Individual, Social and Environmental Correlates of Youth Smoking Cessation

by

Coralynne Schlievert

Submitted in partial fulfilment of the requirements
for the degree of Master of Science

at

Dalhousie University
Halifax, Nova Scotia
August 2012

DALHOUSIE UNIVERSITY

DEPARTMENT OF COMMUNITY HEALTH AND EPIDEMIOLOGY

The undersigned hereby certify that they have read and recommend to the Faculty of

Graduate Studies for acceptance a thesis entitled "Individual, Social and Environmental

Correlates of Youth Smoking Cessation" by Coralynne Schlievert in partial fulfilment of

the requirements for the degree of Master of Science.

Dated: August 17th, 2012

Co-Supervisors: _____

_____

Reader: _____

DALHOUSIE UNIVERSITY

DATE: August 17th, 2012

AUTHOR: Coralynne Schlievert

TITLE: Individual, Social and Environmental Correlates of Youth Smoking
             Cessation

DEPARTMENT OR SCHOOL: Department of Community Health and
                             Epidemiology

DEGREE: MSc   CONVOCATION: October   YEAR: 2012

Permission is herewith granted to Dalhousie University to circulate and to have copied for non-commercial purposes, at its discretion, the above title upon the request of individuals or institutions. I understand that my thesis will be electronically available to the public.

The author reserves other publication rights, and neither the thesis nor extensive extracts from it may be printed or otherwise reproduced without the author's written permission.

The author attests that permission has been obtained for the use of any copyrighted material appearing in the thesis (other than the brief excerpts requiring only proper acknowledgement in scholarly writing), and that all such use is clearly acknowledged.

_____
Signature of Author

DEDICATION

I dedicate this work to my husband, Micheal, for his loving support and patience,

and to our new son, Luke.

TABLE OF CONTENTS

LIST OF FIGURES

ABSTRACT

Introduction: The smoking rate among Canadian grade 9 to 12 students was 14% during the 2008-2009 school year. While 60% of young smokers report wanting to quit smoking and attempting to do so, few succeed. Many studies have examined the key correlates associated with youth smoking and smoking initiation, however, few have examined successful cessation among adolescents. This thesis describes and compares the environmental, social and individual correlates of adolescent smoking cessation to current and never smokers using a theoretical framework.

Method: Data from the 2008-2009 Youth Smoking Survey, a nationally representative survey delivered in Canadian schools were examined using multinomial logit regression. The strongest individual, social and environmental correlates of former smoking as compared to never and current smoking students in grades 9 to 12 were selected for multivariate multinomial logit regression models. Path analysis was conducted separately for females and males.

Results: Former smokers represent a distinct, often intermediary, group of students between current and never smokers, and have some similarities with both groups on certain environmental and individual measures. Social and environmental factors play key roles in differentiating former from current smokers. Social factors were most influential in female smoking cessation whereas environmental and individual factors in addition to social factors were directly and indirectly associated with male smoking cessation.

Conclusion: These results further describe the profile of youth who successfully quit smoking specific to sex. The strong effects from social correlates identified suggest the importance of family and peer support for quitting. These findings inform the development of youth cessation programs and policy decision-making and provide a means to target those youth in which these strategies may be most effective.

BHCRI	Beatrice Hunter Cancer Research Institute
CCS	Canadian Cancer Society
CI	confidence interval(s)
CIHR	Canadian Institutes of Health Research
M	mean
n	number
N-O-T	Not on Tobacco (youth smoking cessation program)
OR	odds ratio
p	p-value
Q4L	Quit for Life (youth smoking cessation program)
RRR	relative risk ratio
sd	standard deviation
SRNT	Society for Research on Nicotine and Tobacco
t	t-statistic
TTI	Theory of Triadic Influence
YSS	Youth Smoking Survey
YTCC	Youth Tobacco Cessation Collaborative

ACKNOWLEDGEMENTS

First I would like to thank my thesis supervisors Drs. Louise Parker and Mark Asbridge. Dr. Parker supported my enthusiasm to use the 2008-2009 YSS dataset which I collected the data for from Nova Scotia. Dr. Parker has an extensive epidemiology background in cancer risk factors and Dr. Asbridge in youth risk behaviours and tobacco. I deeply appreciate the many learning opportunities offered from multiple perspectives. I would also like to thank Dr. Donald Langille, the third member of my thesis committee, for his unique insight into youth health risk behaviours and being available to bounce ideas back and forth. Furthermore, I would like to thank Dr. Michael Chaiton, the external reviewer and Dr. Yukiko Asada for acting as Chair for my defense examination.

I would like to extend a special thank you to Dr. Steve Manske, Tammy Cummings and Dr. Rashid Ahmed of the Propel Centre for Population Health Research at the University of Waterloo for their assistance in using the 2008-2009 Youth Smoking Survey dataset. I strongly believe the YSS is a valuable national tool that can be used to improve school health and student wellbeing.

I would also like to thank Dr. Louise Parker and the CCS-Nova Scotia Division for providing office space for me to work free from distractions and Dr. Trevor Dummer for helping me format the YSS dataset to Stata.

Finally, I would like to especially thank my family and friends for their unconditional support during my Masters studies.

Financial support
CIHR provided considerable financial support for this project with a Masters Award. In addition, I received a travel bursary from BHCRI, and supplementary travel funds from Dr. Mark Asbridge's Dalhousie research account and the Propel Centre for Population Health Impact to present a poster at the SRNT annual conference in Toronto, February 2011. Dr. Mark Asbridge also provided funds from his research account to cover my first Stata license. The financial support allowed me to better focus my efforts on research.

CHAPTER 1

Introduction

Thesis Overview

The smoking rate among Canadian youth (aged 15-19) was 15% in 2008, unchanged from 2007 and 2006. While over 60% of youth smokers report wanting to quit smoking and attempting to do so, few succeed. Understanding what affects cessation remains a key public health goal. While many studies have examined the key correlates associated with youth smoking and smoking initiation, few have examined cessation among young smokers. The purpose of this study is to identify those factors associated with tobacco cessation among youth.

This thesis draws on secondary data from Canadian high school students (grades 9-12) who completed the 2008-2009 Youth Smoking Survey (YSS). The YSS is a biennial survey used by Health Canada to monitor the effectiveness of national, provincial and regional tobacco control strategies. The YSS is an ideal dataset to examine factors related to youth smoking as it measures smoking behaviours and attitudes among a nationally representative sample of school students. This project aims to examine information from current, former and never smokers using individual, cross-sectional data from the 2008-2009 YSS with the goal of identifying individual, social and environmental factors that shape decisions to quit and remain smoke free. Factors measured in the YSS that are associated with quitting are identified using descriptive and analytical analyses.

The Theory of Triadic Influence (TTI) is used as a framework to organise the factors associated with smoking status, dividing them into three streams (individual, social and environmental) with respect to differing levels of causal influence. The three streams of the TTI range from most upstream or 'ultimate' factors to midstream or 'distal' factors to most downstream or 'proximal' factors that influence behaviours such as smoking. The TTI provides a useful guide to model the varying potential influences on smoking cessation, and to highlight important target areas to inform the development of youth

1

smoking cessation strategies. Findings will inform the development of youth cessation programs and policy decision-making as well as target those youth in which these strategies may be most effective.

This research thesis first reviews the relevant literature on adolescent smoking in this introduction (Chapter 1), including strategies used to reduce smoking rates, factors associated with youth smoking behaviours, theoretical frameworks that explain smoking behaviours and my thesis objectives. Findings are then presented in two manuscripts.

In the first manuscript (Chapter 2), the TTI is used to compare students who quit smoking with current and never smoking students along the dimensions of the TTI model by stream and level. By using the TTI framework as a tool in examining youth cessation, areas within the framework that show strong associations highlight appropriate action areas for youth cessation intervention.

The second manuscript (Chapter 3) builds on the first by exploring the characteristics of smoking cessation that are specific to females and males. Informed by the TTI results from Chapter 2, a path analysis is performed to understand direct and indirect effects of key predictors of smoking cessation by sex. The aim of Chapter 3 is to highlight sex specific needs to guide the development of youth smoking cessation interventions.

The concluding section (Chapter 4) summarizes the main findings from the papers, provides a profile of the adolescent former smoker, offers recommendations for targeted youth tobacco cessation strategies, lists the strengths and limitations from this study, and discusses areas for future research.

Youth Smoking

Rates of adolescent daily smoking remain unacceptably high. In 2008, 15% of Canadian youth (age 15 to 19), approximately 300,000 people, were current smokers (reported smoking at time of survey), unchanged from 2007 and 2006.(1,2) Of these young smokers, 60% smoked daily and 40% smoked occasionally, with daily smokers reportedly consuming, on average, 12 cigarettes per day.(2) With smoking prevalence

remaining stable over recent years, action is required to further reduce adolescent smoking.

Cigarette smoking is an addictive behaviour that is most likely to become established during adolescence.(1,3,4) The number of years a person smokes and how much they smoke has the greatest impact on tobacco related mortality and morbidity.(5) Although many health consequences result from a longer smoking history, adolescent smokers are at increased risk for immediate health problems during adolescence and young adulthood. Smoking during adolescence reduces lung growth rate, lung function, overall fitness, and increases risk of respiratory problems.(6)

Smokers who start at a younger age are more likely to develop higher levels of nicotine dependence and are likely to have more difficulty quitting smoking and be affected more by the ill effects of smoking.(7) The most common time to try smoking is during the ages of 14 and 15 and the most common time to progress to becoming a daily smoker is during the ages of 16 and 17.(8) Over 80% of adult smokers report having started smoking before age 18.(9) Experts predict that half of adolescent smokers will continue to smoke for 16 to 20 years.(10,11) Delaying smoking cessation until adulthood has both immediate and longer term negative health consequences.(7,8,12)

Adolescents likely become nicotine dependent before they become daily smokers. Much evidence suggests both daily and occasional adolescent smokers report withdrawal symptoms similar to those reported by adult smokers.(6,12,13) A number of studies have shown that a substantial number of adolescent smokers are nicotine dependent (14) with rates ranging from 19 to 63%.(7) In addition, nicotine dependence may develop rapidly in a subset of adolescents.(14,15) Among a large sample of young (age 12-13) smokers, 10% had become nicotine dependent within two days, 25% within one month and 50% had become nicotine dependent by the time they smoked seven cigarettes per month.(12)

As another indicator of smoking dependence, young smokers often report difficulty in quitting or lack of confidence in their ability to do so. One study found that only 43% of a sample of adolescent smokers felt confident that they would ever quit smoking.(16) Moreover, approximately 40% of adolescent smokers attempting to quit are unable to

refrain from smoking for longer than one week, and almost 60% of these youth report that quitting is fairly or very difficult.(6)

Researchers have examined the progression from non-smoker to smoker. The 1994 US Surgeon General's Report described the process in five stages: i.) forming attitudes and beliefs about tobacco; ii.) trying tobacco; iii.) experimenting with tobacco further; iv.) using tobacco regularly; and v.) becoming addicted to tobacco. The researchers estimated that it takes, on average, three years to become addicted to tobacco.(6) However, a longitudinal study of young female smokers did not support the idea that adolescents progress through well-defined smoking stages.(4) Other research has demonstrated that many young smokers become addicted to cigarettes much sooner than with three years of smoking and show withdrawal symptoms similar to those shown by adults.(12) Starting smoking at a younger age and smoking over a longer period of time during adolescence is predictive of nicotine dependence in adulthood, while smoking cessation at one year during adolescence reduces later nicotine dependence.(17)

Many anti-tobacco initiatives at the national,(11,18,19) provincial,(11) community,(11,20-22) and school (11,23-25) levels have focused on developing prevention strategies for youth and have been shown to be effective in reducing smoking uptake. Educational strategies, in conjunction with community-based and media-based activities, can postpone or prevent smoking onset in 20 to 40% of adolescents.(11) The prevention approach has been the primary means of reducing tobacco use among adolescents to date. However, the fact that 15% of youth still smoke despite prevention efforts, a figure which has failed to decline further in the last few years, signifies a large, vulnerable population that lacks the resources and support networks to help them stop smoking.

The Need for Youth Smoking Cessation Strategies

The availability of tobacco cessation strategies for adolescent smokers is particularly important because the rate of 'spontaneous' (also known as unassisted or naturally occurring) quitting among this group is surprisingly low. It has been largely assumed that young smokers will grow out of smoking or easily quit on their own. However, the yearly

prevalence of unassisted quitting among adolescents is similar to the 5 to 6% observed among adults.(7) Mermelstein (7) reviewed several longitudinal studies assessing adolescent smoking cessation (cessation was defined as refraining from smoking for at least 30 days) and found the prevalence of unassisted cessation ranged from 4 to 21%. In another review, Buttross and Kastner (26) reported prevalence rates of youth smoking cessation ranging from 0 to 11%. Naturally occurring quit rates of occasional young smokers were found to be higher, but still surprisingly low.(7) Similar to adult smokers without intervention, very few adolescent smokers stop smoking unassisted, which suggests a need for cessation interventions directed towards adolescents, occurring early in their smoking 'career.'(7)

The majority of young smokers report wanting to quit smoking and attempt to do so,(27,28) despite the fact that only a few will succeed.(7,6,27,29) Many studies report over 60% of adolescent smokers wish to quit smoking.(8,30-33) In one study, over half of adolescent smokers in Ontario reported that they had attempted to quit smoking in the past year.(33,34) Another large survey asking Australian adolescent smokers their readiness to quit smoking found that 71% had considered quitting at some point, 43% were currently contemplating quitting, 28% of weekly smokers were taking action to quit, and 55% had made a quit attempt in the last year.(30) A five year longitudinal study of children (age 12-13) found that a serious desire to quit for a quarter of adolescent smokers occurred at 1.5 months after first cigarette inhalation, the first serious quit attempt occurred at 2.5 months, lacking self-confidence in the ability to quit occurred at 18.4 months, and awareness of the difficulty of quitting smoking occurred at 32.2 months.(35) Hence, the desire to quit smoking and attempting to quit will occur for many adolescents soon after smoking their first cigarette.

The process of quitting smoking is complex. Researchers have tested the trans-theoretical model of change, also known as 'The Stages of Change Model,' used to explain the process of adult smoking cessation, among high school students. They identified six time dependent cessation stages: i.) recent *acquisition* of smoking in the last six months; ii.) *pre-contemplation* when quitting is not considered during the next six months; iii.) *contemplation* when thoughts about quitting occur in the next six months or thoughts

about quitting occur in the next month without having previously considered quitting; iv.) *preparation* when thinking about quitting in the next month after having a previous quit attempt within the last six months; v.) *action* when a quit attempt has occurred in the last six months and has been sustained; and vi.) *maintenance* when a quit attempt has occurred and has been sustained for longer than six months.(36) From these stages experts project that at any point in time, approximately 15 to 19% of adolescent smokers are considering a quit attempt soon,(36,37) a significant population to target for intervention, and an additional 30% could be 'primed' for future intervention efforts.(37)

Knowing the reasons for quitting is an important part in developing motivational strategies in cessation interventions. Quantitative studies suggest the primary reason adolescents wish to quit smoking is for future health reasons.(38-41) Concerns about physical appearance,(39,42) the cost of cigarettes,(39,43) and athletic performance,(38,39) especially among males,(38) have also been reported to be important motivators by the majority of young smokers. In one study, daily smokers were more likely to report wanting to quit because they are 'addicted' in comparison to the reasons for quitting expressed by occasional smokers.(40)

Despite the majority of adolescent smokers endorsing quitting cigarettes, focus groups have revealed that many adolescents are unfamiliar with smoking cessation interventions. Youth in these focus groups were hesitant about how they would develop a plan to quit smoking, were unable to create a concrete plan and did not know where to seek support.(44) In a large survey, adolescents cited 'the use of willpower' most frequently as a method used in past quitting attempts; however, this method was also cited most frequently at being ineffectual. In this survey only 3% of adolescents reported trying a recognized cessation strategy to help them quit.(41)

In summary, considering that a significant proportion of adolescents smokers facing increased risk of immediate and future health consequences and that few adolescent smokers quit on their own despite the large majority who wish to do so, there is a need for effective targeted adolescent cessation strategies. Unfortunately, research in adolescent smoking cessation is limited.

