conducting secondary data analyses that focus on each individual study subject's behavior using data from a study designed primarily to carry out analyses using school as the unit of analysis.

The attrition analyses suggested that children in the later baseline years, older subjects, those born outside Canada, those not living in a two-parent family, and those who reported that their parents did not encourage non-smoking were more likely to be lost to follow-up. Attrition also differed by family origin. Many of the children born outside Canada were recent immigrants. Their families may have been more mobile than immigrant families which had been living in Canada for longer periods. Thus, the decline in follow-up rates over time may relate to the changing ethnic mix of subjects over time. Children who were older than others in their grade may have been more likely to transfer to other schools including secondary schools or other specialized institutions. Therefore, specific characteristics of this study population (i.e., high proportion of children from recent immigrant families and of those aged 11-12 years) could account for high attrition due to changing schools.

Age and not living in a two-parent family were predictors of smoking onset in previous studies. In addition, lack of parental encouragement of non-smoking might also be a predictor of smoking initiation, since antismoking socialization by parents has been reported to be associated with a reduced risk of smoking onset among children and adolescents (Jackson & Henriksen, 1997a; Jackson et al., 1998; Wang et al., 1995). A school-based cohort study which tracked smoking behavior of subjects lost to follow-up suggested that absentees from school and transfers to other schools had a higher prevalence of daily smoking compared to those who remained in the study (Pirie, Murray, & Luepker, 1988). Although children lost to follow-up and those who remained in this study did not differ with respect to smoking behavior at baseline, it is possible that children lost to follow-up, in this study, were at higher risk for smoking onset. The observed prevalence of current and ever smoking at follow-up, and the likelihood of becoming a current smoker or an ever smoker are likely to be underestimated in this study, and therefore, our findings may have limited generalizability to lower risk subgroups within the target population. The predictors of smoking and the strength of the associations found in this study need to be corroborated in future studies with lower attrition.

6.2 Prevalence of current and ever smoking

6.2.1 Prevalence of current and ever smoking among study subjects

The prevalence of ever smoking at follow-up in this study was 30.5%, and is comparable to or somewhat higher than prevalence reported in previous research. Because ever smokers at baseline, as well as subjects lost to follow-up, were excluded, the prevalence estimates obtained in this study are underestimated. Our baseline data suggest that one in six children had already started smoking in grade 4. Although the influence of ethnicity on smoking onset needs to be clarified, overall, smoking initiation among children in underprivileged areas in Montreal appears to begin earlier than that reported in other studies.

6.2.2 Gender differences in smoking prevalence

The prevalence of baseline current smoking among boys was significantly higher than that among girls, as was the prevalence of ever smoking. This suggests that boys might start smoking earlier than girls. However, the pattern of progression in smoking over two years was similar between male and female never smokers, consistent with findings reported in an earlier one-year follow-up study (O'Loughlin et al., 1998a).

An interesting aspect of this multiethnic population, with respect to smoking, is that, with the exception of Canadian-born mothers, the proportion of mothers who smoked was low despite low SES (Appendix IV). Differences in the prevalence of smoking by income group are reported to be more apparent among women than men in Canada; 33% of low income women smoke, compared to 23% of higher income women (Health Canada, 1995b). The prevalence of mothers' smoking at baseline in this study was 21.7% (95% CI 18.1-25.3%), which was comparable to the smoking prevalence among higher income women in the national survey. The prevalence of mothers' smoking sharply contrasted with the high prevalence of fathers' smoking observed in this study population (42.1%, 95%CI 37.6-46.5%). However, the similarity in the patterns of progression of smoking in boys and girls may indicate that these children will not

maintain the gender differences in smoking observed among their parents (i.e., high prevalence among adult men, but low prevalence among adult women).

A recent study reported that female regular smokers are less likely to quit smoking than male regular smokers, and this may contribute to gender differences in smoking prevalence among adolescents (i.e., female adolescents smoke more than male adolescents) (Patton et al., 1998). Although we did not study quitting behavior in this study, this association needs to be investigated in future studies to increase understanding of changes in the gender differences in smoking prevalence over time.

6.2.3 Cohort effect

The baseline prevalence of ever smoking decreased significantly over time in the 1993, 1994, and 1995 cohorts. A possible reason for this downward trend may be changes in the demographic makeup of the study population. Our data suggest that the proportion of children born in Canada decreased over time, while there was an increase in the proportion of children born outside Canada (Appendix V). More specifically, an analysis of time trends by family origin suggested that the proportions of children of Canadian and European family origin decreased over time while that of Asian, Central American/Caribbean, and "Other/Unclassified" family origin increased (Appendix VI). According to a previous cross-sectional study in this study population (O'Loughlin et al., 1998b), children of Canadian and European family origin were more likely to be ever smokers, while children of Asian origin were least likely to be ever smokers. In addition, the proportion of children whose parent(s) smoked was lower in the later baseline years in this study (Appendix VII). It has been reported that, in the Canadian population, the smoking prevalence among francophones is higher than that among anglophones and that the smoking prevalence among allophones is even lower, relative to francophones and anglophones (Health Canada, 1995c). The decrease in smoking prevalence observed over time, therefore, may reflect a true secular trend, due, in part, to changes in the ethnic mix in these dynamic populations. Changes in the demographic profile of the study population complicate the interpretation of results from this longitudinal study, and could affect the analysis of predictors of smoking initiation in this population.

6.3 Two-year predictors of current/ever smoking among boys

Among boys who had never smoked at baseline, friends' smoking was the only significant predictor of current smoking. Since there were few current smokers available for this analysis (n = 17), low statistical power might have limited our ability to identify other predictors. Sibling smoking and friends' smoking were independent predictors of ever smoking among boys, after controlling for other important predictors identified in the literature. These results replicate findings from previous studies which have consistently found peer influences on smoking initiation. Parental smoking was marginally significant (p = .06) in the univariate analysis of ever smoking but lost its significance in multivariate analysis. Cultural factors (i.e., country of birth and family origin) were not important predictors; nor were they found to be effect modifiers among boys. Overall, these results provide support for prevention programs across ethnic subgroups, which teach children to resist peer pressure to smoke.