Youth Smoking Cessation Strategies

Few good empirical studies examining smoking cessation interventions for adolescents have been reported.(7) A review commented that those studies found tend to be of low quality having: poorly described interventions and methods, inadequate measures of cessation, brief follow up periods, low retention rates, and no control or comparison group.(7) Sussman (45) reviewed 66 reports on cessation interventions: 47 were published in peer-reviewed journals, 15 were randomised experimental trials, 22 used a quasi-experimental design with a comparison group, and the remainder (29 reports) used a single group design that lacked a comparison group. Sussman's review (45) is noteworthy for its comprehensive description of intervention programs, its detailed examination of treatment effects by theoretical approaches, the approach setting, and potential moderators of intervention effectiveness (e.g., sex).

Sussman (45) suggested that the most effective cessation interventions for adolescents tend to be adolescent focused in the form of school- or community-based programs that teach social, behavioural and coping skills. The mean quit-rate at a 3- to 12-month average follow-up among the program conditions was 12%, compared to 7% among control groups. Classroom-based programs had the highest quit rates (17%), and school-based clinics (12%) also showed promise. It is noted that smoking behaviour in males and females is influenced by different social and environmental factors and this is an area in need of future research, as programs tailored to age and sex may be more successful over the longer term.(45)

Willingness to quit, smoking history, level of addiction and treatment cost have also been identified as important factors in considering the most appropriate treatment for youth.(8) In a later review by Sussman (46) of 64 empirical studies, the author recommends cessation programming be delivered in a context structured for youth, such as a school, a sports club, or a health clinic and that it should consist of at least five sessions. They also suggest programming should be as much fun and as interesting as possible, involving games, dramatizations, and use of alternative medicine concepts.(46)

Due to the methodological challenges of systematically comparing data across the variety of youth cessation strategies, the Youth Tobacco Cessation Collaborative (YTCC),(47,48) comprised of members from Canadian public and private organizations involved in tobacco addiction and cessation research, services and policy, was formed. The initial purpose of the group was to identify best practices; however, the group consensus was that there was too little evidence to make such designations. They identified intervention areas that held promise, such as cognitive–behavioural interventions, approaches for which inconclusive evidence exists, such as pharmacological interventions, and approaches that would not be recommended because of potential for harm or based on expert opinion, such as fear appeal or sensory deprivation. They highlighted the following research gaps: profiles of youth who quit smoking, theoretical approaches explaining adolescent smoking cessation, and testing youth cessation interventions by delivery setting and type of provider.(47) A key goal highlighted by the YTCC was to expand bio-behavioural models of cessation specific to youth and within important subgroups (e.g., sex and age).(48)

A more recent systematic review of youth tobacco cessation also concluded more work is necessary in developing and testing effective cessation strategies for this population. This Cochrane Review of tobacco cessation interventions for young people (age < 20) included intervention controlled trials that used or tested the stages of change approach, pharmacological aids (nicotine replacement therapy and bupropion), and psychosocial (cognitive behavioural and motivational) therapies. Fifteen trials met the inclusion/ exclusion criteria. Trials evaluating stages of change interventions achieved moderate long-term tobacco cessation success at one year (odds ratio (OR)=1.70, 95% confidence interval (CI)=1.25-2.33) that persisted at two-year follow up (OR=1.38, 95% CI=0.99-1.92). Pharmacological interventions were not effective; however, these trials were small, with limited power to detect an effect. Interventions using cognitive behavioural therapy were not found to be effective for tobacco cessation, except when trials were pooled for the Not-on-Tobacco (N-O-T) cessation program (OR=1.87, 95% CI=1.00-3.50) suggesting some degree of effectiveness. Trials that incorporated motivational interviewing as an intervention component achieved a pooled OR for tobacco cessation of

2.05 (95% CI=1.10-3.80), however, separating the effect of the motivational interviewing was impossible so that its independent effectiveness remains unclear.(49)

The authors identified a lack of youth cessation studies with high quality research designs, adequate power and long term follow up. Along with the need for more rigorously conducted trials, this Cochrane Review recommended more research be done to characterise youth who quit smoking.(49) A central aim of this thesis is to address this gap in knowledge and to provide a profile of adolescent former smoking within an ecological framework that includes a broad range of individual, social and environmental factors.

Factors Associated with Youth Smoking Behaviours

Observational studies have discovered a multitude of correlates that can be grouped into individual, social and environmental factors associated with different adolescent smoking behaviours. Conceptualized stages of adolescent smoking have been proposed where additional correlates strongly differentiate later smoking stages. Smoking stages have been used to define smoking status and are categorised based on smoking frequency and recency, they are: i) never smokers; ii) experimental smokers (reported trying smoking, but did not smoke in the last 30 days); iii) intermittent/occasional smokers (reported some smoking in the last 30 days); iv) regular smokers (reported having a cigarette every day for the last 30 days); and v) ex-smokers (reported quitting and refrained from smoking in the last 30 days).(50)

Adolescent individual, social and environmental factors have been differentially associated with each smoking stage. There is much known about the correlates of youth smoking susceptibility, smoking initiation and becoming a smoker; however, relatively few studies have examined correlates for youth cessation. Youth smoking profiles for most stages of the smoking continuum are well documented in the literature, noting a range of childhood predictors for different smoking trajectories (51,52) and correlates dependent on sex,(8,53-59) and grade-level/age.(50,60,61) Students in grades 6 to 9 significantly differ from senior students in grades 10 to 12 on a variety of measures relating to tobacco use. Examples include the proportion of students reporting having

tried a variety of tobacco products and having access to purchasing cigarettes from a retail source; older students tend to have greater access to tobacco products and thus tend to experiment more frequently.(62)

The broad range of influential factors associated with smoking can be organised into three categories: individual (intrapersonal/biological), social (interpersonal) and environmental (cultural/attitudinal). The constructs for individual, social and environmental factors are based on the Theory of Triadic Influence (TTI) for substance use which will be used in this thesis.(63) Observational studies have commonly examined relationships between individual, social and environmental factors and smoking behaviours, but rarely within an ecological model such as the TTI. The conceptual framework of the TTI will be described in more detail later.

Smoking initiation and experimentation

Many factors associated with early smoking stages, such as smoking initiation and experimentation, have been identified to target youth who are at greatest risk of smoking. High smoking susceptibility, where non-smokers do not exhibit a firm commitment to try not to smoke or would not refuse a cigarette if offered by a friend, is a strong correlate of smoking onset.(60,64-65) Other correlates of smoking uptake are listed in Table 1 (page 13).

The transition from trial to experimental smoking involves cigarette availability and peer smoking as well as alcohol and marijuana use.(60) Alcohol use has been found to be more strongly associated with early smoking stages (e.g., initiation and experimentation) as compared to later smoking stages (e.g., daily smoking).(50) Peer influences have consistently been the strongest correlate of smoking initiation and experimentation through modeling smoking, providing more opportunities to smoke and reinforcing smoking.(66)

Although examined less frequently, perceptions of smoking prevalence explain additional variance in smoking uptake, independent of peer role-model effects.(67) Smoking by senior students has been shown to be positively associated with smoking rates of younger students.(56,68-71) In addition, weak bonds with school and church have been shown to

10

predict both smoking uptake and experimentation.(72) Weak family bonds are also associated with smoking uptake, but not as strongly associated as poor school connectedness.(65)

Smoking susceptibility

Because susceptibility to smoking is such a strong correlate of smoking onset, factors associated with smoking susceptibility have been examined with the goal of informing prevention strategies. Not surprisingly, similar correlates have been observed for susceptibility as for smoking initiation, such as lack of health knowledge and older role models that smoke.(61,73) Interestingly, perceived body image,(74) lack of physical activity,(75) and increased screen (i.e., TV, computer) time (75) have also been associated with higher smoking susceptibility. See Table 1 for other factors found to be associated with smoking susceptibility.

Regular Smoking (Daily or Occasional)

Age (older) and race (Caucasian) are strong individual correlates of progressing to regular smoking.(76) Longitudinal studies have shown that engaging in risk-taking behaviours,(3) having more peers who smoke,(3,58) having a stressful life event,(3) and low academic achievement (58) escalate the progression from experimental to regular smoker. Current smokers tend to report more positive mood effects associated with smoking (36) and report a lower sense of community at school.(72)

Parental and family influences have been shown to have the greatest association with regular smoking.(60,77) When older siblings are included in analyses, the association with family smoking is stronger than with parental smoking alone;(78) sibling smoking increases both experimentation and regular smoking among younger siblings.(79)

Other findings from a large cross-sectional sample reported that higher grade level, having more daily smoking peers, ethnicity (white, non-immigrants), and reduced school connectedness were strongly associated with regular smoking but not with experimental smoking.(50) Studies have consistently shown that youth who report smoking also report lower school connectedness than their non-smoking peers.(80,81) Variables found to increase smoking risk are listed in Table 1 (page 13).

Smoking cessation

Unfortunately, most observational studies examining smoking behaviour among youth have not made comparisons with youth who have successfully quit smoking. One large cross-sectional study did not examine associations with successful cessation in their sample of 517 ex-smokers due to the lack of study power.(50) Of the studies that have been completed, sample sizes are relatively small and often examine only a subset of variables, and do not examine a range of factors from all domains (individual, social and environmental) within a conceptual framework.

One study of 135 adolescents who were attempting to quit smoking revealed that those youth with a high sense of personal control (i.e., self-efficacy) to quit, who reported fewer positive smoking effects, and who consumed fewer cigarettes, were more at tobacco cessation at four weeks but not at two months.(82) Another study showed that predictors of being a former smoking adolescent varied with the age of smoking initiation. This small study concluded that for younger adolescents, cessation was related to parental influences; while older adolescents tended to primarily respond to peer influences in choosing cessation.(66)

Adolescent psychosocial, individual factors (e.g., self-efficacy and self-esteem) and the social environment are also important antecedents to cessation that may in turn further reinforce cessation in a bi-directional relationship.(36,83) Factors observed to be associated with smoking cessation are listed in Table 1.

Table 1: Environmental, social and individual factors associated with smoking behaviours

	Smoking susceptibility	Smoking initiation	Smoking	Smoking cessation
Individual	· female sex (52) · perceived poor body image (74,75) · less physical activity (75)	· female sex (52,56) · early puberty (51) · higher school grade (60) · lower self-esteem (65) · increased smoking susceptibility (60,64-65)	· older age (60,61) · depressive symptoms (50) · female sex (59) · early puberty (51) · Caucasian (non-immigrant) race/ethnicity (50,76) · higher school grade (50) · lower self-esteem (55) · vital lung capacity (51) · more working time (84)	· sex moderator (59) · greater motivation to quit (59,85,86) · less perceived stress (85) · health reason for quitting (59) · higher self-efficacy to quit smoking (83,86) · higher self-esteem (36,83) · longer smoking history (59,85)
Social	· parental smoking (68) · peer smoking (52,68) · more screen time (75) · sibling smoking (68,73) · perceived instrumental value (52,61)	· parental smoking (54,61,65,87) · peer smoking (52,60,73) · perceived instrumental value (52)	· complex family structure (79) · less family time (79) · parental smoking (60,61,77,78) · less parental smoking disapproval (88,89) · peer smoking (50,60,61,77) · sibling smoking (60,77,78) · perceived instrumental value (61) · perceived positive mood effects (36*)	· greater parental attachment (85,90) · parental influences (83,91) · peer influences (36,83,90,91) · perceived positive mood effects of quitting smoking (91) · perceived social benefit effects of quitting smoking (91)
Environmental	· deviance acceptance (52) · less health knowledge (61) · senior student smoking prevalence (68)	· peer deviance acceptance (52) · deviant behaviours (92) · less health knowledge (65) · lower socioeconomic status (65) · lower religiosity (72) · lower school connectedness (72) · senior student smoking prevalence (56,70,71) · use of alcohol (50) · use of drugs (60,93)	· delinquency (50) · less health knowledge (94) · lower socioeconomic status (95) · lower school connectedness (50,72,80,81,89) · use of alcohol (50,93) · use of drugs (93)	· correct health beliefs (59,90,91)

A cross-sectional study of 5300 grade 7 to 12 students conducted in 1980-1985 used chi-square tests to compare a group of former smokers (those who had tried smoking but hadn't had a cigarette in the last month) to current smokers (those who had smoked in the last month) and never smokers (those who had never tried smoking) on a variety of social, demographic, attitudinal and behavioural variables. This study found that former smokers were a distinct group that showed characteristics intermediate to never smokers and current smokers, but were more similar to never smokers. Fewer former smokers than current smokers but more former smokers than never smokers reported having close friends that smoked, and mothers and fathers that smoked. Successful quitters were less likely than never smokers but more likely than current smokers to have parents and close friends that would be upset if they smoked; to believe smoking is a health problem; to disagree that smoking helps people relax; to disagree that smoking is socially acceptable; to disagree that family and friends enjoy smoking; and to agree that there should be separate areas designated for smoking.(91)

Because both being motivated and having self-efficacy to quit smoking are such important parts of cessation (86) some research has been done to identify factors indicating readiness to quit smoking. Not surprisingly, students with shorter smoking histories, who consumed fewer cigarettes (96,97) and who had had previous quit attempts (97) were more likely to express readiness to quit smoking, and to be white, female students.(96)

Not enough studies have examined adolescent smoking cessation behaviours, such as readiness to quit, relapse and successful quitting.(7) As mentioned previously, reviews of youth cessation research (7,47,49) have noted that factors predicting youth motivation to quit and those predicting successful quitting need to be explored further. Based on the wide range of correlates identified with certain smoking behaviours, it is evident that the decision to smoke cigarettes is based on a complex web of variables. Some thought has been put into explaining how these variables interact with and mediate each other within theoretical frameworks.

Theoretical Frameworks Explaining Youth Smoking

A theoretical framework not only provides a tool for understanding behaviour; it can also be used to inform the development of interventions and a profile of those who might benefit most. Sussman (45) identified eight theoretical frameworks used in the 66 cessation intervention studies he reviewed. To summarize broadly, these included: social influence models; cognitive-behavioural approaches; motivational enhancement; response-contingent reinforcement; supply reduction approaches; addiction focused approaches; stages of change (trans-theoretical) approaches; and affect clarification.(45) Most studies focus on one approach, while some draw from several. There is little research that directly compares these approaches in regards to youth tobacco cessation.(7)

Collins and Ellickson (98) reviewed four major theories explaining youth smoking behaviour: the Theory of Planned Behavior, Social Learning Theory, Social Attachment Theory, and Problem Behavior Theory. Key factors from each theory correlated with smoking initiation and regular smoking are summarized in Table 2 (page 16). The researchers did not examine correlates for smoking susceptibility, readiness to quit, or tobacco cessation. Four theory specific models were tested using cross-sectional data of adolescent smoking behaviours and attitudes. All four theories had strong predictive power, with concordance (R^2) ranging 72 to 75%. Furthermore, when correlates from all four models were integrated, a concordance of 77% was found for predicting current smoking behaviour.(98) The YSS is an instrument that measures many of these factors among others and would be an ideal starting point to analyze potential correlates of tobacco cessation among youth against known correlates of various smoking behaviours.