6.4 Two-year predictors of current/ever smoking among girls

Among girls, family origin was a significant independent predictor of current smoking. Canadian girls were 5.9 times more likely to become current smokers than girls with family origins outside Canada. Parental smoking confounded the association between family origin and current smoking. Our data suggest that the prevalence of parental smoking (either father or mother, or both) among Canadian girls was significantly higher than that among girls with non-Canadian family origin (79.2% among Canadian girls and 42.9% among non-Canadian girls). Nevertheless, controlling for parental smoking decreased the odds ratio of Canadian origin only moderately, suggesting that the effect of Canadian origin was not totally accounted for by differences in the prevalence of parental smoking. Additionally, the possible effect modification by family origin on parental smoking (which could not be assessed in this study sample because of a zero cell count) still needs to be considered. An effect modification on parental smoking by country of birth, found in the analysis of ever smoking, provides support for this possibility. The interaction term composed of parental smoking and country of birth, which was statistically significant (p = .01) in the analysis of ever smoking, indicates that parental smoking is influential on smoking onset among girls

born in Canada, but not among girls born outside Canada. Two possible interpretations of these findings are discussed in the following paragraphs.

First, this finding may suggest that predictors of smoking initiation differ and are modified by acculturation since children born outside Canada include immigrant children with differing levels of acculturation. Although the effects of acculturation on smoking initiation among immigrant girls have not been reported, a Canadian study suggested that women from non-western societies, where smoking prevalence among women is lower than that among men, may be more likely to start smoking as they become more integrated into Canadian society (Health Canada, 1995c). Our study findings may indicate that adoption of the host country's smoking behavior among immigrant females begins as early as elementary school in low SES populations, regardless of parents' smoking behavior. Or it may indicate that immigrant girls, from countries where there is a distinct gender difference in smoking prevalence (i.e., men smoke more than women), are less susceptible or more resilient to parental smoking compared to girls born in Canada, at elementary school age.

Second, in addition to acculturation, the observed differential effects of parental smoking by family origin might be rooted in ethnic differences in the predictors of smoking. In a recent study based on a US national sample (Griesler & Kandel, 1998), maternal smoking was an independent correlate of adolescent (average age 12.4 years) current smoking among white adolescents, but not among African-American or Hispanic adolescents. This association was stronger among daughters than sons. Maternal smoking was also a significant correlate of ever smoking in the univariate analysis among white adolescents only. Although this finding is not directly relevant to this study because of differences in study populations and methods of measurement of ethnicity and parental smoking (only mother's smoking was examined in that study), the lack of influence of parental smoking observed among ethnic subgroups other than whites is noteworthy. The majority of Canadian girls in our study population were of "Caucasian" family origin. It has been suggested that the stronger negative norms against smoking held by parents might explain the differences in smoking between African-American and white children

(Clark, Scarisbrick-Hauser, Gautam, & Wirk, 1999). However, antismoking socialization, which was measured in this study by asking subjects if their father/mother talked about the dangers of smoking, was not predictive of current/ever smoking, regardless of family origin. The mechanisms for the differential effects of parental smoking by cultural factors need to be clarified.

To be noted, among girls, family origin was predictive of current smoking, but not of ever smoking. Our data indicate that Canadian girls who had never smoked at baseline were more likely to initiate smoking and to sustain the habit, while girls with non-Canadian family origins who initiated smoking were more likely to be past smokers at follow-up (Appendix VIII). This could indicate a delay in the progression of smoking among girls whose family origin was outside Canada. A recent Australian study reported a delay in smoking onset among grade 7-8 students who spoke languages other than English at home (LOTE), compared to their English-speaking counterparts (Tang et al., 1998). Since the variable (LOTE or not) was similar to our family origin variable (which incorporated languages spoken by the subject), the similarity in findings is notable. Tang et al. (1998) also reported that one-year predictors of smoking initiation differed between these subgroups; "close friends smoke" was the only significant independent predictor of smoking initiation among LOTE students, but four additional predictors including brothers' smoking, sisters' smoking, thinking it acceptable to smoke, and perceiving benefits of smoking were identified among those who spoke English at home. Furthermore, studies from the US have also reported a delay in smoking onset among ethnic minority groups other than native Americans, as well as different predictors of smoking onset among different racial/ethnic groups (USDHH, 1998). Whether or not the observed protective effects of non-Canadian family origin among elementary school girls continue into adulthood is of interest. Also, the reasons for faster adoption of smoking behavior among Canadian girls, compared to non-Canadian girls, deserve further exploration.

School was a significant predictor of ever smoking among girls in both univariate and multivariate analyses. This finding could indicate that clustering of smoking behavior within schools is more common among girls, and that girls' smoking is more influenced

by factors represented by schools (e.g., smoking among schoolmates, strictness of school policy against child smoking, etc.) or communities in which schools are located (e.g., existence of corner stores where minors can buy cigarettes easily). A recent study reported that boys had more difficulty than girls did in purchasing cigarettes over the counter (Forster, Hourigan, & McGovern, 1992). Thus, the availability of cigarettes might have differed by gender within the same school district and that partially explains the observed gender-specific effect of school.

It is notable that, in contrast to the boys' model, friends' smoking was not a significant predictor of current smoking among girls. Although gender-specific effects in peer influence have been reported (Clayton, 1991; Hu, Flay, Hedeker, & Siddiqui, 1995; Wang et al., 1995), the following three possibilities should be considered. First, friends' smoking was a strong predictor of ever smoking among girls, indicating that friends' smoking was a predictor of trying cigarettes, but not of becoming a current smoker. Second, combining the category of past smokers with that of never smokers, in order to dichotomize the outcome into "currently smoking" and "not currently smoking (including past smokers and never smokers)", may have obscured the effect of friends' smoking on current smoking. If friends' smoking predicts both becoming a current smoker and becoming a past smoker, comparing current smokers with an aggregated category, including never and past smokers, could distort the influence of friends' smoking which would have been found in a comparison of never smokers and current smokers. Pairwise comparisons among these three outcome categories might have enabled exploration of this hypothesis. Unfortunately, our sample size was not large enough to examine pairwise comparisons. Finally, even though the effect of friends' smoking was strong, we might have failed to detect it because the analysis did not take into account changes in exposure status between baseline and follow-up. Our data indicate that the proportion of those who changed their exposure status in friends' smoking was higher among girls than boys, that is, 35.0% and 30.3%, respectively (Appendix IX). Misclassification of exposure status, due to changes in exposure status over time, may have resulted in this negative finding, suggesting that the timeframe of a two-year follow-up may have been too long for the variable of friends' smoking.

Unexpectedly, sibling smoking was protective in the analysis of ever smoking. This finding contradicts previous research, including both the cross-sectional and one-year follow-up studies conducted in the same study population (O'Loughlin et al., 1998a, 1998b). Possible explanations for this discordant finding include the small number of subjects who had siblings who smoked, sample selection, and the time-variant nature of this variable. First, the number of girls who reported sibling smoking at baseline was only 14 (5.2% of study subjects). Second, sibling smoking was a strong correlate of baseline smoking status, with an unadjusted OR of 3.4 (95%CI (2.1, 5.5)) among 695 girls at baseline. Girls who were susceptible to sibling smoking might already have initiated smoking at the time of the baseline survey. Therefore, girls who never smoked at baseline despite their smoking sibling(s) may have been less susceptible or more resilient to sibling smoking. Third, during the two-year follow-up, siblings might have begun smoking and influenced study subjects to take up cigarettes. In further analyses, 12 of 27 girls (44.4%) whose sibling(s) started smoking reported ever smoking, while only 2 out of 12 girls (14.3%) whose siblings smoked at baseline reported ever smoking at the two-year follow-up. Thus, the observed odds ratio smaller than one could relate to the low prevalence of subjects who reported sibling smoking, the study design, and/or changes in exposure status during the follow-up period. The interpretation of this finding requires caution.

6.5 Gender differences in predictors of smoking onset

Smoking by friends was the strong predictor of early smoking onset in both genders. Nevertheless, our findings suggest that the predictors of early smoking onset differ somewhat by gender in these multiethnic populations. The effects of cultural background and factors associated with school environment appeared to be more important among girls than boys. Furthermore, predictors of smoking onset may differ by cultural background among girls only. More studies are needed to address how cultural factors and school influence smoking onset among girls, in order to develop culturally appropriate approaches in smoking prevention interventions.

6.6 Limitations

This section discusses potential limitations of this study, including internal validity and external validity.

6.6.1 Internal validity

There are three major biases that threaten the validity of the findings from this study, namely, information bias, selection bias, and unmeasured as well as residual confounding.

Information bias: This study did not use objective measures to validate self-reported smoking behavior. Although existing biochemical measures are far from perfect for detecting infrequent smoking among children, the credibility of self-report may be a concern. Without biochemical validation, we do not know to what extent social desirability or "faking good/bad" influenced children's self-reports. It is possible that infrequent smokers claimed to be never smokers or past smokers, and that this misclassification might be differential, for example, by gender, or by ethnicity. Although no study, to date, has investigated misclassification regarding self-report smoking status among children from ethnically diverse populations, several studies have identified factors affecting the validity of self-reports among adult ethnic subgroups or adolescent racial subgroups. The frequency of misclassification was reported to be significantly different by country of origin among Southeast Asian immigrants in the US (the discrepancies in self-reported and cotinine adjusted smoking prevalence were significant among Cambodian men but not among Laotian or Vietnamese men). It was also higher among females than males (Wewers et al., 1995). It is conceivable that immigrant girls from non-western countries are more likely to underreport their smoking behavior than girls with more westernized social norms. Although the observed differences could not be totally explained by differences in underreporting, such differential misclassification (e.g., Canadian girls reported more honestly than girls whose family origin was not Canada) might have resulted in an overestimation of the effect of Canadian origin on current smoking among girls.

We did not update the information on several time-variant factors including friends' smoking, parental smoking, and sibling smoking. Secondary data analyses suggested that many children changed status in these variables between assessments (Appendix IX). This type of error is generally considered acceptable in cohort studies with dichotomous exposures, since it attenuates the magnitude of the true association between exposure and outcome. Nonetheless, if duration of follow-up is too long relative to the postulated latency between exposure and outcome, this generalization may not be applicable (MacMahon & Trichopoulos, 1996). As other researchers have suggested, shorter time intervals are preferable for studies of smoking onset using time-variant variables (Wang et al., 1999).

Selection bias: Several researchers have explored potential selection bias related to the type of parental consent (i.e., active consent or passive consent) obtained in adolescent smoking studies, and suggested that the generalizability of findings from studies that used active consent forms might be limited (Severson & Biglan, 1989; Severson & Ary, 1983). Children who are omitted from a study because of lack of action on the part of the parent were at higher risk for a number of health and social problems, including cigarette smoking (Dent et al., 1993). The smoking behavior of those who participated in this study might have differed from that of those whose parent(s) refused consent. In addition, non-random attrition was a possible source of bias in this study. If probable smokers were more likely to be lost to follow-up, the observed prevalence at follow-up is likely to be underestimated. More importantly, if the predictors of smoking differed between children who remained in the study and those lost to follow-up, the significance and the strength of the associations observed for the predictors identified in this study might be distorted.