Table 2: Theoretical frameworks of youth smoking behaviour (98)

Theory (approach)	Key Correlates	Other Correlates	Smoking Behaviour
Planned Behaviour (cognitive)	Behavioural intentions	Perceived control Family and peer approval Attitudes	Smoking (99)
Social Learning/ Cognitive	Family and peer behaviour Self-efficacy	Family and peer approval Past behaviour Perceived prevalence Attitudes	Initiation (87)
Social Attachment/ Development	Bonds with school and family	Peer behaviour Peer approval	Initiation (100) Smoking (101)
Problem Behaviour (comprehensive)	Deviant behaviours	Family background Family and peer approval Peer behaviour Aspirations Opportunity to smoke Self-esteem Deviant attitudes	Smoking (65,102)

Few theories of health behaviour take a comprehensive approach, and those that do are limited in various ways. An integrative theory of health-related behaviour, the Theory of Triadic Influences (TTI), has been used in a variety of disciplines including youth substance use. The TTI is one of the most comprehensive and integrative ecological models of health behaviour to date. The TTI categorizes factors into three streams of influence by level of causation (Figure 1).

The three streams are: a.) the *environmental* or cultural stream, which includes cultural-environmental influences on knowledge and values, influencing attitudes; b.) the *social* stream which includes social situation-context influences on social bonding and social learning, influencing social normative beliefs; and c.) the *individual* or biology/personality stream, which includes intrapersonal influences on self-determination/control and social skills, leading to self-efficacy. In addition to the direct influences of these streams, there are important inter-stream effects and influences that flow between causation levels.

The streams are divided by level of causation: from ultimate, upstream causes at the population level, to distal, midstream causes at the community and group level to proximal, downstream causes at the individual level. The theory is intended to account for factors that have direct effects as well as indirect effects on behaviour. Experiences with related behaviours and early experiences with a new behaviour lead to feedback

loops through all three steams adding to the prior influences of these streams.(103) The TTI can show direct and indirect (through mediators) associations with smoking cessation, the behaviour of interest, with appropriate analyses.

THE THEORY OF TRIADIC INFLUENCE
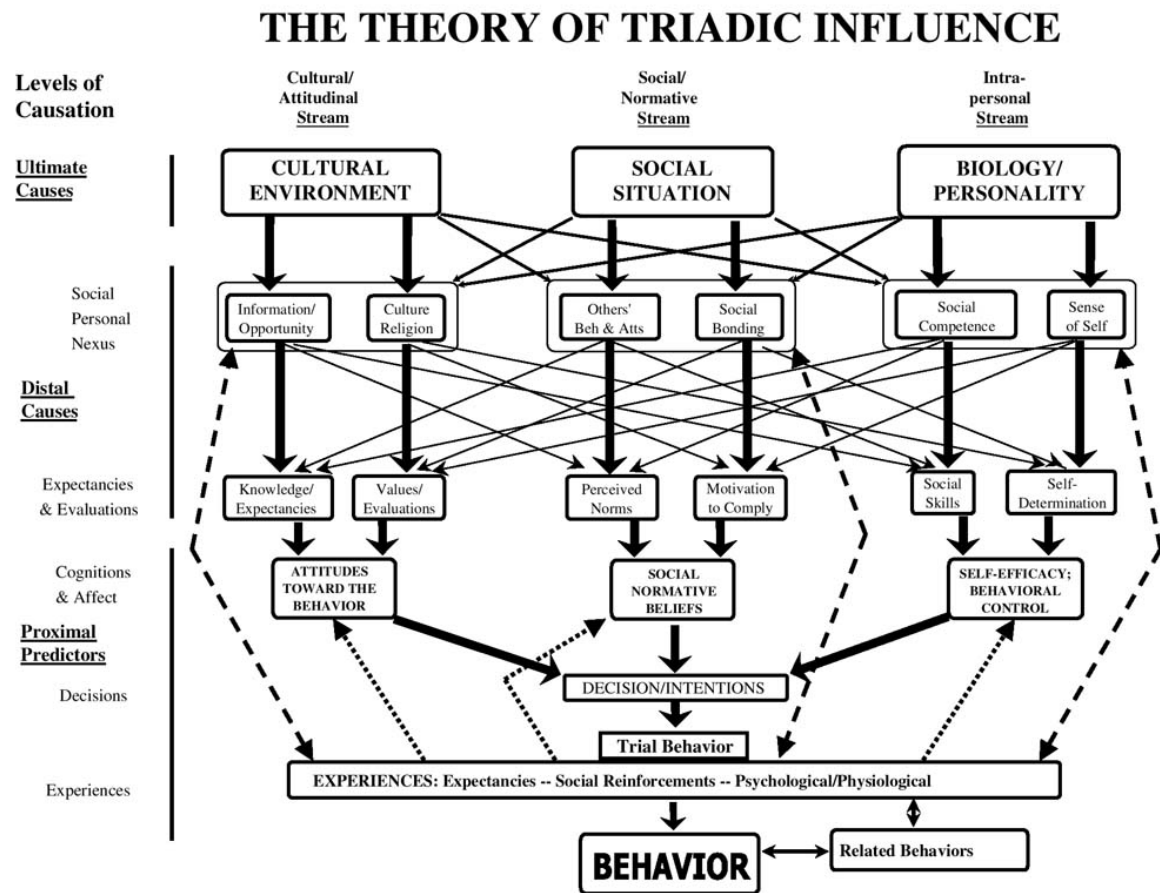
Figure 1: The Theory of Triadic Influence (60)

The TTI framework is particularly useful in health promotion for both explaining health behaviours and targeting areas for behaviour change (Table 3). Looking at the framework from a health promotion perspective strategies can be identified that influence behaviour within the three streams. Population health should focus on the distal and ultimate causes of health behaviour (contextual change), where these factors influence multiple behaviours more efficiently and in a more sustained way. Other frameworks have focused on individual-level behavioural change (e.g. Theory of Planned Behaviour).

17

The TTI is easily incorporated into planning and evaluation models such as the Precede-Proceed model and has already been adapted for intervention planning implemented at schools.(104) Specifically, the TTI is helpful in a) identifying predisposing, enabling, and reinforcing factors that influence behaviour; b) selecting or including strategies within an intervention; and c) predicting and understanding a program's impact.(103) Because the TTI is such an integrative explanatory model that can incorporate measures from the 2008-2009 YSS and examine the relationships between these factors in a way that may inform anti-tobacco planning, the TTI was considered the ideal heuristic device for organizing the range of potential correlates of smoking cessation.

Table 3: Causes of behaviour, reasons for behavior change, and strategies for contextual and behavioural change (103)

The Big 3 Causes Of Behavior	INTRA**P**ERSONAL Genetic/Biological, Personality		**S**OCIAL SITUATION/CONTEXT Family, School, Friends		SOCIO-CULTURAL **E**NVIRONMENT Culture/Ethnicity, SES, Media Exposure, Social (Dis)organization	
The 6 Causes Of Behavior	Sense of self, self determination, self control	General competence, social skills	Social attachment to (bonding with) family, friends, school	Observed (modeled) behaviors & attitudes of others	Value of expected consequences	Knowledge of expected consequences
Big 3 Reasons For Behavior Change	Self-Efficacy: "I have the behavioral skills and self-determination (Skill + Will)"		Social Normative Beliefs: "Important others would like me to"		Attitudes toward the behavior: "It will be good for me"	
Six Reasons For Behavior Change	I really want to OR I can't help myself	I find it easier to do than not to	To please others -- Social acceptance	Because "everyone else is doing it"	To improve myself (or my health) in ways I value	To avoid negative consequences or gain positive ones
6 Classes Of Strategies For Contextual Change*	**Improve group empowerment**	**Improve general/social competencies**	**Change sources and levels of social support**	**Change normative environment, role models**	**Change the socio-cultural/values environment**	**Change the informational environment**
6 Classes Of Strategies For Behavioral Change	Improve self control/image; Provide cues & reminders	Teach, learn, practice improved (social) skills	Increase social attachments; Provide/find sources of social support	Model desired behavior; Correct or alter normative expectations	Teach cultural values, clarify or (re)develop values/evaluations	Provide information, change expectations
					Teach problem-solving and decision-making	
Modes Or Channels Of Change	Individual counseling, small groups, schools; Media for modeling and cues		Modeling and increasing opportunities, in communities, schools, families and small groups, parent training, support groups,		Societal opportunities, legislation, policies, taxes, media (messages, counter advertising), communities, schools, health care systems	

Note: The six classes of strategies for contextual change in bold represent the need to focus on upstream causes of behaviour, where multiple behaviours are influenced more efficiently and in a more sustained way as compared to strategies which deal with more proximal causes, such as affectively/cognitively-focused interventions.

Objective

The primary objective of this thesis is to describe and compare the environmental, social and individual characteristics of youth who quit smoking as compared to current and never smokers. To frame the broad range of factors associated with smoking and smoking cessation, the TTI model is drawn upon to guide analysis. Beyond understanding smoking cessation among youth, study findings may help to highlight potential action areas to target for smoking cessation interventions for youth. To achieve this end, two manuscripts were prepared.

In the first manuscript, the objective was to identify characteristics as measured by the 2008-2009 Youth Smoking Survey of Canadian grade 9 to 12 students that quit smoking in comparison to current and never smoking students to provide a profile for former smoking and highlight key individual, social and environmental characteristics that fit the Theory of Triadic Influence (TTI) framework.

The objective of the second manuscript was to explore the direct and indirect effects of individual, social and environmental correlates of smoking cessation specific to females and males with path models with the goal of identifying sex specific factors.

References

(1) Health Canada. Youth Smoking in Canada. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_ctums-esutc_fs-if/2000-youth-eng.php. Accessed 10/15, 2010.

(2) Health Canada. Canadian Tobacco Use Monitoring Survey: Annual results 2008. 2008; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_ctums-esutc_2008/ann_summary-sommaire-eng.php. Accessed 12/06, 2009.

(3) Hirschman R. The development of smoking behavior: conceptualization and supportive cross-sectional survey data. 1984;14:184.

(4) McNeill A. The development of dependence on smoking in children. 1991;86:589.

(5) Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. BMJ 2004 Jun 26;328(7455):1519.

(6) U.S. Department of Health and Human Services. Preventing tobacco use among young people: A Report of the Surgeon General. 1994.

(7) Mermelstein R. Teen smoking cessation. Tob.Control 2003 Jun;12 Suppl 1:i25-34.

(8) Adelman WP. Tobacco use cessation for adolescents. Adolesc.Med.Clin. 2006 Oct;17(3):697-717; abstract xii.

(9) Health Canada. Canadian Tobacco Use Monitoring Survey: data for 2007 (Cycle 1 – February to June). 2007; Available at: http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/ctums/index.html. Accessed 11/11, 2009.

(10) Pierce JP, Gilpin E. How long will today's new adolescent smoker be addicted to cigarettes? Am.J.Public Health 1996;86(2):253-256.

(11) Shah CP. Public Health and Preventive Medicine in Canada. http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php ed. Toronto, Ontario: Elsevier Saunders; 2003.

(12) DiFranza JR. Hooked from the first cigarette. J.Fam.Pract. 2007 Dec;56(12):1017-1022.

(13) Rojas NL, Killen JD, Haydel KF, Robinson TN. Nicotine dependence among adolescent smokers. Archives of pediatrics adolescent medicine 1998;152(2):151.

(14) Colby SM, Tiffany ST, Shiffman S, Niaura RS. Are adolescent smokers dependent on nicotine? A review of the evidence. Drug Alcohol Depend. 2000;59 Suppl 1:S83-S95.

(15) Eissenberg T, Balster RL. Initial tobacco use episodes in children and adolescents: current knowledge, future directions. Drug Alcohol Depend. 2000;59 Suppl 1:S41-S60.

(16) Sussman S, Dent CW, Nezami E, Stacy AW, Burton D, Flay BR. Reasons for quitting and smoking temptation among adolescent smokers: gender differences. Substance use misuse 1998;33(14):2703-2720.

(17) Van De Ven M, Greenwood P, Engels R, Olsson C, Patton G. Patterns of adolescent smoking and later nicotine dependence in young adults: a 10-year prospective study. Public Health 2010;124(2):65-70.

(18) Health Canada. Federal Tobacco Control Strategy. 2009; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php. Accessed 11/25, 2009.

(19) Health Canada. A National Strategy. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/ns-sn/index-eng.php. Accessed 11/25, 2009.

(20) Altman DG, Wheelis AY, McFarlane M, Lee H, Fortmann SP. The relationship between tobacco access and use among adolescents: a four community study. Soc.Sci.Med. 1999 Mar;48(6):759-775.

(21) Sowden AJ, Stead LF. Community interventions for preventing smoking in young people. 2003(1).

(22) Thomas R, Perera R. School-based programmes for preventing smoking. The Cochrane database of systematic reviews 2006;3:CD001293-CD001293.

(23) Barnett TA, Gauvin L, Lambert M, O'Loughlin J, Paradis G, McGrath JJ. The influence of school smoking policies on student tobacco use. Arch.Pediatr.Adolesc.Med. 2007 Sep;161(9):842-848.

(24) Murnaghan DA, Leatherdale ST, Sihvonen M, Kekki P. A multilevel analysis examining the association between school-based smoking policies, prevention programs and youth smoking behavior: evaluating a provincial tobacco control strategy. Health Educ.Res. 2008;23(6):1016-1028.

(25) Norman CD, Maley O, Li X, Skinner HA. Using the internet to assist smoking prevention and cessation in schools: a randomized, controlled trial. Health Psychol. 2008 Nov;27(6):799-810.

(26) Buttross LS, Kastner JW. A brief review of adolescents and tobacco: what we know and don't know. Am.J.Med.Sci. 2003 Oct;326(4):235-237.

(27) Centers for Disease Control and Prevention. Youth tobacco surveillance—United States, 2000. MMWR CDC Surveill.Summ. 2001;50:1-84.

(28) Leatherdale ST, McDonald PW. What smoking cessation approaches will young smokers use? Addict.Behav. 2005 Sep;30(8):1614-1618.

(29) Hammond D. Smoking behaviour among young adults: beyond youth prevention. Tob.Control 2005 Jun;14(3):181-185.

(30) Stanton WR, Lowe JB, Gillespie AM. Adolescents' experiences of smoking cessation. Drug Alcohol Depend. 1996;43(1-2):63-70.

(31) Burt RD, Peterson AV,Jr. Smoking cessation among high school seniors. Prev.Med. 1998 May-Jun;27(3):319-327.

(32) Bancej C, O'Loughlin J, Platt RW, Paradis G, Gervais A. Smoking cessation attempts among adolescent smokers: a systematic review of prevalence studies. Tob.Control 2007 Dec;16(6):e8.

(33) Fritz DJ. Adolescent smoking cessation: how effective have we been? J.Pediatr.Nurs. 2000 Oct;15(5):299-306.

(34) Adlaf EM, Ivis FJ, Smart RG. Ontario student drug use survey 1977-1997. Toronto: Addiction Research Foundation, 1997.

(35) O'Loughlin J, Gervais A, Dugas E, Meshefedjian G. Milestones in the process of cessation among novice adolescent smokers. Am.J.Public Health 2009 Mar;99(3):499-504.

(36) Pallonen UE, Prochaska JO, Velicer WF, Prokhorov AV, Smith NF. Stages of acquisition and cessation for adolescent smoking: An empirical integration. Addict.Behav. 1998 05;23(3):303-324.

(37) Engels RC, Knibbe RA, de Vries H, Drop MJ. Antecedents of smoking cessation among adolescents: who is motivated to change? Prev.Med. 1998;27(3):348-357.

(38) Aung AT, Hickman NJ,3rd, Moolchan ET. Health and performance related reasons for wanting to quit: gender differences among teen smokers. Subst.Use Misuse 2003 Jun;38(8):1095-1107.

(39) Riedel BW, Robinson LA, Klesges RC, McLain-Allen B. What motivates adolescent smokers to make a quit attempt? Drug Alcohol Depend. 2002 Oct 1;68(2):167-174.

(40) Stone SL, Kristeller JL. Attitudes of adolescents toward smoking cessation. Am.J.Prev.Med. 1992;8(4):221-225.

(41) Stanton WR. DSM-III-R tobacco dependence and quitting during late adolescence. Addict.Behav. 1995;20(5):595-603.

(42) Peters EN, Hughes JR, Callas PW, Solomon LJ. Goals indicate motivation to quit smoking. Addiction 2007 Jul;102(7):1158-1163.

(43) Fisher KJ, Stanton WR, Lowe JB. Healthy behaviors, lifestyle, and reasons for quitting smoking among out-of-school youth. Journal of adolescent health 1999;25(4):290-297.

(44) Balch GI. Exploring perceptions of smoking cessation among high school smokers: input and feedback from focus groups. Prev.Med. 1998 Sep-Oct;27(5 Pt 3):A55-63.

(45) Sussman S. Effects of sixty six adolescent tobacco use cessation trials and seventeen prospective studies of self-initiated quitting. Tob Induc Dis. 2002 Jan 15;1(1):35-81.

(46) Sussman S, Sun P. Youth tobacco use cessation: 2008 update. Tobacco induced diseases 2009;5:3-3.

(47) Backinger C, McDonald P, Ossip-Klein D, Colby S, Maule C, Fagan P, et al. Improving the future of youth smoking cessation. Am.J.Health Behav. 2003;27 Suppl 2:S170-S184.

(48) Orleans CT, Arkin E, Backinger C, Best A, Crossett L, Grossman D, et al. Youth Tobacco Cessation Collaborative and National Blueprint for Action. Am.J.Health Behav. 2003;27 Suppl 2:S103-S119.

(49) Grimshaw GM, Stanton A. Tobacco cessation interventions for young people. Cochrane database of systematic reviews 2006(4):CD003289-CD003289.

(50) Lloyd-Richardson E. Differentiating stages of smoking intensity among adolescents: Stage-specific psychological and social influences. J.Consult.Clin.Psychol. 2002;70(4):998.

(51) Becklake MR, Ghezzo H, Ernst P. Childhood predictors of smoking in adolescence: a follow-up study of Montreal schoolchildren. CMAJ 2005 Aug 16;173(4):377-379.

(52) Abroms L, Simons-Morton B, Haynie DL, Chen R. Psychosocial predictors of smoking trajectories during middle and high school. Addiction 2005 Jun;100(6):852-861.

(53) Winter AL, de Guia NA, Ferrence R, Cohen JE. The relationship between body weight perceptions, weight control behaviours and smoking status among adolescents. Can.J.Public Health 2002 Sep-Oct;93(5):362-365.

(54) Hoving C, Reubsaet A, de Vries H. Predictors of smoking stage transitions for adolescent boys and girls. Prev.Med. 2007 Jun;44(6):485-489.

(55) Kaufman AR, Augustson EM. Predictors of regular cigarette smoking among adolescent females: does body image matter? Nicotine Tob.Res. 2008 Aug;10(8):1301-1309.

(56) Leatherdale ST, Manske S, Kroeker C. Sex differences in how older students influence younger student smoking behaviour. Addict.Behav. 2006 Aug;31(8):1308-1318.

(57) Koval JJ, Pederson LL, Chan SS. Psychosocial variables in a cohort of students in grades 8 and 11: a comparison of current and never smokers. Prev.Med. 2004 Nov;39(5):1017-1025.

(58) Karp I, O'Loughlin J, Paradis G, Hanley J, DiFranza J. Smoking trajectories of adolescent novice smokers in a longitudinal study of tobacco use. Ann.Epidemiol. 2005 Jul;15(6):445-452.

(59) Rose JS, Chassin L, Presson CC, Sherman SJ. Prospective predictors of quit attempts and smoking cessation in young adults. Health Psychol. 1996 Jul;15(4):261-268.

(60) Flay BR, Hu FB, Richardson J. Psychosocial predictors of different stages of cigarette smoking among high school students. Prev.Med. 1998 09/30;27(5):A9-18.

(61) Tyc VL, Hadley W, Allen D, Varnell S, Ey S, Rai SN, et al. Predictors of smoking intentions and smoking status among nonsmoking and smoking adolescents. Addict.Behav. 2004 Aug;29(6):1143-1147.

(62) Health Canada. Summary of results for the 2006-07 Youth Smoking Survey. Tobacco Use Statistics. Ottawa, Ontario: Health Canada. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2006-2007/result-eng.php. Accessed 11/11, 2009.

(63) Petraitis J, Flay BR, Miller TQ. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. Psychol Bull 1995 01;117(1):67-86.

(64) Prokhorov A, de Moor C, Hudmon K, Hu S, Kelder S, Gritz E. Predicting initiation of smoking in adolescents: evidence for integrating the stages of change and susceptibility to smoking constructs. Addict.Behav. 2002;27(5):697-712.

(65) Conrad KM, Flay BR, Hill D. Why children start smoking cigarettes: predictors of onset. Br.J.Addict. 1992 12;87(12):1711-1724.

(66) Chassin L, Presson CC, Sherman SJ, Montello D, McGrew J. Changes in peer and parent influence during adolescence: Longitudinal versus cross-sectional perspectives on smoking initiation. Dev.Psychol. 1986 05/01;22(3):327-334.

(67) Chassin L, Presson CS, SS, Corty E, Olshavsky R. Predicting the onset of cigarette smoking in adolescents: A longitudinal study. J.Appl.Soc.Psychol. 1984 05/01;14(3):224-243.

(68) Leatherdale ST, Brown KS, Cameron R, McDonald PW. Social modeling in the school environment, student characteristics, and smoking susceptibility: a multi-level analysis. J.Adolesc.Health 2005 Oct;37(4):330-336.

(69) Leatherdale ST, Cameron R, Brown KS, Jolin MA, Kroeker C. The influence of friends, family, and older peers on smoking among elementary school students: low-risk students in high-risk schools. Prev.Med. 2006 Mar;42(3):218-222.

(70) Leatherdale ST, Cameron R, Brown KS, McDonald PW. Senior student smoking at school, student characteristics, and smoking onset among junior students: a multilevel analysis. Prev.Med. 2005 Jun;40(6):853-859.

(71) Leatherdale ST, Manske S. The relationship between student smoking in the school environment and smoking onset in elementary school students. Cancer Epidemiol.Biomarkers Prev. 2005 Jul;14(7):1762-1765.

(72) Battistich V, Hom A. The relationship between students' sense of their school as a community and their involvement in problem behaviors. Am.J.Public Health 1997 December 1;87(12):1997-2001.

(73) Leatherdale ST, McDonald PW, Cameron R, Brown KS. A multilevel analysis examining the relationship between social influences for smoking and smoking onset. Am.J.Health Behav. 2005 Nov-Dec;29(6):520-530.

(74) Koval JJ, Pederson LL, Zhang X, Mowery P, McKenna M. Can young adult smoking status be predicted from concern about body weight and self-reported BMI among adolescents? Results from a ten-year cohort study. Nicotine Tob.Res. 2008 Sep;10(9):1449-1455.

(75) Leatherdale ST, Wong SL, Manske SR, Colditz GA. Susceptibility to smoking and its association with physical activity, BMI, and weight concerns among youth. Nicotine Tob.Res. 2008 Mar;10(3):499-505.

(76) Flay BR. Youth tobacco use: Risk patterns and control. In: Slade J, Orleans CT, editors. Nicotine addiction: Principles and management New York: Oxford University Press; 1993. p. 653-661.

(77) Mayhew KP, Flay BR, Mott JA. Stages in the development of adolescent smoking. Drug Alcohol Depend. 2000 5/1;59(Supplement 1):61-81.

(78) Avenevoli S, Merikangas KR. Familial influences on adolescent smoking. Addiction 2003 05;98(1):1-20.

(79) Todd QM, Robert JV. Family relationships and adolescent cigarette smoking: Results from a national longitudinal survey. Journal of Drug Issues; Tallahassee 2002 06/01;32(3):945-972.

(80) Bonny AE, Britto MT, Klostermann BK, Hornung RW, Slap GB. School Disconnectedness: Identifying Adolescents at Risk. Pediatrics 2000 November 1;106(5):1017-1021.

(81) Faulkner GEJ, Adlaf EM, Irving HM, Allison KR, Dwyer J. School Disconnectedness: Identifying Adolescents at Risk in Ontario, Canada. J.Sch.Health 2009;79(7):312.

(82) Van Zundert RMP, Nijhof LM, Engels RCME. Testing Social Cognitive Theory as a theoretical framework to predict smoking relapse among daily smoking adolescents. Addict.Behav. 2009 3;34(3):281-286.

(83) Chassin L, Presson CC, Sherman SJ. Cognitive and social influence factors in adolescent smoking cessation. Addict.Behav. 1984 01/01;9(4):383-390.

(84) Carriere G. Weekly work hours and health-related behaviours in full-time students. Health Rep. 2005 Jun;16(4):11-22.

(85) Sussman S, Dent CW, Severson H, Burton D, Flay BR. Self-initiated quitting among adolescent smokers. Prev.Med. 1998 09/30;27(5):A19-28.

(86) Heale R, Griffin MT. Self-efficacy with application to adolescent smoking cessation: a concept analysis. J.Adv.Nurs. 2009 Apr;65(4):912-918.

(87) Akers RL, Lee G. A longitudinal test of social learning theory: adolescent smoking. J.Drug Iss. 1996 03/01;26(2):317-343.

(88) Sargent JD, Dalton M. Does parental disapproval of smoking prevent adolescents from becoming established smokers? Pediatrics 2001;108(6):1256-1262.

(89) Rasmussen M, Damsgaard M, Holstein B, Poulsen L, Due P. School connectedness and daily smoking among boys and girls: the influence of parental smoking norms. Eur.J.Public Health 2005;15(6):607.

(90) Skinner WF, Massey JL, Krohn MD, Lauer RM. Social influences and constraints on the initiation and cessation of adolescent tobacco use. J.Behav.Med. 1985 12/01;8(4):353-376.

(91) O'Rourke T, Nolte AE, Smith BJ. Improving anti-smoking education: profiling the ex-smoker. J.Drug Educ. 1985;15(1):7-22.

(92) Reynolds C. Personality and behavioral correlates of cigarette smoking: one-year follow-up. Psychol.Rep. 1976;38(1):251.

(93) McGee R. A longitudinal study of reasons for smoking in adolescence. Addiction 1993;88(2):265.

(94) Christophi CA, Savvides EC, Warren CW, Demokritou P, Connolly GN. Main determinants of cigarette smoking in youth based on the 2006 Cyprus GYTS. Prev Med 2009;48(3):232-236.

(95) Langille D, Curtis L, Hughes J, Murphy G. Association of socio-economic factors with health risk behaviours among high school students in rural Nova Scotia. Canadian Journal of Public Health 2003;94(6):442-447.

(96) Turner LR, Veldhuis CB, Mermelstein R. Adolescent smoking: are infrequent and occasional smokers ready to quit? Subst.Use Misuse 2005;40(8):1127-1137.

(97) Woodruff SI, Lee J, Conway TL. Smoking and quitting history correlates of readiness to quit in multiethnic adolescents. Am.J.Health Behav. 2006 Nov-Dec;30(6):663-674.

(98) Collins RL, Ellickson PL. Integrating four theories of adolescent smoking. Subst.Use Misuse 2004 Jan;39(2):179-209.

(99) Hill AJ, Boudreau F, Amyot E, Dery D, Godin G. Predicting the stages of smoking acquisition according to the theory of planned behavior. Journal of Adolescent Health 1997;21(2):107-115.

(100) Battistich V, Hom A. The relationship between students' sense of their school as a community and their involvement in problem behaviors. American Journal of Public Health; Washington 1997 12/01;87(12):1997-2001.

(101) Bauman KE, Fisher LA, Bryan ES, Chenoweth RL. Antecedents, subjective expected utility, and behavior: a panel study of adolescent cigarette smoking. Addict.Behav. 1984;9(2):121-136.

(102) Jessor R, Jessor SL. Problem Behavior and Psychosocial Development. New York: Academic Press; 1977.

(103) Flay BR, Snyder F, Petraitis J. The Theory of Triadic Influence. In: DiClemente RJ, Kegler MC, Crosby RA, editors. Emerging Theories in Health Promotion Practice and Research. 2nd ed.: Jossey-Bass; 2009. p. 451-495.

(104) Positive Action I. Positive Action: Positive development for schools, families and communities, Theoretical basis. 2012; Available at: http://www.positiveaction.net/research/index.asp. Accessed 03/12, 2012.

CHAPTER 2

Individual, Environmental and Social Factors within the Theory of Triadic Influence Associated with Never, Current and Former Smoking Students

Abstract

Introduction: Determinants of adolescent smoking are well documented, though few studies have identified the factors associated with successful smoking cessation. Drawing on the Theory of Triadic Influence, this paper examines smoking cessation among youth to inform the development of targeted smoking cessation interventions.

Method: This study examines data from the 2008-2009 Youth Smoking Survey, a nationally representative sample of Canadian school youth. Individual, social, and environmental correlates of never (n=20,265), current (n=3630) and former smokers (n=447) in grades 9-12 were compared using bivariate and multivariate multinomial logistic regression.

Results: Youth who quit smoking represent a distinct, often intermediary group as compared to never and current smokers. Former smokers were more likely than current smokers to be female, in senior grades, report easy access to cigarettes, score higher on tobacco health knowledge, have attended an anti-tobacco event, and have lower school connectedness.

Conclusion: The findings highlight areas for school based smoking cessation strategy development, specifically anti-tobacco activities and peer and family focused smoking cessation support.

Introduction

Smoking during adolescence is complex, with smoking patterns varying considerably between individuals, as well as within the individual over time. Such patterns reflect the frequency, intensity and recency of the smoker experience, and include daily and occasional current smokers, experimental smokers, as well as those who never smoke.(1) Very important from a tobacco control perspective are those smokers who successfully quit smoking – former smokers. Studies of smoking among youth have extensively examined the individual, social and environmental factors associated with the two largest groups – never smokers and current smokers. A range of determinants for these adolescent smoking trajectories has been identified,(1,2) including the specific correlates associated with smoking among girls and boys,(3-10) youth in varying school grades,(11,12) and of varying ages.(11,13) However, much less is known about adolescents who quit smoking.(14)

Even though the majority of young smokers express a desire to quit smoking, most of their attempts to quit fail (15) and few effective smoking cessation interventions are available to or tailored specifically for young people.(14,16) An examination of the determinants of quitting within a theoretical framework – to provide a general profile of quitters and point to areas for intervention – fills an important gap in the tobacco control literature.