Unmeasured/residual confounding: Because of the young age of study subjects and the limited time that was allocated for the questions about smoking in the questionnaire, the number of potential predictors of smoking investigated was restricted. Other potential predictors of early smoking, including parental SES, race, academic

performance, parental attitude, accessibility of cigarettes, beliefs, intentions, stress /distress, self-esteem, self-control, susceptibility, pubertal stage, disposable income, and weight concerns were not investigated in this study. Although it has been reported that educational attainment or income accounts for only some of the differences in smoking behavior between the racial/ethnic minority groups (USDHH, 1998), the observed effects of Canadian family origin on becoming a current smoker among girls should be confirmed with adjustment for an appropriate measure of SES, since ethnicity can be strongly confounded by SES. In addition, although we adjusted for possible confounders, there might be problems of residual confounding. Our family origin variable, with seven categories, might be more comprehensive and practical for differentiating the characteristics of various ethnic subgroups compared to the simplified race/ethnicity categories (i.e., whites, black/African-American, Hispanic, and so forth). Nevertheless, aggregating the family origin (measured by country of birth and languages spoken) into seven categories, or further dichotomizing them might have obscured the true effect of predictors that are potentially different by the countries of origin even within the same category. Furthermore, even within the same family origin, children with various levels of acculturation may evolve different social norms or attitude about smoking. Residual confounding is possible and further in-depth investigation of the family origin variable and acculturation requires a large sample.

6.6.2 External validity

Use of active consent forms and non-random attrition might limit generalization of the study findings to somewhat lower risk subgroups within the target population. In addition, excluding ever smokers at baseline restricted generalizabiliy of the study findings to grade 4 children who had never smoked. The unexpected protective effects of sibling smoking, observed among girls, might be the evidence that this restriction limits the generalizability of findings from this study to children who started smoking before grade 4. Finally, the study schools were not randomly selected from among the 86 schools in the lowest poverty index quartile in Montreal. Participating schools may differ in ethnicity from those that did not participate. Thus, the study findings might not be

generalizable to all school children in multiethnic, low-income, inner-city neighborhoods in Montreal.

7. Conclusion

Two-year predictors of smoking onset were identified among grade 4 children living in multiethnic, low-income, inner-city neighborhoods. The prevalence of smoking at baseline indicated that smoking begins early among children living in these low-income, inner-city areas in Montreal. The predictors of early smoking differed somewhat by gender and the outcome investigated (i.e., becoming current smokers or ever smokers at follow-up). Overall, the strong influences of smoking in children's social environment (i.e., friends' smoking and sibling smoking) were congruent with findings in other populations as well as those found in the previous one-year follow-up study. Weaker effects of parental smoking on smoking initiation were also confirmed among boys. Effects of parental smoking differed by cultural factors (county of birth/family origin) among girls. Parental smoking was predictive of smoking initiation among girls born in Canada only. The influences of family origin and school were gender-specific, that is, Canadian girls were at higher risk for becoming current smokers than girls with family origins outside Canada. School was predictive of smoking initiation among girls only.

Smoking prevention interventions should be initiated early in high-risk populations. The findings from this study provide support for prevention programs, across ethnic subgroups, which teach children to resist peer pressure to smoke. Nevertheless, future studies with larger sample sizes are needed to investigate specific needs in specific ethnic subgroups, in order to develop "culturally-sensitive" smoking prevention programs.

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Appendix I

Questionnaire

Youth Lifestyle Survey, 1993

Youth Lifestyle Survey

1. **What is your name?** _____
   First name Last name

2. **You are a** 1 ☐ Boy 2 ☐ Girl

3. **You are** ☐ **years old**

4. **You were born on...**

January ____	May ____	September ____
February ____	June ____	October ____
March ____	July ____	November ____
April ____	August ____	December ____

5. **You are in grade**
   4 ☐
   5 ☐
   6 ☐

6. **During the last month, have you been...**

   1 ☐ Not at all worried about your health
   2 ☐ A bit worried about your health → **Why?** _____
   3 ☐ Very worried about your health → **Why?** _____

S.V.P. tourne la page

7. Whom do you live with?

- ☐ 1 Your mother
- ☐ 1 Your father
- ☐ 1 Your father's girlfriend
- ☐ 1 Your mother's boyfriend
- ☐ 1 Your brother(s) → **How many brothers?** ☐
- ☐ 1 Your sister(s) → **How many sisters?** ☐
- ☐ 1 Your grandmother
- ☐ 1 Your grandfather
- ☐ 1 Other_____

_____

8. Who decides what you eat for supper?

- ☐ 1 You
- ☐ 2 Your mother
- ☐ 3 Your father
- ☐ 4 Your mother and your father
- ☐ 5 The family all together
- ☐ 6 Another person

9. Who decides what you do when you get home from school?

- ☐ 1 You
- ☐ 2 Your mother
- ☐ 3 Your father
- ☐ 4 Your mother and your father
- ☐ 5 The family all together
- ☐ 6 Another person

S.V.P. tourne la page ☞

What would you choose to do after school?

10.	☐	Play outside	**OR**	Play Nintendo	☐
11.	☐	Watch a TV program	**OR**	Take a walk	☐
12.	☐	Play sports	**OR**	Watch a video	☐
13.	☐	Talk on the phone to a friend	**OR**	Take a walk with a friend	☐
14.	☐	Go to the shopping mall with your friends	**OR**	Play sports with your friends	☐

Let's talk about physical activity

15. Your mother does physical activity or plays sports...

1 ☐ Hardly ever or never 2 ☐ Some-times 3 ☐ Often 8 ☐ Not applicable

16. Your mother tells you to be physically active or to play sports...

1 ☐ Hardly ever or never 2 ☐ Some-times 3 ☐ Often 8 ☐ Not applicable

17. Your father does physical activity or plays sports...

1 ☐ Hardly ever or never 2 ☐ Some-times 3 ☐ Often 8 ☐ Not applicable

18. Your father tells you to be physically active or to play sports...

1 ☐ Hardly ever or never 2 ☐ Some-times 3 ☐ Often 8 ☐ Not applicable

S.V.P. tourne la page ☞

19. Think about activities you did last week from Monday to Sunday. For each activity you did <u>for 15 minutes or more without stopping</u>, mark an X to show on which day you did that activity.