Theoretical frameworks are helpful in explaining how determinants interact with each other and target areas for health promotion. The Theory of Triadic Influence (TTI) is a comprehensive and integrative ecological model of health behaviour (including youth substance use).(17) The TTI organises predictors of behaviour into three 'streams of influence' (individual, social and environmental): i.) cultural-environmental influences on knowledge and values, influencing attitudes; ii.) social situation-context influences on social bonding and social learning, influencing social normative beliefs; and iii.) intrapersonal influences on self determination/control and social skills, leading to self-efficacy. The three 'streams of influence' flow through the 'levels of causation' of behavior that range from 'proximal' to 'distal' to 'ultimate' with room for the inclusion of other influencing factors that feedback into the model.(17) The TTI has already been

applied by a school-based intervention framework, Positive Action, to develop tobacco control school-based health interventions.(18)

With regard to current smoking among adolescents, it is useful to profile individual determinants to assist in the development of targeted interventions. Being female,(9) older,(11,13) a bigger risk taker and having lower self-esteem (5) have previously been reported as individual factors associated with adolescent current smoking. Social influences on adolescent smoking most often come from family and peers. Young smokers tend to have parents (11,13,19,20) and siblings (11,19,20) who smoke, who are more accepting of smoking and who do not restrict smoking in the home.(21,22) They are more likely to report having friends who smoke (11-13,19) and to perceive a higher prevalence of senior student smoking on school property.(23,24) Not surprisingly, young smokers report a higher instrumental value of smoking (13) and perceive more positive mood effects from smoking.(25) Environmental determinants driving adolescent smoking behaviour exist within the community and school and include access to cigarettes,(26) school rules restricting smoking,(27) experiencing lower school connectedness,(12,22,28-30) and lower tobacco health knowledge.(31)

Studies comparing current and former smoking youth are often limited by focusing on differences in past smoking histories and quit attempts.(9,32) Factors associated with quitting include occasional rather than daily smoking frequency, length of previous quit attempt, lower perceived chance of continued smoking, and fewer depressive symptoms; these factors have been shown to have cumulative effects.(33) The literature provides mixed findings with regard to individual characteristics of youth smoking cessation such as sex and age/grade.(33,34) Many factors conducive to supportive anti-smoking environments and social cultures are evident such as parental and peer role modeling and tolerance;(25,34-36) reduced cigarette availability,(37) and knowledge of the benefits of quitting;(9,34,36) but it is difficult to judge how these factors work in relation to one another. Reviews of youth cessation research have noted the need for identifying additional determinants of quitting smoking and examining these within a theoretical framework to help profile the young former smoker and inform the development of targeted youth smoking cessation interventions.(14,15,38)

The current study examines data from the 2008-2009 Youth Smoking Survey (YSS), a nationally representative sample (n=51,922) of school youth that measures a broad range of smoking behaviours and attitudes.(39) Because the TTI is an integrative explanatory model that incorporates a broad range of measures associated with smoking and related behaviours, the TTI was employed as a heuristic device for informing the choice of individual, social and environmental factors to be modeled with smoking cessation. The present study first compares current smokers to never smokers to corroborate previous findings. Then, a comparison of former smokers to current and never smokers is made to investigate whether youth who quit smoking have a unique individual, social and environmental profile. In addition, using findings from the comparison of former smokers to current smokers with the TTI model in conjunction with the Positive Action Framework may highlight key areas for developing targeted school-based smoking cessation interventions.(18)

Method

Participants

Data from the 2008-2009 Youth Smoking Survey (YSS) were examined. The YSS is a biennial survey sponsored by Health Canada and administered by the Propel Centre for Population Health Impact at the University of Waterloo. The YSS is a large cross-sectional survey representative of the Canadian grade 6 to 12 student population that provides national and provincial data on youth smoking rates as well as attitudes and behaviours with respect to tobacco.(39) Public and private middle and secondary schools in the ten Canadian provinces were randomly sampled, using a complex sampling frame stratified for health region and school type. All students enrolled in recruited schools were eligible to participate. Youth living in institutions or on First Nation Reserves, and youth attending special schools or schools on military bases were not included. Students completed the 45 minute paper survey during class time. Detailed information regarding the research design, sampling, weighting and core measures have been published online.(40)

Active information for passive consent was employed, where students' parents received information regarding the survey by mail and were asked to call a toll-free number if they refused their child's participation. Participating students were surveyed during class time and did not receive compensation. Surveys were collected from 51,922 registered students in grade 6 to 12 during the 2008-2009 school year. The participation rate for sampled school board/divisions was 84%, for schools was 59%, and for students was 73%.(39) The University of Waterloo Office of Research Ethics and appropriate provincial, School Board and Public Health Ethics committees approved all data collection procedures. Dalhousie University Health Sciences Research Ethics Board approved the use of these data for the purposes of this study.

The target population for the current study consisted of students in grades 9 to 12 who were never, current or former smokers. Grade 6-8 students were excluded as too few former smokers occurred in these grades, in addition, the grade 9-12 range fits most Canadian high schools which is ideal for targeted school-based intervention development. Never smokers (n=20,265) were defined as those who had never smoked a whole cigarette; current smokers (n=3630) were defined as those who had smoked at least 100 cigarettes and had smoked in the previous month; and former smokers (n=447) were defined as those who had smoked at least 100 cigarettes but had not smoked in the previous month. Students who had smoked one or more but fewer than 100 cigarettes (experimental smokers) were excluded to keep the number of comparison groups to three. The arbitrary 100 cigarette criterion for current/past smoking is well established (41) and these definitions for former and current smoking have been previously used in studies examining adolescent smoking cessation.(33,15)

Questionnaire measures

Only measures known to be associated with current and former smoking and that fit the TTI model, as described in detail by Flay et al.,(17) were included as independent variables (Table 1). Factors were organised by the three 'streams of influence' (individual, social and environmental) in the TTI framework: i.) cultural-environmental influences on knowledge and values, influencing attitudes; ii.) social situation-context influences on social bonding and social learning, influencing social normative beliefs;

33

and iii.) intrapersonal influences on self determination/control and social skills, leading to self-efficacy. The three 'streams of influence' that flow through the 'levels of causation' of behavior that range from very proximal to distal to ultimate. Weekly spending money ($0-20 or more than $20) was included as an 'other' factor. In some cases a measure was used as a proxy within a dimension. Age first tried marijuana was a proxy for risk taking; social benefits, mood effects, and social acceptability of smoking were proxies for perceived norms; attendance at anti-tobacco events and tobacco education lessons were proxies for anti-smoking activities; and use of marijuana and truancy were proxies for rebelliousness.

Table 1. Variables from 2008-2009 YSS fitting dimensions of the TTI

	Individual	Social	Environmental
Ultimate	• Sex • Grade		
Distal I	• Risk-taking: age first tried marijuana	• Home rules restricting smoking	• School anti-smoking rules • Anti-smoking activities: anti-tobacco events and tobacco education lessons • Tobacco accessibility
Distal II	• Self-esteem	• Perceived norms: social benefit effect, mood effect and social acceptability	• School connectedness • Rebelliousness: use of marijuana and truancy
Proximal		• Parent, sibling and peer smoking • Perceived smoking prevalence at school	• Tobacco health knowledge

Individual factors examined included: sex (female or male); school grade (9–12); age first used marijuana (8-18 years old) as a proxy measure of risk taking; and self-esteem. Self-esteem (score 0-12; a higher score indicates better self-esteem) is a derived variable from summing the responses (scored 0-3, disagree-agree) from three items: i.) in general, I like the way I am, ii.) when I do something, I do it well, and iii.) I like the way I look. The self-esteem scale was based on part of the General-Self Scale from Marsh's (42) Self-description Questionnaire and has been found to be sufficiently valid and reliable

using YSS data from previous school years.(39) The self-esteem scale is a derived variable from the YSS and has been found to be sufficiently valid and reliable from previous YSS data.(39) In this dataset the Cronbach's alpha coefficient for self-esteem was reliable (α=0.9).

Social factors included: home rules restricting smoking (none versus some), having at least one parent/guardian, sibling and close friend who smokes, perceived student smoking on school property (few to none versus some to a lot), and three smoking related perceived norms: social acceptability, positive mood effects and social benefit effects. Social acceptability (none versus some) was based on two questions: i.) Should smoking be allowed around kids in cars? and ii.) Should smoking be allowed around kids at home? The social acceptability variable was founded on beliefs regarding second hand smoke exposure (44) and the Cronbach's alpha was dependable (α=0.9). Positive mood effects from smoking (none versus some) was based on two questions: i.) Can smoking help people when they are bored? and ii.) Does smoking help people relax? The positive social benefit effects from smoking (none versus some) variable was based on three questions: i.) Does smoking help people stay slim? ii.) Do people who smoke become more popular? and iii.) Do you think smoking is cool? The positive social benefit effects and positive mood effects variables were derived from Ford et al.(43) who found these variables to be sufficiently valid and reliable among middle school children, in this dataset the Cronbach's alpha was sufficiently reliable for social benefit effects (α=0.9) and positive mood effects (α=0.8).

Environmental factors included: cigarette accessibility (easy versus difficult); having a clear set of school rules restricting smoking (none versus some); attendance of a school anti-tobacco lesson (none versus at least one) and anti-tobacco event in the community/school (none versus at least one), both in the previous year; truancy in the last month (none versus skipping at least one class) as a construct for deviance behaviour;(45) use of marijuana (never versus occasional, once or less, versus regularly, more than once) in the previous month as a construct for deviance behavior;(45) tobacco health knowledge and school connectedness.

School connectedness (score 0-15, higher score indicates greater school connectedness) was based on a five item scale: i.) I feel close to people at my school, ii.) I feel I am part of my school, iii.) I am happy to be at my school, iv.) I feel the teachers at my school treat me fairly, and v.) I feel safe in my school; similar to the scale used in the National Longitudinal Study of Adolescent Health (Add Health).(46) The school connectedness scale is a derived variable from the YSS and has been found to be sufficiently valid and reliable from previous YSS data (39) and in this dataset the Cronbach's alpha coefficient for school connectedness was reliable (α=0.8).

Tobacco health knowledge (score 0-7, higher score indicates better tobacco health knowledge) was based on the correct response (yes or no) to seven questions: i.) Do people have to smoke for many years before it will hurt their health? ii.) Is there any danger to your health from an occasional cigarette? iii.) Does quitting smoking reduce health damage even after many years of smoking? iv.) Does smoking help people stay slim? v.) Can people become addicted to tobacco? vi.) Can tobacco smoke be harmful to the health of non-smokers? and vii.) Can smokers quit anytime they want? The school connectedness and tobacco health knowledge scales were derived variables from the YSS and have been found to be sufficiently valid and reliable using data from previous YSS school years.(39) Tobacco health knowledge is a derived variable from the YSS and has been found to be sufficiently valid and reliable from previous YSS data.(39) Although in this dataset the Kuder-Richardson Formula 20 coefficient for tobacco health knowledge (KR-20=0.6) was below the widely accepted .70 cutoff, it is acceptable by Loewenthal's standard, which indicates that a Cronbach's $\alpha \geq .60$ is adequate for short scales.(47)

Detail regarding the response options for each survey question is available online (www.yss.uwaterloo.ca). Missing and don't know responses were treated similarly using not stated 'dummy' variables. Other responses that were controlled for with dummy variables included having no siblings for sibling smoking and never having tried marijuana for age first tried marijuana.

Statistical analysis

Descriptive analyses examining the individual responses from never, former and current smoking students were performed for all variables. Chi square tests were used to examine differences between groups. Two-tailed, two-sample t-tests were performed to compare sample means of current and former smokers for continuous measures.

Bivariate multinomial logistic regression was performed comparing current smokers to never smokers, and former smokers with never smokers and current smokers. Multinomial logistic regression is used when the dependant variable is nominal and consists of more than two categories.

As in other forms of linear regression, multinomial logistic regression uses a linear predictor function $f(k,i)$ to predict the probability that observation i has outcome k, of the following form:

$$f(k,i) = \beta_{0,k} + \beta_{1,k}x_{1,i} + \beta_{2,k}x_{2,i} + \ldots + \beta_{m,k}x_{m,i}$$

Where $\beta_{m,k}$ is a standardized regression coefficient associated with the mth explanatory variable, x and the kth outcome.(48)

Multivariate multinomial logistic regression models were constructed with the Theory of Triadic Influence (TTI) in mind. The 'strongest' variable was chosen for each TTI dimension that had more than one variable for three reasons: i) to reduce the number of variables to create a more parsimonious model for the limited sample size; ii) to avoid multicollinearity; and iii) to include a broad representation of variables from the three streams and levels of the TTI. The t-statistic was observed as a measure of effect size as most variables were significant at $p<0.001$. The factors in the bivariate models with the highest t-scores within each domain (ultimate, distal I, distal II and proximal) for each TTI stream (individual, environmental and social) as shown in Table 1 were chosen for inclusion for the multivariate model. The exception to this rule was the ultimate, individual domain which included grade and sex, both variables were deemed too important to exclude.

All analyses were weighted using the sample weights provided by the Propel Centre for Population Health Impact for the 2008-2009 YSS. To account for the complex survey

design of the YSS in the estimation of variance, we used the balanced repeated replication method with provided bootstrap weights as directed by the Propel Centre for Population Health Impact for the 2008-2009 YSS.(39) The statistical package Stata 12.0 was used for all analyses, specifically, the svyset, brrweight and subpop commands.(49)

Results

Of the 29,296 students in grades 9 to 12 who participated in the 2008-2009 YSS, 20,265 (70%) students in grades 9 to 12 were never smokers and 4077 (15%) reported having smoked at least 100 cigarettes in their lifetime. Of those students who had smoked 100 or more cigarettes, 3630 (88%) were current smokers and 447 (12%) were former smokers. The remaining 4954 (15%) students were experimental smokers and were excluded.

There was no significant difference between the percentages of current smokers (30%) and former smokers (28%) who reported at least one previous quit attempt (data not shown). The former smoker group likely includes youth who have spontaneously stopped smoking and intermittent smokers along with those that quit smoking.

Table 2 presents the number and percentage for all categorical measures, and the mean and standard deviation for continuous measures. Chi square tests revealed significant (p<0.001) differences between the distributions of smoking status groups for all categorical measures. Similarly, all continuous measures significantly differed between at least two smoking status groups.

Current and former smokers who had tried marijuana, tried marijuana at a significantly younger age than those that were never smokers (both p<0.001); and current smokers tried marijuana at a younger age than former smokers (p<0.001). Current and former smokers had significantly lower school connectedness scores as compared to never smokers (both p<0.001); there was no significant difference between current and form smokers. With regard to tobacco health knowledge, current smokers scored significantly lower than both never (p=0.035) and former smokers (p<0.001); and former smokers scored significantly higher than never smokers (p<0.001). Never smokers scored significantly higher on self-esteem than current and former smokers (both p<0.001); and former smokers scored significantly higher than current smokers (p=0.013).

Table 2: Description of current, former and never smoking students in grade 9 to 12

Categorical Measure		Never, n=20,265		Current, n=3630		Former, n=447	
		n[a]	%[b]	n	%	n	%
Sex	Female	10 299	49	1587	41	222	55
	Male	9966	51	2043	59	225	45
Grade	9	6589	29	708	15	79	12
	10	5937	26	1014	26	138	21
	11	4670	25	1051	28	121	25
	12	3069	20	857	31	109	42
Access to cigarettes	Difficult	2013	11	104	4	12	2
	Easy	10892	55	3380	92	405	91
School rules	No clear set	4007	21	637	18	89	20
	Clear set	15994	78	2899	80	347	79
Anti-tobacco lessons (last year)	None	9937	46	1946	53	228	48
	At least 1	8084	43	1380	39	169	41
Anti-tobacco events (last year)	None, not stated	773	4	262	6	26	2
	At least 1	19492	96	3368	94	421	98
Truancy (last month)	None	14398	64	1098	26	233	37
	At least 1	5642	35	2440	72	204	62
Use of marijuana (monthly)	Never	15511	72	261	9	72	14
	Occasional	3152	20	1142	28	205	51
	Regular	869	6	1977	57	135	27
Home rules	No rules	1560	6	820	18	73	9
	Some rules	18454	93	2743	80	367	91
Social acceptability	Not acceptable	17808	89	2261	66	340	83
	Acceptable	2032	9	1268	32	98	15
Positive mood effects	None	4365	19	204	5	58	12
	Some	15486	78	3323	93	381	86
Social benefits	None	17055	83	2093	53	317	76
	Some	2801	15	1438	45	121	22
Parents that smoke	None	12439	64	1087	35	186	44
	At least 1	7717	36	2511	65	258	56
Siblings that smoke	None	15609	78	1630	50	239	61
	At least 1	3158	15	1729	42	178	35
Friends that smoke	None	13237	65	146	5	106	34
	At least 1	6871	34	3443	94	334	65
Smoking on school property	Few to none	7281	37	1048	30	126	33
	Some to a lot	12631	62	2475	67	307	65
Weekly spending money	0-$20	8892	43	976	27	129	23
	> $20	8517	43	2206	60	252	49
Continuous Measure		n	M[c](SE)[d]	n	M(SE)	n	M(SE)
Age first tried marijuana (8-18)		3987	14.4(0.02)	2989	12.8(0.02)	329	13.1(0.04)
School connectedness (0-15)		20265	10.1(0.03)	3630	8.9(0.03)	447	9.0(0.10)
Tobacco health knowledge (0-7)		20265	4.7(0.01)	3630	4.6(0.02)	447	5.2(0.05)
Self-esteem (0-12)		20265	9.2(0.01)	3630	8.8(0.02)	447	9.0(0.04)

[a]number, [b]population weighted percentage, [c]mean, [d]standard error of the mean; sums may not equal 100% due to not stated, don't know, never tried and no siblings responses or from rounding

Table 3 presents the relative risk ratio, 95% confidence interval and t-statistic for each measure from bivariate multinomial regression. Each measure showed a significant difference between never and current smoking in the expected direction.