15 minutes or more	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Gym class at school							
Bicycling							
Skipping rope							
Playing elastics							
Aki							
Flags							
Roller skating							
Skateboarding							
Badminton							
Wall ball							
Racquetball							
Squash							
Tennis							
Ping-pong							
Softball							
Baseball							
Basketball							
Football							
Handball							
Kinball							
Volleyball							
Soccer							
Boxing							
Wrestling							
Fencing							
Self-defense							
Judo							
Karate							
Aikido							
Jiu-jitsu							
Tai-chi							
Tae Kwon Do							
Hockey							
Ball hockey							
Figure skating							
Speed skating							
Free skating							
Broom ball							
Curling							

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15 minutes or more							
Ringuette							
Downhill skiing							
Cross-country skiing							
Snowshoeing							
Tobogganing							
Classical ballet							
Jazz ballet							
Aerobic dance							
Folk dance							
Modern dance							
Free dance							
Track and field							
Calisthenics							
Gymnastics							
Jogging							
Walking							
Ball games							
Kickball							
Catch							
Frisbee							
Swimming							
Synchronised swimming							
Diving							
Wind surfing							
Water polo							
Bowling							
Horseback riding							
Obstacle course							
Archery (bow and arrow)							
Golf							
Other							

OR

☐ You did not do any of these activities last week.

S.V.P. tourne la page

20. Usually you play video games like Gameboy or Nintendo...

1 ☐ Every day
2 ☐ A couple of times each week
3 ☐ Hardly ever
4 ☐ Never

21. On schooldays, you usually watch...

1 ☐ 6 or more TV programs a day
2 ☐ 4 or 5 TV programs a day
3 ☐ 2 or 3 TV programs a day
4 ☐ 1 TV program a day
5 ☐ You don't watch TV on schooldays

22. On Saturday morning, you usually watch TV or videos...

1 ☐ All morning
2 ☐ A part of the morning
3 ☐ Not at all during the morning

23. On Saturday afternoon, you usually watch TV or videos...

1 ☐ All afternoon
2 ☐ A part of the afternoon
3 ☐ Not at all during the afternoon

S.V.P. tourne la page ☞

24. On Saturday night, you usually watch TV or videos...

1 ☐ All evening
2 ☐ A part of the evening
3 ☐ Not at all during the evening

25. Think about sports teams <u>at school</u>. Since school started last fall, you belonged to the school...

Yes	No	
1 ☐	2 ☐	Cross country ski team
1 ☐	2 ☐	Basketball team
1 ☐	2 ☐	Volleyball team
1 ☐	2 ☐	Gymnastics team
1 ☐	2 ☐	Handball team
1 ☐	2 ☐	Floor hockey team
1 ☐	2 ☐	Other _____

26. Now think about sports teams <u>outside of school</u>. Since last summer, you belonged to a...

Yes	No	
1 ☐	2 ☐	Basketball team
1 ☐	2 ☐	Volleyball team
1 ☐	2 ☐	Soccer team
1 ☐	2 ☐	Gymnastics team
1 ☐	2 ☐	Hockey team
1 ☐	2 ☐	Football team
1 ☐	2 ☐	Swimming team
1 ☐	2 ☐	Baseball team
1 ☐	2 ☐	Judo or karate or taichi team
1 ☐	2 ☐	Other _____

S.V.P. tourne la page ☞

27. Now think about sports or dance <u>lessons</u>. Since last summer, you took...

Yes	No	
1 ☐	2 ☐	Swimming lessons
1 ☐	2 ☐	Downhill ski lessons
1 ☐	2 ☐	Hockey school
1 ☐	2 ☐	Dance or ballet lessons
1 ☐	2 ☐	Judo or karate or taichi lessons
1 ☐	2 ☐	Gymnastics lessons
1 ☐	2 ☐	Skating lessons
1 ☐	2 ☐	Other _____

Tell me what you think...

28. Something that prevents you from getting sick is...

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Very good	Good	Neither good nor bad	Bad	Very bad

29. To be in good health is...

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Very good	Good	Neither good nor bad	Bad	Very bad

30. To please your parents is...

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Very good	Good	Neither good nor bad	Bad	Very bad

S.V.P. tourne la page ☞

		Very sure	A little sure	Not sure
31.	How sure are you that you can do physical activities on Saturday mornings?	1 ☐	2 ☐	3 ☐
32.	How sure are you that you can play outdoors on Saturday mornings?	1 ☐	2 ☐	3 ☐
33.	How sure are you that you can run 3 times around your school without stopping?	1 ☐	2 ☐	3 ☐
34.	How sure are you that you can be good at physical activities?	1 ☐	2 ☐	3 ☐
35.	How sure are you that you can do physical activities when you have lots of homework to do?	1 ☐	2 ☐	3 ☐
36.	How sure are you that you can do physical activities if you get home late after school?	1 ☐	2 ☐	3 ☐
37.	How sure are you that you can exercise and keep moving most of the time during gym class?	1 ☐	2 ☐	3 ☐
38.	How sure are you that you can do physical activities when your parents want to do something else?	1 ☐	2 ☐	3 ☐
39.	How sure are you that you can do physical activities when it's very cold outside?	1 ☐	2 ☐	3 ☐
40.	How sure are you that you can do physical activities even when you don't feel like it?	1 ☐	2 ☐	3 ☐

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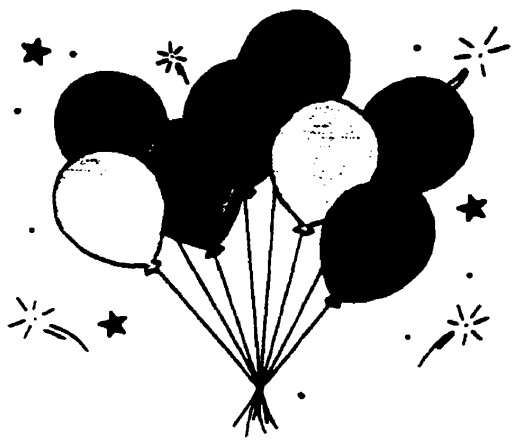
When you do physical activities, do you think that...