Comparing former versus current smokers, former smokers differed significantly in a similar direction as observed for never smokers on all measures with the exception of five variables. More former smokers as compared to current smokers were in grade 12 and reported 'easy' access to cigarettes. There was no significant difference between former and current smokers with respect to having school rules restricting smoking, school connectedness, and spending money.

Comparing former versus never smokers, former smokers differed significantly on all measures with three exceptions. There was no significant difference between former and never smokers with respect to having school rules restricting smoking, attending at least one anti-tobacco lesson in the past year and occasional use of marijuana. However, the degree to which former smokers differed from never smokers was not as pronounced on most factors as for current smokers compared to former smokers.

All individual factors were strongly associated with smoking status and were included in the multivariate multinomial model as these factors did not compete amongst themselves with respect to the domains of the TTI. Both sex and grade were included from the ultimate individual domain as both variables showed strong effects and were deemed too important to exclude. All social factors were significantly associated with smoking status; however, only the factors with the largest effect sizes (indicated by highest average t-statistic across all smoking status comparisons) at each causation level of the social stream, as outlined by the TTI, were kept for inclusion in the multivariate multinomial model. These measures were: home rules restricting smoking, social benefit effects from smoking, and having friends who smoke. Similarly, all environmental factors were also significantly associated with smoking status. Following the same procedure for social factors, the following measures were included in the multivariate multinomial model: access to cigarettes, school connectedness, truancy, and tobacco health knowledge. Weekly spending money was strongly associated with smoking status and was included in the multivariate multinomial model as an 'other' factor outlined in the TTI model.

Table 3: Bivariate multinomial regression of current (n=3630), former (n=447) and never smoking (n=20,265) grade 9 to 12 students

Measure		Current vs Never RRR (95% CI), t[a]	Former vs Never RRR (95% CI), t	Former vs Current RRR (95% CI), t
Individual Measures:				
Sex	Male	1.00	1.00	1.00
	Female	0.74(0.69-0.79), -9***	1.27(1.11-1.46), 3**	1.73(1.53-1.95), 9***
Grade	9	1.00	1.00	1.00
	10	1.76(1.65-1.88), 17***	1.82(1.59-2.09), 9***	1.03(0.87-1.22), 0
	11	2.16(2.03-2.29), 26***	2.35(1.96-2.82), 9***	1.09(0.88-1.34), 1
	12	2.87(2.70-3.06), 33***	4.93(4.38-5.55), 26***	1.71(1.52-1.93), 9***
Age first used marijuana (8-18)		0.66(0.65-0.67), -49***	0.70(0.69-0.72), -31***	1.07(1.05-1.09), 9***
Self-esteem (0-12)		0.92(0.91-0.93), -23***	0.94(0.92-0.96). -6***	1.02(1.00-1.04), 2*
Social Measures:				
Home rules	No rules	1.00	1.00	1.00
	Some rules	0.28(0.27-0.29), -64***	0.67(0.61-0.74), -8***	2.40(2.19-2.62), 19***
Social acceptability of smoking	Not acceptable	1.00	1.00	1.00
	Acceptable	4.77(4.54-5.02), 61***	1.77(1.54-2.04), 8***	0.37(0.32-0.43), -14***
Positive mood effects of smoking	None	1.00	1.00	1.00
	Some	4.55(4.27-4.85), 46***	1.76(1.47-2.11), 6***	0.39(0.32-0.47), -9***
Social benefits from smoking	None	1.00	1.00	1.00
	Some	4.84(4.67-5.02), 84***	1.60(1.46-1.77), 10***	0.33(0.30-0.36), -25***
Parents/guardians who smoke	None	1.00	1.00	1.00
	At least one	3.31(3.18-3.44), 60***	2.25(2.04-2.47), 17***	0.68(0.60-0.77), -6***
Siblings who smoke	None	1.00	1.00	1.00
	At least one	4.45(4.30-4.60), 87***	3.09(2.76-3.45), 20***	0.69(0.63-0.77), -7***
Friends who smoke	None	1.00	1.00	1.00
	At least one	34.66(31.03-38.71), 63***	3.70(3.13-4.36), 16***	0.11(0.09-0.13), -24***
Smoking on school property	Few to none	1.00	1.00	1.00
	Some to a lot	1.34(1.26-1.44), 9***	1.18(1.07-1.32), 3**	0.88(0.79-0.98), -2*
Environmental Measures:				
Access to cigarettes	Difficult	1.00	1.00	1.00
	Easy	4.93(4.20-5.78), 20***	8.37(6.39-10.97), 15***	1.70(1.22-2.36), 3**
School rules	No clear rules	1.00	1.00	1.00
	Clear rules	1.20(1.09-1.31), 4***	1.08(0.84-1.39), 1	0.90(0.67-1.22), -1
Anti-tobacco lessons (last year)	None	1.00	1.00	1.00
	At least one	0.79(0.76-0.82), -12***	0.92(0.81-1.05), -1	1.17(1.02-1.35), 2*
Anti-tobacco events (last year)	None	1.00	1.00	1.00
	At least one	0.53(0.50-0.56), -20***	1.46(1.26-1.69), 5***	2.77(2.40-3.19), 14***
School connectedness (0-15)		0.89(0.89-0.90), -48***	0.90(0.89-0.92), -12***	1.01(1.00-1.03), 1
Truancy (last month)	None	1.00	1.00	1.00
	At least one	5.08(4.75-5.43), 48***	3.14(2.95-3.36), 32***	0.62(0.57-0.67), -12***
Use of marijuana (monthly)	Never	1.00	1.00	1.00
	Occasional	0.87(0.81-0.94), -4***	1.20(0.91-1.58), 1	1.38(1.04-1.84), 2*
	Regular	6.28(5.77-6.84), 43***	2.26(1.81-2.82), 7***	0.36(0.28-0.46), -8***
Tobacco health knowledge (0-7)		0.95(0.94-0.96), -10***	1.22(1.17-1.27), 9***	1.27(1.22-1.33), 12***
Other Measures:				
Weekly spending money	0-$20	1.00	1.00	1.00
	$20 or more	2.24(2.12-2.37), 28***	2.13(1.87-2.42), 12***	0.95(0.81-1.11), 1

[a] Relative risk ratio and 95% confidence interval adjusted for not stated, never tried, no siblings and don't know responses with t-statistic, *p<0.05, **p<0.01, ***p<0.001

Fit of the current versus never, former versus never, and former versus current smoker multivariate models (Table 3) were deemed acceptable as the Hosmer-Lemeshow lack of fit tests were not significant, $X^2(8)=8.35$, p=0.40, $X^2(8)=5.92$, p=0.66, and $X^2(8)=3.96$, p=0.86, respectively. Factors in the multivariate model comparing current versus never smoking maintained similar levels of significance as in bivariate tests except for sex which was no longer significant.

Table 4: TTI multivariate multinomial regression models of current (n=3630), former (n=447) and never smoking (n=20,265) among grade 9 to 12 students

Measures		Current vs Never RRR (95% CI), t[a]	Former vs Never RRR (95% CI), t	Former vs Current RRR (95% CI), t
Individual Measures:				
Sex	Male	1.00	1.00	1.00
	Female	0.96(0.89-1.03),-1	1.51(1.28-1.79),5***	1.58(1.38-1.80),7***
Grade	9	1.00	1.00	1.00
	10	1.56(1.46-1.68),13***	1.65(1.41-1.94),6***	1.06(0.89-1.25),1
	11	1.40(1.30-1.50),9***	1.59(1.35-1.89),5***	1.14(0.92-1.41),1
	12	2.04(1.88-2.21),17***	3.37(3.01-3.78),21***	1.66(1.47-1.87),8***
Age first used marijuana (8-18)		0.67(0.66-0.68),44***	0.67(0.66-0.68),-40***	1.00(0.98-1.02),0
Self-esteem (0-12)		0.95(0.94-0.96),-8***	0.95(0.93-0.98),-4***	1.00(0.98-1.02),0
Social Measures:				
Home rules	No rules	1.00	1.00	1.00
	Some rules	0.41(0.38-0.44),-25***	0.85(0.76-0.95),-2**	2.08(1.88-2.31),14***
Social benefits effects of smoking	None	1.00	1.00	1.00
	Some	3.28(3.10-3.47),42***	1.36(1.25-1.47),7***	0.41(0.37-0.46),-18***
Friends who smoke	None	1.00	1.00	1.00
	At least one	18.14(15.90-20.70),43***	1.93(1.65-2.26),8***	0.11(0.09-0.13),-23***
Environmental Measures:				
Access to cigarettes	Difficult	1.00	1.00	1.00
	Easy	1.26(1.06-1.51),3*	3.28(2.53-4.24),9***	2.60(1.86-3.63),6***
Truancy (last month)	None	1.00	1.00	1.00
	At least one	1.74(1.65-1.84),20***	1.21(1.11-1.32),4***	0.69(0.64-0.75),-9***
Tobacco health knowledge (0-7)		0.91(0.90-0.93),-14***	1.16(1.11-1.42),7***	1.27(1.22-1.33),12***
Other Measures:				
Weekly spending money	0-$20	1.00	1.00	1.00
	$20 or more	1.37(1.30-1.44),12***	1.25(1.11-1.42),4***	0.92(0.79-1.07),-1

[a] Relative risk ratio and 95% confidence interval adjusted for not stated, never tried, no siblings and don't know responses with t-statistic, *p<0.05, **p<0.01, ***p<0.001

Discussion

Drawing on Canadian student data from the 2008-2009 YSS, and informed by the TTI, this paper demonstrates that adolescents that quit smoking represent a distinct group as compared to current and never smokers, with some similarities with both groups on certain individual and environmental measures, respectively. On most measures, quitters exhibited characteristics intermediate between current and never smokers in bivariate and multivariate tests. Former smokers are female, are in more senior grades, have higher tobacco health knowledge, are more likely to have attended an anti-tobacco event and tend to report being less connected to school. Most characteristics (excluding self-esteem and age of first marijuana use) remained significant in the full TTI model, suggesting that the reasons or motivations for quitting smoking are complex.

Overall these results are complemented by findings from previous studies. Similar to the current findings, social determinants previously associated with youth smoking cessation include non-smoking parents and friends;(25,33-36) perceived positive mood effects and social benefits of quitting (34) and higher tobacco health knowledge.(9,34,36) Similarly, truancy and poor parental monitoring have been previously found to be positively associated with substance use, including smoking, among students.(49,50) The current profile of youth who quit smoking relative to those who have never smoked and those who continue to smoke mimics that which was observed in a small comparative study that identified differences on a few key individual (sex and grade), social (having parents and peers who smoke, perceived social acceptability and positive mood effects of smoking) and environmental (tobacco health knowledge) determinants.(34)

One previous study reported no significant effect of sex or age with respect to being a former smoker,(33) however, in this study former smokers were more likely to be female and in higher grades as compared to both current and never smokers. Lower cigarette availability has previously been reported to be associated with not smoking,(37) however, in the current study quitters were more likely to report easy access to cigarettes. It might be that they have access to more social sources of cigarettes, having formed previous relationships with smokers or that they may be more sensitive to cigarette sources. More information is necessary in order to explain this effect.

43

With regard to self-esteem, youth who quit smoking had higher self-esteem than current smokers in the bivariate test, a finding reported in other studies,(25,35) but this factor did not remain significant in the full model. Self-esteem may be a poor indicator of self for this TTI domain for tobacco cessation; a better measure for this domain may be the occurrence of depressive symptoms which has shown to be predictive of tobacco use and quitting among adolescents.(51,52)

With the exception of sex and grade, former smokers and current smokers did not differ much on individual factors. Compared with the never smoker, former and current smokers can be described as senior female students (grades 10-12), who exhibit risk-taking behaviour such as first trying marijuana at a younger age, have lower self-esteem and greater weekly spending money as compared to never smoking students; this profile provides a useful target for youth cessation interventions. Future research should examine why females decide to quit and how they are more in doing so.

Based on study findings it appears that cessation occurs at a greater regularity among students in older grades (11 and 12). While tobacco programs directed at youth are largely oriented towards prevention,(14,16) the adoption of school based smoking cessation support should be made available to senior students in addition to ongoing prevention programs. Cessation is clearly an issue for young people,(15,53) particularly older youth, yet only limited resources exist to address it.

School-based programming may be the ideal setting for youth smoking cessation for its closer proximity to students. Cessation interventions delivered through classrooms programs and school-based health clinics have already been shown to be effective.(54) Even programs reformatted for the school setting, such as the Not-on-Tobacco (N-O-T) program, have increased smoking cessation initiation and continued cessation at one month.(55)

Looking at the TTI model from a health promotion perspective strategies can be identified that influence behaviour within the three streams. Population health should focus on the distal and ultimate causes of health behaviour (contextual change), where these factors influence multiple behaviours more efficiently and in a more sustained way.

Positive Action, an evidence-based, character education program designed for schools is recognised for improving student behaviours including tobacco control, and already uses the TTI framework for understanding health behaviour and for suggesting new approaches for health promotion.(18) Social (influences from family and friends) and environmental factors (influences from school and the larger community) play the most important role in differentiating former from current smokers. Interventions that address these aspects of the student smoker's life may more support smoking cessation.

The findings from this study in conjunction with the Positive Action Framework (18) suggest that increasing health and tobacco education, organizing anti-tobacco events, improving thinking and communication skills with the aim of changing perceived norms regarding tobacco, and having a clear set of school rules restricting smoking are important components for a success school-based smoking cessation intervention. These recommendations are further supported by youth cessation programs that work by increasing student skills and knowledge about smoking, such as Quit for Life (Q4L).(56).

These findings also bring to light the important role family and peers play in supporting tobacco cessation. The strongest factors differentiating quitters from current smokers were social influences, specifically having friends that smoke. Those who successfully quit smoking may choose new non-smoking friends or quit together. Youth smoking cessation interventions must advocate for peer support and participation. Family non-smoking and restricting smoking at home were also strongly associated with cessation. Parents should be included in supporting cessation through additional education and be connected with adult smoking cessation interventions; successful methods already known to reduce youth smoking.(57)

This is the first study to examine a broad range of correlates with youth smoking cessation in a large, nationally representative sample of young people; however, it is subject to a number of limitations. First, the cross-sectional design of this study limits findings to those of association; causal conclusions about quitting would only be possible with a longitudinal design where characteristics are measured before and after quitting. Second, this study relied upon self-reported data provided by students in a classroom setting regarding risk behaviours. These responses are prone to social desirability and

45

recall bias which may result in an underestimate of effect size due to under-report of risk taking.(52,58) Third, because this study used secondary data it was limited to the measures and data collection of the 2008-2009 YSS. Not all constructs identified by the TTI framework associated with smoking (e.g., socioeconomic status, family structure, depressive symptoms, academic achievement, etc.) were included. These other factors that influence quitting smoking may be stronger correlates to include in a full model and may provide a more complete profile.