		No	Maybe not	Maybe yes	Yes
41.	It pleases your parents?	1 ☐	2 ☐	3 ☐	4 ☐
42.	It's good for your health?	1 ☐	2 ☐	3 ☐	4 ☐
43.	It prevents you from getting sick?	1 ☐	2 ☐	3 ☐	4 ☐

44. Since last Christmas, did you take any sports, dance, or gymnastics lessons or did you belong to a sports or dance club? Do not count gym class at school.

1 ☐ Yes → **How many hours per week did you do these activities?** ☐ hours per week

2 ☐ No



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Let's talk about smoking

45. Have you ever smoked a cigarette, even just a puff?

- 1 ☐ No
- 2 ☐ Yes, 1 or 2 times
- 3 ☐ Yes, 3 to 10 times
- 4 ☐ Yes, more than 10 times

46. Check the <u>one</u> box below which describes you best.

- 1 ☐ You have never smoked
- 2 ☐ You have smoked, but you have not smoked at all in the past year
- 3 ☐ You smoked once or a couple of times in the past year
- 4 ☐ You smoke a couple of times each month → You smoke ☐ cigarettes each month
- 5 ☐ You smoke a couple of times each week → You smoke ☐ cigarettes each week
- 6 ☐ You smoke every day → Yesterday you smoked ☐ cigarettes

47. <u>If you have ever smoked a cigarette</u>, how old were you when you had your first puff from a cigarette?

☐ years old OR 96 ☐ Don't remember

77 ☐ You have never smoked

48. How many of your friends smoke cigarettes?

1 ☐ None 2 ☐ A few 3 ☐ Most 7 ☐ Don't know

49. Write the correct number in the box.

You have ☐ brothers who smoke cigarettes

You have ☐ sisters who smoke cigarettes

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50. Does your mother smoke cigarettes?

1 ☐ Yes 2 ☐ No 8 ☐ Not applicable

51. Does your mother talk to you about the dangers of smoking?

1 ☐ Yes 2 ☐ No 8 ☐ Not applicable

52. Does your father smoke cigarettes?

1 ☐ Yes 2 ☐ No 8 ☐ Not applicable

53. Does your father talk to you about the dangers of smoking?

1 ☐ Yes 2 ☐ No 8 ☐ Not applicable

Let's talk about eating

What would you choose?

54.	☐	Fruit for dessert	**OR**	Ice cream for dessert	☐
55.	☐	French fries	**OR**	A baked potato	☐
56.	☐	A chocolate bar as a snack	**OR**	Yogurt as a snack	☐
57.	☐	Raw vegetables as a snack	**OR**	Chips as a snack	☐
58.	☐	Ice cream for dessert	**OR**	Frozen yogurt for dessert	☐
59.	☐	Oatmeal for breakfast	**OR**	Froot Loops for breakfast	☐
60.	☐	A sandwich with white bread	**OR**	A sandwich with brown bread	☐

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61. During the past week from Monday to Sunday, how often did you eat the following foods...

	Every day	Once or a couple of times	Never
Fruit (orange, apple, banana)	1 ☐	2 ☐	3 ☐
Fruit juice	1 ☐	2 ☐	3 ☐
Cereal	1 ☐	2 ☐	3 ☐
Granola bar	1 ☐	2 ☐	3 ☐
Donuts or cakes or pastries	1 ☐	2 ☐	3 ☐
Cookies	1 ☐	2 ☐	3 ☐
Crackers	1 ☐	2 ☐	3 ☐
Croissant or sweetrolls	1 ☐	2 ☐	3 ☐
Muffin	1 ☐	2 ☐	3 ☐
Candy or chocolate bars	1 ☐	2 ☐	3 ☐
Ice cream	1 ☐	2 ☐	3 ☐
Potato chips, fritos, doritos	1 ☐	2 ☐	3 ☐
Cooked vegetables	1 ☐	2 ☐	3 ☐
Raw vegetables	1 ☐	2 ☐	3 ☐
Green salad or lettuce	1 ☐	2 ☐	3 ☐
Milk	1 ☐	2 ☐	3 ☐
Cheese	1 ☐	2 ☐	3 ☐
Yogurt	1 ☐	2 ☐	3 ☐
Butter	1 ☐	2 ☐	3 ☐
Margarine	1 ☐	2 ☐	3 ☐
Soft drinks	1 ☐	2 ☐	3 ☐
Brown bread	1 ☐	2 ☐	3 ☐
White bread	1 ☐	2 ☐	3 ☐
Rice or potatoes	1 ☐	2 ☐	3 ☐

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62. During the past week from Monday to Sunday, how often did you eat the following foods?