Lastly, it is highly likely that the low number of cigarettes smoked (100) used to establish smoking status and the short time period (30 days) for refraining from smoking used to define smoking cessation led to misclassification by including smokers who spontaneously stopped smoking and intermittent smokers that will start smoking again. Only 28% of former smokers reported having at least one quit attempt, indicating that the majority of students in this group if asked would not identify themselves as ex-smokers. As defined, the 'former smoker' category is likely a dynamic group that includes intermittent smokers and students in the process of initiation. This misclassification would cause an underestimate of effect size when comparing to current smokers and an overestimate when comparing to never smokers. In fact, the effect observed for 'easy' cigarette access on the former smoker group may point to prevention strategies to stop initiators from progressing to more regular smoking.

The present findings provide evidence that students who quit smoking are distinct from those who continue to smoke especially with regard to social and environmental correlates. More research is required to examine how these differences should be best incorporated into the design of adolescent smoking cessation interventions. It would be helpful to examine why and how female senior students are more likely to quit smoking; examining differences by sex may provide a starting point. More research focused on tobacco cessation is necessary to examine additional measures, such as reasons for quitting and relapse, socioeconomic status, depressive symptoms and family structure, to provide a more complete profile. In addition, longitudinal studies are required to observe the transition to former smoking over a longer time period, to test determinants as predictors of quitting and to examine intermittent smoking.

Conclusion

Adolescents who quit smoking exhibit distinct characteristics from those who never smoke and those who continue to smoke and are generally more similar to current smokers with respect to self-esteem, age of first using marijuana and availability of spending money. Successful quitters tend to be female in senior grades and tend to exhibit traits intermediate to never and current smokers. They are most likely to report easy access to cigarettes and have the highest tobacco health knowledge. School, family and friend networks are important environmental and social influences that can be targeted to support smoking cessation. Specifically, school-based smoking cessation programs should aim to provide tobacco education to students and their parents, promote anti-tobacco events, encourage peer support and participation and focus on changing perceived norms regarding smoking. Future longitudinal research is required to examine reasons why more senior females stop smoking and to examine the direction and strength of the relationships between correlates of smoking cessation among adolescents.

References

(1) Becklake MR, Ghezzo H, Ernst P. Childhood predictors of smoking in adolescence: a follow-up study of Montreal schoolchildren. CMAJ 2005 Aug 16;173(4):377-379.

(2) Abroms L, Simons-Morton B, Haynie DL, Chen R. Psychosocial predictors of smoking trajectories during middle and high school. Addiction 2005 Jun;100(6):852-861.

(3) Winter AL, de Guia NA, Ferrence R, Cohen JE. The relationship between body weight perceptions, weight control behaviours and smoking status among adolescents. Can J Public Health 2002 Sep-Oct;93(5):362-365.

(4) Hoving C, Reubsaet A, de Vries H. Predictors of smoking stage transitions for adolescent boys and girls. Prev Med 2007 Jun;44(6):485-489.

(5) Kaufman AR, Augustson EM. Predictors of regular cigarette smoking among adolescent females: does body image matter? Nicotine Tob Res 2008 Aug;10(8):1301-1309.

(6) Leatherdale ST, Manske S, Kroeker C. Sex differences in how older students influence younger student smoking behaviour. Addict Behav 2006 Aug;31(8):1308-1318.

(7) Koval JJ, Pederson LL, Chan SS. Psychosocial variables in a cohort of students in grades 8 and 11: a comparison of current and never smokers. Prev Med 2004 Nov;39(5):1017-1025.

(8) Karp I, O'Loughlin J, Paradis G, Hanley J, Difranza J. Smoking trajectories of adolescent novice smokers in a longitudinal study of tobacco use. Ann Epidemiol 2005 Jul;15(6):445-452.

(9) Rose JS, Chassin L, Presson CC, Sherman SJ. Prospective predictors of quit attempts and smoking cessation in young adults. Health Psychol 1996 Jul;15(4):261-268.

(10) Adelman WP. Tobacco use cessation for adolescents. Adolesc Med Clin 2006 Oct;17(3):697-717; abstract xii.

(11) Flay BR, Hu FB, Richardson J. Psychosocial predictors of different stages of cigarette smoking among high school students. Prev Med 1998 09/30;27(5):A9-18.

(12) Lloyd-Richardson E. Differentiating stages of smoking intensity among adolescents: Stage-specific psychological and social influences. J Consult Clin Psychol 2002;70(4):998.

(13) Tyc VL, Hadley W, Allen D, Varnell S, Ey S, Rai SN, et al. Predictors of smoking intentions and smoking status among nonsmoking and smoking adolescents. Addict Behav 2004 Aug;29(6):1143-1147.

(14) Grimshaw GM, Stanton A. Tobacco cessation interventions for young people. Cochrane database of systematic reviews 2006(4):CD003289-CD003289.

(15) Mermelstein R. Teen smoking cessation. Tob Control 2003 Jun;12 Suppl 1:i25-34.

(16) Shah CP. Public Health and Preventive Medicine in Canada. http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php ed. Toronto, Ontario: Elsevier Saunders; 2003.

(17) Flay BR, Snyder F, Petraitis J. The Theory of Triadic Influence. In: DiClemente RJ, Kegler MC, Crosby RA, editors. Emerging Theories in Health Promotion Practice and Research. 2nd ed.: Jossey-Bass; 2009. p. 451-495.

(18) Positive Action I. Positive Action: Positive development for schools, families and communities, Theoretical basis. 2012; Available at: http://www.positiveaction.net/research/index.asp?ID1=3andID2=67. Accessed 03/12, 2012.

(19) Mayhew KP, Flay BR, Mott JA. Stages in the development of adolescent smoking. Drug Alcohol Depend 2000 5/1;59 Suppl 1:61-81.

(20) Avenevoli S, Merikangas KR. Familial influences on adolescent smoking. Addiction 2003 05;98(1):1-20.

(21) Sargent JD, Dalton M. Does parental disapproval of smoking prevent adolescents from becoming established smokers? Pediatrics 2001;108(6):1256-1262.

(22) Rasmussen M, Damsgaard M, Holstein B, Poulsen L, Due P. School connectedness and daily smoking among boys and girls: the influence of parental smoking norms. Eur J Public Health 2005;15(6):607.

(23) Leatherdale ST, Cameron R, Brown KS, McDonald PW. Senior student smoking at school, student characteristics, and smoking onset among junior students: a multilevel analysis. Prev Med 2005 Jun;40(6):853-859.

(24) Leatherdale ST, Manske S. The relationship between student smoking in the school environment and smoking onset in elementary school students. Cancer Epidemiol Biomarkers Prev 2005 Jul;14(7):1762-1765.

(25) Pallonen UE, Prochaska JO, Velicer WF, Prokhorov AV, Smith NF. Stages of acquisition and cessation for adolescent smoking: An empirical integration. Addict Behav 1998 05;23(3):303-324.

(26) Altman DG, Wheelis AY, McFarlane M, Lee H, Fortmann SP. The relationship between tobacco access and use among adolescents: a four community study. Soc Sci Med 1999 Mar;48(6):759-775.

(27) Pinilla J, Gonzlez B, Barber P, Santana Y. Smoking in young adolescents: an approach with multilevel discrete choice models. J Epidemiol Community Health 2002;56(3):227-232.

(28) Battistich V, Hom A. The relationship between students' sense of their school as a community and their involvement in problem behaviors. Am J Public Health 1997 December 1;87(12):1997-2001.

(29) Bonny AE, Britto MT, Klostermann BK, Hornung RW, Slap GB. School disconnectedness: Identifying adolescents at risk. Pediatrics 2000 November 1;106(5):1017-1021.

(30) Faulkner GEJ, Adlaf EM, Irving HM, Allison KR, Dwyer J. School Disconnectedness: Identifying Adolescents at Risk in Ontario, Canada. J Sch Health 2009;79(7):312.

(31) Christophi CA, Savvides EC, Warren CW, Demokritou P, Connolly GN. Main determinants of cigarette smoking in youth based on the 2006 Cyprus GYTS. Prev Med 2009;48(3):232-236.

(32) Sussman S, Dent CW, Severson H, Burton D, Flay BR. Self-initiated quitting among adolescent smokers. Prev Med 1998 09/30;27(5):A19-28.

(33) Zhu SH, Sun J, Billings SC, Choi WS, Malarcher A. Predictors of smoking cessation in U.S. adolescents. Am J Prev Med 1999;16(3):202-207.

(34) O'Rourke T, Nolte AE, Smith BJ. Improving anti-smoking education: profiling the ex-smoker. J Drug Educ 1985;15(1):7-22.

(35) Chassin L, Presson CC, Sherman SJ. Cognitive and social influence factors in adolescent smoking cessation. Addict Behav 1984 01/01;9(4):383-390.

(36) Skinner WF, Massey JL, Krohn MD, Lauer RM. Social influences and constraints on the initiation and cessation of adolescent tobacco use. J Behav Med 1985 12/01;8(4):353-376.

(37) Turner K, Gordon J, Young R. Cigarette access and pupil smoking rates: a circular relationship? Health Promot Internation 2004;19(4):428-436.

(38) Backinger C, McDonald P, Ossip-Klein D, Colby S, Maule C, Fagan P, et al. Improving the future of youth smoking cessation. Am J Health Behav 2003;27 Suppl 2:S170-S184.

(39) Propel Centre for Population Health Impact. Youth Smoking Survey 2008-2009 Microdata User Guide. 2009.

(40) Elton Marshall T, Leatherdale ST, Manske SR, Wong K, Ahmed R, Burkhalter R. Research methods of the Youth Smoking Survey (YSS). Chronic diseases and injuries in Canada 2011;32(1):47-54.

(41) Bondy SJ, Victor JC, Diemert LM. Origin and use of the 100 cigarette criterion in tobacco surveys. Tob Control 2009;18(4):317-323.

(42) Marsh HW. Self-description Questionnaire, SDQ Manual. San Antonio: The Psychological Corporation 1998.

(43) Ford KH, Diamond PM, Kelder SH, Sterling KL, McAlister AL. Validation of scales measuring attitudes, self-efficacy, and intention related to smoking among middle school students. Psychol Addict Behav 2009 06;23(2):271-278.

(44) Leatherdale S, Ahmed R. Second-hand smoke exposure in homes and in cars among Canadian youth: current prevalence, beliefs about exposure, and changes between 2004 and 2006. Cancer Causes & Control. 2009 Aug 1:20(6):855-65.

(45) Petraitis J, Flay BR, Miller TQ. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. Psychol Bull 1995 01;117(1):67-86.

(46) Resnick MD, Bearman PS, Blum RW, Bauman KE, Harris KM, Jones J, Tabor J, et al. Protecting adolescents from harm. Findings from the National Longitudinal Study on Adolescent Health. JAMA. 1997;278(10):823-832.

(47) Loewenthal KM. An introduction to psychological tests and scales. 1st ed. London: UCL Press Limited; 1996.

(48) Greene, William H., Econometric Analysis, fifth edition, Prentice Hall, 1993: 720-723.

(49) StataCorp. 2009. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.

(50) Alwan H, Viswanathan B, Rousson V, Paccaud F, Bovet P. Association between substance use and psychosocial characteristics among adolescents of the Seychelles. BMC pediatrics 2011;11:85-85.

(51) Hooshmand S, Willoughby T, Good M. Does the direction of effects in the association between depressive symptoms and health-risk behaviors differ by behavior? A longitudinal study across the high school years. Journal of adolescent health 2012;50(2):140-147.

(52) Stanton WR, Lowe JB, Gillespie AM. Adolescents' experiences of smoking cessation. Drug Alcohol Depend. 1996;43(1-2):63-70.

(53) Bancej C, O'Loughlin J, Platt RW, Paradis G, Gervais A. Smoking cessation attempts among adolescent smokers: a systematic review of prevalence studies. Tob.Control 2007 Dec;16(6):e8.

(54) Sussman S. Effects of sixty six adolescent tobacco use cessation trials and seventeen prospective studies of self-initiated quitting. Tob Induc Dis. 2002 Jan 15;1(1):35-81.

(55) Joffe A, McNeely C, Colantuoni E, An M, Wang W, Scharfstein D. Evaluation of school-based smoking-cessation interventions for self-described adolescent smokers. Pediatrics 2009;124(2):e187-e194.

(56) Health Canada. Evaluation of the Quit4Life Youth Cessation Demonstration Project. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/quit-cesser-progeval/index-eng.php#a8. Accessed 07/15, 2012.

(57) Otten R, Bricker J B, Liu J, Comstock B A, Peterson A V. Adolescent psychological and social predictors of young adult smoking acquisition and cessation: A 10-year longitudinal study. Health psychology 2011;30(2):163-170.

(58) Stanton WR. DSM-III-R tobacco dependence and quitting during late adolescence. Addict Behav 1995;20(5):595-603.

CHAPTER 3

Individual, Social and Environmental Correlates of Youth Smoking Cessation for Males and Females Using the Theory of Triadic Influence Framework

Abstract

Introduction: Some correlates of adolescent smoking cessation have been identified; however, few studies explore whether these associations differ by sex; a potentially critical factor to examine for tobacco cessation intervention design.

Method: Responses from former and current smoking Canadian students in grades 9 to 12 who completed the 2008-2009 Youth Smoking Survey were compared using multivariate logistic regression and path models for females (n=1809) and for males (n=2268).

Results: Social factors were the most influential in female former smoking whereas environmental and individual factors in addition to social factors were directly and indirectly associated with male former smoking resulting in a much more complex path model.

Conclusion: This investigation demonstrates important sex differences in adolescents who quit smoking. More research is in order to better understand how these sex differences may be incorporated into interventions designed to improve cessation success rates among adolescent smokers.

Introduction

Despite decreases in smoking over the past ten years, the rates of regular smoking among Canadian adolescents remain unacceptably high. In 2008, 15% of Canadian youth (age 15-19) were current smokers, unchanged from 2006 and 2007. Of these young smokers, 60% smoked daily and 40% smoked occasionally, with daily smokers reportedly consuming, on average, 12 cigarettes per day. With smoking prevalence remaining stable over recent years, continued action is required to further reduce adolescent smoking.(1)

Although we know a great deal about adolescent smokers, considerably less is known about adolescents who quit smoking. Of studies published, sample sizes are relatively small and often consider only a subset of variables associated with quitting. For example, Van Zundert et al.'s study of 135 adolescent smokers attempting to quit revealed some factors associated with quitting at one month including a high sense of self-efficacy to quit, perceiving fewer positive smoking effects and consuming fewer cigarettes.(2) Chassin et al.(3) examined peer and parental influences on quitting and found that factors influencing cessation varied with the age of smoking initiation; younger adolescents responded more to parental influences while older adolescents tended to primarily respond to peer influences.(3) Not surprisingly, students with shorter smoking histories, those who consume fewer cigarettes (4,5) and those with previous quit attempts (5) have been found to be more likely to express readiness to quit smoking. They also tend to be white, female students.(5)

Being motivated and having self-efficacy to quit smoking have been found to be important parts of successful cessation.(6) Other predictors of adolescent smoking cessation include parental smoking, level of addiction, smoking frequency, and readiness to quit.(7-11) Most studies, however, do not explore whether these associations differ by sex; a potentially critical factor to examine considering the differential prevalence of adolescent female and male smoking, smoking cessation (12) and the different motivations behind quitting that females and males express.(13-15)

Rates of adolescent smoking cessation vary considerably by sex in the literature; some studies have shown higher cessation rates among females,(16,17) while others indicate

54

higher rates among males (18) or no difference in smoking cessation.(19) Results of the 2008-2009 Youth Smoking Survey (YSS) previously presented (Chapter 2) showed of current smokers, a higher proportion were male (59%), while a higher proportion of former smokers were female (55%). While it is impossible to conclude that more females quit smoking due to the cross-sectional nature of the study and the limited definition of former smoking, the fact that more males currently smoke suggests more females are quitting smoking.