	3 or more times	1 or 2 times	Never
Fish	1 ☐	2 ☐	3 ☐
Fried chicken (Kentucky)	1 ☐	2 ☐	3 ☐
Chicken	1 ☐	2 ☐	3 ☐
Hot dogs	1 ☐	2 ☐	3 ☐
Hamburgers	1 ☐	2 ☐	3 ☐
French fries or poutine	1 ☐	2 ☐	3 ☐
Steak, roastbeef, hamburger steak	1 ☐	2 ☐	3 ☐
Cold cuts (salami, bologna, pepperoni)	1 ☐	2 ☐	3 ☐
Bacon or sausages	1 ☐	2 ☐	3 ☐
Eggs	1 ☐	2 ☐	3 ☐
Spaghetti or macaroni or noodles	1 ☐	2 ☐	3 ☐

		Very sure	A little sure	Not sure
63.	How sure are you that you can choose a snack that is good for you at the corner store?	1 ☐	2 ☐	3 ☐
64.	How sure are you that, at home, you can choose foods that are good for you most of the time?	1 ☐	2 ☐	3 ☐
65.	How sure are you that you can like foods that are good for you?	1 ☐	2 ☐	3 ☐
66.	How sure are you that you can choose foods that are good for you most of the time when you are with your friends?	1 ☐	2 ☐	3 ☐
67.	How sure are you that, at home, you can choose a snack that is good for you?	1 ☐	2 ☐	3 ☐

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		Very sure	A little sure	Not sure
68.	How sure are you that, at school, you can eat foods that are good for you most of the time?	1 ☐	2 ☐	3 ☐
69.	How sure are you that you can make yourself a snack that is good for you?	1 ☐	2 ☐	3 ☐

When you eat foods that are good for you, do you think that...

		No	Maybe not	Maybe yes	Yes
70.	It's good for your health?	1 ☐	2 ☐	3 ☐	4 ☐
71.	It prevents you from getting sick?	1 ☐	2 ☐	3 ☐	4 ☐
72.	It pleases your parents?	1 ☐	2 ☐	3 ☐	4 ☐

To finish off, a few general questions.

73. How long have you lived in Canada?

96 ☐ All your life

☐☐ Years

77 ☐ Don't know

74. Your mother was born in...

1 ☐ Canada

2 ☐ elsewhere. Where? _____

7 ☐ Don't know

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75. **Your father was born in...**

1 ☐ Canada
2 ☐ elsewhere, **Where?** _____
7 ☐ Don't know

76. **You were born in...**

1 ☐ Canada
2 ☐ elsewhere, **Where?** _____
7 ☐ Don't know

77. **How many of the following do you have in your house or apartment?**

Bathrooms ☐
Bedrooms ☐

78. **Does your father work?** (Include part-time)

1 ☐ Yes
2 ☐ No
7 ☐ Don't know

79. **Does your mother work?** (Include part-time)

1 ☐ Yes
2 ☐ No
7 ☐ Don't know

S.V.P. tourne la page

Finally, for question 80, you can check off more than one answer, but don't count languages where you only know a few words.

80. You speak...

- 1 ☐ French
- 1 ☐ English
- 1 ☐ Portuguese
- 1 ☐ Greek
- 1 ☐ Spanish
- 1 ☐ Italian
- 1 ☐ Chinese
- 1 ☐ Vietnamese
- 1 ☐ Other _____

If there's another language you speak not listed here, write it on the line at the bottom and check "Other".

Finished!!! Thank you.

Appendix II

Categorization Used for Composition of the "Family origin variable"

Canada	French-speaking Canadians, English-speaking Canadians.
Europe	Portugal, Italy, Greece, Cyprus, Poland, Yugoslavia, Romania, Bulgaria, Czechoslovakia, Turkey, Hungary.
Asia	China/Hong Kong, Vietnam, Cambodia/Laos, India, Sri Lanka, Bangladesh, Pakistan.
Arabic-speaking countries	Lebanon, Syria, Iraq, Palestine, Jordan, Kuwait, Saudi Arabia, United Arab Emirates, Egypt, Tunisia, Algeria, Morocco.
South America	Venezuela, Uruguay, Peru, Columbia, Chile, Argentina, Ecuador, Brazil, Bolivia, Guyana, Surinam, French Guyana.
Central America /Caribbean	Honduras, Nicaragua, Mexico, Panama, Cuba, Jamaica, Trinidad, Grenada, St. Lucia, Barbados, Belize, Antigua, St. Vincent.
Other	Undetermined family origin or other family origin including 43 countries.

Appendix III

Variables Investigated, Coding for Categories of Response, and the Number of Missing Data

Variables	Coding	Number of subjects with missing data[a]	
		Boys	Girls
Baseline year	1994 vs.1993, 1995 vs.1993. (2 dummy variables)	0	0
Gender	0 = boy, 1 = girl.	0	0
Age (years)	0 = 9-10, 1 = 11-12.	0	0
School	(13 dummy variables)	0	0
Family structure	0 = Two-parent family, 1 = Single-parent family/other.	0	0
Born in Canada	0 = Yes, 1 = No	0	0
Family origin	Canada (reference), Europe, Asia, Arabic-speaking countries, South America, Central America/Caribbean, other. (6 dummy variables)	1	0
Family origin (dichotomized)	0 = Outside Canada, 1 = Canada.	1	0
Parental unemployment	0 = No (at least one parent was employed), 1 = Yes (Both parents unemployed/employment status for both parents were unknown).	0	0
Friends smoke	0 = None/don't know, 1=A few/most.	0	0
Parent(s) smoke(s)	0 = None of parents smoke/not applicable, 1 = Either/both parent(s) smoke(s).	1	0
Sibling(s) smoke(s)	0 = None/ not applicable, 1 = Yes (at least one smokes).	1	2
Parent(s) encourage(s) of non-smoking	0 = Yes (Either/both of parent(s) encourage(s)), 1 = No (None of parents encourages).	0	0
Overweight	0 = No (BMI less than 90th percentile), 1 = Yes (BMI greater or equal to 90th percentile).	0	0
Number of TV programs/day	0 = Less than six, 1 = More or equal to six.	0	0
Physically inactive	0 = No (Physical activity score > 6 or missing), 1 = Yes (Physical activity score ≤ 6).	0	0
Participated in sports activities or sports lessons	0 = Yes (Participated in any sports activity at school, outside school, or taking any sports lesson or missing), 1 = No (Did not participate at all).	0	0

Note. [a] The number of missing data presented were among 229 boys and 272 girls, respectively.

Appendix IV

Parental Smoking at baseline by Family Origin Among Elementary Schoolchildren in Multiethnic, Low-income, Inner-city Neighborhoods, Montreal, Canada, 1993-1995

Family Origin	Father smokes			Mother smokes		
	Subjects *n*	%	(95% CI)	Subjects *n*	%	(95% CI)
Canada	89	59.6	(49.4, 69.7)	90	56.7	(46.7, 66.9)
Europe	92	47.8	(37.6, 58.0)	93	21.5	(13.2, 29.9)
Asia	70	54.3	(34.0, 57.4)	71	1.4	(0.0, 4.1)
Arabic-speaking countries	25	28.0	(12.1, 49.4)[a]	26	23.1	(9.0, 43.4)[a]
South America	24	58.3	(22.7, 60.7)[a]	23	30.4	(13.4, 51.5)[a]
Central America /Caribbean	115	20.0	(12.7, 27.3)	123	12.2	(6.4, 18.0)
Other/ unclassified	63	34.9	(23.1, 46.7)	67	10.5	(3.1, 17.8)
Total[b]	478	42.1	(37.6, 46.5)	493	21.7	(18.1, 25.3)

Note. The proportion of father's smoking differs by family origin. χ^2 (6, n = 478) = 45.64, $p < .001$. The proportion of mother's smoking differs by family origin. χ^2 (6, n = 493) = 94.55, $p < .001$.

[a] Confidence intervals were calculated by using the binomial distribution table (Rohlf & Sokal, 1981).

[b] Totals differ because of missing values.

Appendix V

Proportion of Children Born in Canada by Baseline Year, Montreal, Canada, 1993-1995

Born in Canada	Total		Baseline Year					
			1993		1994		1995	
	n	*n*	% (95%CI)	*n*	% (95%CI)	*n*	% (95%CI)
Yes	764	271	59.7 (55.2, 64.2)	261	56.9 (52.3, 61.4)	232	52.8 (48.2, 57.5)
No	588	183	40.3 (35.8, 44.8)	198	43.1 (38.6, 47.7)	207	47.2 (42.5, 51.8)

Note. χ^2 (2, N = 1352) = 4.29, p = .12.

Appendix VI

Proportion of children by baseline year and family origin, Montreal, Canada, 1993-1995

Family Origin	Baseline Year					
	1993		1994		1995	
	n	%	*n*	%	*n*	%
Canada	45	20.0	51	22.2	20	13.5
Europe	52	23.1	52	22.6	13	8.8
Asia	30	13.3	25	10.9	32	21.6
Arabic-speaking countries	12	5.3	15	6.5	7	4.7
South America	10	4.4	9	3.9	10	6.8
Central America /Caribbean	44	19.6	58	25.2	39	26.4
Other/unclassified	32	14.2	20	8.7	27	18.2
Total	225	100.0	230	100.0	148	100.0

Note. χ^2 (12, N = 603) = 33.64, p = .001.

Appendix VII

Proportion of Parental Smoking by Baseline Year, Montreal, Canada, 1993-1995

Parent(s) smoke(s)	Total	Baseline Year					
		1993		1994		1995	
	n	*n*	% (95%CI)	*n*	% (95%CI)	*n*	% (95%CI)
No	664	211	43.1 (38.7, 47.4)	243	52.2 (47.6, 56.7)	210	47.5 (42.9, 52.2)
Yes	734	279	56.9 (52.6, 61.3)	223	47.8 (43.3, 52.4)	232	52.5 (47.8, 57.1)

Note. χ^2 (2, N = 1398) = 7.91, p = .019.

Appendix VIII

Smoking Status at Follow-up among Girls by Family Origin (Canadian Origin or Not), Montreal, Canada, 1995-1997

Family origin	Total *n*	Smoking status at two-year follow-up					
		Never smoker		Past smoker		Current smoker	
		%	95% CI	%	95% CI	%	95% CI
Outside Canada	224	79.5	74.2 - 84.8	17.0	12.0 - 21.9	3.6	1.4 - 6.5
Canada	48	70.8	58.0 - 83.7	10.4	1.8 - 19.1	18.8	7.7 - 29.8
Total	272	77.9	73.0 - 82.9	15.8	11.5 - 20.1	6.3	3.4 - 9.1

Note. χ^2 (2, $N = 272$) = 16.02, $p = .001$.

Appendix IX

Proportion of Children with Changes in Exposure Status

Variable	Percentage of children who changed exposure status during the two-year follow-up			
	Boys		Girls	
	Total [a] *n*	%	Total [a] *n*	%
Parental smoking	229	7.2	272	13.8
Sibling smoking	225	7.1	270	10.7
Friends smoking	229	30.3	272	35.0

Note. [a] Totals differ because of missing values.

Variable	Exposure status	Children with/without changes in exposure status			
	Baseline----Follow-up	Boys		Girls	
		n	%	*n*	%
Parent(s) smoke(s)	No-------No	105	50.2	108	41.4
	Yes------Yes	89	42.6	117	44.8
	No-------Yes	9	4.3	21	8.1
	Yes-------No	6	2.9	15	5.8
Sibling(s) smoke(s)	No-------No	199	88.4	229	84.8
	Yes------Yes	10	4.4	12	4.4
	No-------Yes	10	4.4	27	10.0
	Yes-------No	6	2.7	2	0.7
Friends smoke	No-------No	140	61.4	158	58.3
	Yes------Yes	19	8.3	18	6.6
	No-------Yes	50	21.9	67	24.7
	Yes-------No	19	8.3	28	10.3