Some differences among females and males with regard to how they smoke and what influences their smoking behaviour have been noted. Conclusions from one study suggest that smoking among girls may be more sensitive to restricting social influence than in boys.(20) Another study found that females are more strongly influenced by the senior student smoking rate at school, whereas males are more influenced by peer smoking.(21) The need for school based prevention programs to be tailored and targeted to address different gender influences has been noted.(21) Similarly, school based cessation interventions are likely to be more successful if tailored to sex.(22)

Research shows adolescent males and females experience differential motivation to quit and success in quitting. Males are more likely to have had a quit attempt, females are more likely to report smoking to regulate ones affective state and to avoid nicotine withdrawal as reasons to continue smoking (12) and are more likely to report weight gain while quitting as a barrier to smoking cessation.(17) Social approval of quitting and disapproval of smoking has been found to motivate the decision to quit among females but not males.(13) Although health related reasons are the primary motivator for youth smoking cessation overall, males are more likely to report quitting for performance-related reasons.(15)

Few studies examine sex differences with respect to a range of correlates of adolescent smoking cessation. Branstetter et al.(19) examined gender differences in 755 adolescents enrolled in the American Lung Association's Not-on-Tobacco (N-O-T) program between 1998 and 2009. Participants completed a series of questionnaires before and immediately following the cessation intervention. Measures included smoking history and dependence, social context, intervention readiness and reasons for smoking and were

analysed using structural equation modeling. Having parents, siblings and romantic partners who smoke and perceiving that those around them will support a quit attempt had direct and indirect effects on cessation. Females were more likely to have lower motivation and confidence quitting if they had a parent who smokes. Males, conversely, were more likely to have lower motivation and confidence to quit overall and were less likely to quit if they reported having at least one friend who smokes.(19)

The present study examines direct and indirect associations associated with smoking cessation as categorized by the Theory of Triadic Influence (TTI) theoretical framework,(23) for males and females separately. The TTI is a comprehensive ecological model that categorizes factors by different 'levels of causation' of behavior that range from very proximal to distal to ultimate, and three 'streams of influence' (environmental, social and individual) that flow through the levels: i.) cultural-environmental influences on knowledge and values, influencing attitudes; ii.) social situation-context influences on social bonding and social learning, influencing social normative beliefs; and iii.) intrapersonal influences on self determination/control and social skills, leading to self-efficacy. In addition to the direct influences of these streams, there are important inter-stream effects and influences that flow between tiers. The theory is intended to account for factors that have direct effects as well as indirect effects on behavior. The TTI explains a range of health behaviours, including youth tobacco use (23) and has already been applied to the development of school-based tobacco control interventions.(24)

Method

Participants

This study examines data from the 2008-2009 Youth Smoking Survey (YSS), a biennial survey administered by the Propel Centre for Population Health Impact at the University of Waterloo and sponsored by Health Canada. The YSS is a large cross-sectional survey representative of the Canadian grade 6 to 12 student population that provides national and provincial data on youth smoking rates as well as attitudes and behaviours with respect to tobacco.(25) Public and private middle and secondary schools in the ten Canadian provinces were randomly sampled, using a complex sampling frame stratified for health

56

region and school type. All students enrolled in recruited schools were eligible to participate. Youth living in institutions or on First Nation Reserves, and youth attending special schools or schools on military bases were not included. Students completed the 45 minute paper survey during class time. Detailed information regarding the research design, sampling, weighting and core measures have been published online.(26)

Active information for passive consent was employed where students' parents received information regarding the survey by mail and were asked to call a toll-free number if they refused their child's participation. Participating students were surveyed during class time and did not receive compensation. For the 2008-2009 school year 51,922 registered students in grade 6 to 12 completed the YSS with a school board/division participation rate of 84%, school participation rate of 59%, and student participation rate of 73%.(27) The University of Waterloo Office of Research Ethics and appropriate provincial, School Board/Division and Public Health Ethics committees approved all collection procedures. The Dalhousie University Health Sciences Research Ethics Board approved the use of this data for the purposes of this study.

The target population for the current study consisted only of students in grades 9 to 12 who had smoked 100 cigarettes or more in their lifetime (n=4077). Grade 6 to 8 students were excluded as too few former smokers occurred in these grades, in addition, the 9 to 12 grade range fits most Canadian high schools which is ideal for targeted school-based intervention development. Former smokers (n=447) were defined as those who had smoked at least 100 cigarettes or more in their lifetime but who had not smoked in the previous 30 days. The 100 cigarette criterion for current and past smoking is well established (28) and this definition for former smoking has been previously used in studies examining adolescent smoking cessation.(11,29) The former smoker group likely includes youth that have spontaneously quit smoking and intermittent smokers along with those that quit smoking as only 28% of these former smokers reported having made at least one previous quit attempt.

Questionnaire measures

Only individual responses for measures fitting the dimensions of the TTI model, as
described in detail by Flay,(23) were included (Table 1). Factors were selected to
represent each dimension of the TTI by greatest effect size as measured by the t-statistic
in bivariate tests from previous results (Chapter 2) and confirmed by separate bivariate
tests specific to sex (data not shown). Factors were organized by the three streams of
influence (individual, social and environmental) and ordered by the level of causation
from the TTI framework. In some cases a measure was used as a proxy within a
dimension. Age first tried marijuana was a proxy for risk taking; social benefits, mood
effects, and social acceptability of smoking were proxies for perceived norms; attendance
at anti-tobacco events and tobacco education lessons were proxies for anti-smoking
activities; and use of marijuana and truancy were proxies for rebelliousness.

Table 1. Variables from 2008-2009 YSS fitting dimensions of the TTI, selected variables
are in bold

	Individual	Social	Environmental
Ultimate	• **Grade**		
Distal I	• **Risk-taking: age first tried marijuana**	• **Home rules restricting smoking**	• School anti-smoking rules • Anti-smoking activities: anti-tobacco events and tobacco education lessons • **Tobacco accessibility**
Distal II	• Self-esteem	• **Perceived norms: social benefits**, mood effect and social acceptability	• School connectedness • **Rebelliousness:** use of marijuana and **truancy**
Proximal		• Parent, sibling and **peer smoking** • Perceived smoking prevalence at school	• **Tobacco health knowledge**

Individual factors examined included: school grade (9–12); age first used marijuana (8-18
years old) as a proxy for risk taking; and self-esteem (score 0-12, a higher score indicates
greater self-esteem). Self-esteem is a derived variable from summing the responses from

three items (each scored 0-3, disagree-agree): i.) in general, I like the way I am, ii.) when I do something, I do it well, and iii.) I like the way I look. The self-esteem scale was based on part of the General-Self Scale from Marsh's (30) Self-description Questionnaire, and has been found to be sufficiently valid and reliable using YSS data from previous school years.(27)

Social factors included: home rules restricting smoking (none versus some), positive social benefit effects (none versus some) for smoking, and having at least one close friend who smokes. The positive social benefit effect was derived from Ford et al.(31) who found this item to be sufficiently valid and reliable among middle school children.

Environmental factors included: cigarette accessibility (easy versus difficult), truancy in the last month (none versus skipping at least one class) as a construct for deviance behaviour,(32) and tobacco health knowledge (score 0-7, a higher score indicates greater knowledge). Tobacco health knowledge is a derived variable from summing the correct responses (yes or no) from seven questions: i.) Do people have to smoke for many years before it will hurt their health? ii.) Is there any danger to your health from an occasional cigarette? iii.) Does quitting smoking reduce health damage even after many years of smoking? iv.) Does smoking help people stay slim? v.) Can people become addicted to tobacco? vi.) Can tobacco smoke be harmful to the health of non-smokers? and vii.) Can smokers quit anytime they want? Tobacco health knowledge has been found to be sufficiently valid and reliable using data from previous YSS school years.(27) Although the Kuder-Richardson Formula 20 coefficient for tobacco health knowledge (KR-20=0.6) was below the widely accepted .70 cutoff, it is acceptable by Loewenthal's standard, which indicates that a Cronbach's $\alpha \geq .60$ is adequate for short scales.(33)

Detail regarding the response options for each survey question is available online (www.yss.uwaterloo.ca). Missing and 'don't know' responses were treated similarly using 'not stated' dummy variables.

Statistical analysis

Descriptive analyses examining female and male students who had smoked 100 or more cigarettes and former smokers were performed for all variables. Chi square tests were

used to examine differences between sexes for categorical data. Two-tailed, two-sample t-tests were performed to compare sample means of male and female former smokers for continuous measures.

Multivariate logistic regression was performed for males and females comparing former with current smokers using the TTI model. A separate path analysis was performed for males and females to examine direct and indirect associations of individual, social and environmental correlates with youth former smoking. Only those factors significant (p<0.05) in the multivariate model were included in the path analysis.

Paths were mapped by organizing the correlates by stream of influence (social, environmental and individual) and by level of causation (ultimate, distal I, distal II, proximal) using dimensions of the TTI framework.(17) This recursive path analysis follows a series of stages. The first stage involves regressing all variables significant from the multivariate model at the ultimate level (grade) on all lower level factors (distal I, distal II and proximal). The second stage involves regressing all significant ultimate and distal I level factors on the lower level factors (distal II and proximal). The third stage involves regressing all ultimate, distal I and distal II level factors on the proximal level factors. The sum of path regression coefficients from the first three stages provides the indirect effect for each variable. The direct effect is the regression coefficient provided by the full multivariate model of all factors regressing upon smoking status. In path regression, beta coefficients are standardized and thus the effect size can be compared between variables of different units.(34)

Only significant associations (p<0.05) between correlates going downstream were included. Direct associations with former smoking were shown with a solid line, while indirect associations between factors were shown with a dashed line. The beta coefficient for each association was presented with a corresponding arrow of relative thickness.

All analyses were weighted using the sample weights provided by the Propel Centre for Population Health Impact for the 2008-2009 YSS. To account for the complex survey design of the YSS in the estimation of variance, we used the balanced repeated replication method with the provided bootstrap weights as directed by the Propel Centre

for Population Health Impact for the 2008-2009 YSS.(27) The statistical package Stata 12.0 was used for all analyses, specifically, the svyset, brrweight and subpop commands.(35)

Results

Table 2 presents the number and population weighted percentage of male and female students who had smoked over 100 cigarettes and former smokers who completed the 2008-2009 YSS. Of the 1809 females who had smoked over 100 cigarettes, 222 (16%) had quit smoking; whereas of the 2268 males who had smoked over 100 cigarettes, 225 (10%) males had quit smoking. Males and females significantly differed on all variables except having home rules restricting smoking and having friends who smoke.

Table 2: Female and Male grade 9 to 12 students who smoked at least 100 cigarettes and former smokers

Categorical Measure		Female		Male		
		≥100 cigs	former	≥100 cigs	Former	
		n^a	$n(\%)^b$	n	$n(\%)$	p^c
Grade	9	377	36(10)	410	43(10)	
	10	507	65(12)	645	73(9)	
	11	527	72(17)	645	49(6)	
	12	398	49(19)	568	60(14)	0.000
Home rules	No rules	444	37(7)	523	43(5)	
	Some rules	1365	185(17)	1745	182(11)	0.321
Social benefits effects of smoking	None	1136	172(20)	1382	154(13)	
	Some	673	50(7)	886	71(7)	0.000
Friends who smoke	None	119	50(58)	181	63(35)	
	At least one	1690	172(11)	2087	162(7)	0.165
Access to cigarettes	Difficult	127	20(12)	165	22(12)	
	Easy	1682	202(16)	2103	203(9)	0.000
Truancy (last month)	None	588	112(18)	845	131(14)	
	At least once	1221	110(14)	1423	94(8)	0.000
Continuous Measure		$M^d(SE)^e$	M(SE)	M(SE)	M(SE)	p
Age first used marijuana (age 8-18)		13.0(0.03)	13.1(0.06)	12.7(0.03)	13.2(0.06)	0.023
Tobacco health knowledge (0-7 score)		4.9(0.02)	5.4(0.03)	4.5(0.02)	4.9(0.08)	0.009

[a]number, [b]population weighted percentage, [c]p-value, [d]mean, [e]standard error of the mean

61

All variables in the full TTI model (from Chapter 2) were significant in the male model and all but two (age first used marijuana and access to cigarettes) were significant in the female model (Table 3). Fit of the multivariate models were deemed acceptable as the Hosmer-Lemeshow lack of fit test was not significant for females or for males, $X^2(8)=3.26$, p=0.92 and $X^2(8)=2.79$, p=0.95, respectively. More females in grades 11 and 12 had stopped smoking while more males in grade 12 alone had stopped. Having at least one friend who smokes was most strongly negatively associated with former smoking for both females and males.

Table 3: Multivariate logistic regression of individual, social and environmental factors of former smoking male (n=225) and female (n=222) grade 9 to 12 students

Measures		Male OR (95% CI), t[a]	Female OR (95% CI), t
Individual Measures:			
Grade	9	1.00	1.00
	10	0.77(0.65-0.91), -3***	1.03(0.83-1.29), 0
	11	0.50(0.37-0.66), -5***	1.51(1.19-1.93), 3**
	12	1.95(1.69-2.26), 9***	1.27(1.08-1.50), 3**
Age first used marijuana (age 8-18)		1.10(1.07-1.14), 6***	0.97(0.92-1.03), -1
Social Measures:			
Home rules	No rules	1.00	1.00
	Some rules	1.60(1.29-1.99), 4***	2.53(2.10-3.06), 10***
Social benefits effects of smoking	None	1.00	1.00
	Some	0.45(0.37-0.55), -8***	0.34(0.28-0.40), -12***
Friends who smoke	None	1.00	1.00
	At least one	0.10(0.08-0.12), -19***	0.09(0.08-0.10), -31***
Environmental Measures:			
Access to cigarettes	Difficult	1.00	1.00
	Easy	2.20(1.28-3.79), 3**	1.11(0.75-1.65), 1
Truancy (last month)	None	1.00	1.00
	At least one	0.47(0.43-0.52), -15***	0.81(0.69-0.95), -3*
Tobacco health knowledge (0-7 score)		1.27(1.20-1.35), 8***	1.46(1.39-1.53), 15***

[a] Odds ratio, 95% confidence interval and t-statistic; adjusted for not stated, never tried, and don't know responses; *p<0.05, **p<0.01, ***p< 0.001

The path model for adolescent female former smoking (Figure 1) included: one ultimate individual correlate, three social (distal I, distal II and proximal) correlates and two

environmental (distal II and proximal) correlates. Two distal II correlates: access to cigarettes and age first tried marijuana, were not significant. The factors in the social stream path showed the strongest direct associations with former smoking. Having friends who smoke and perceiving social benefits from smoking were most negatively associated with former smoking (β=-2.6, p<0.001 and β=-1.0, p<0.001, respectively); and having rules at home restricting smoking (β=0.9, p=0.001) was most positively associated with former smoking. Being in a senior grade had indirect associations with all factors. Tobacco health knowledge was indirectly associated with all upstream factors.

All of the correlates maintained significance in the path model for adolescent male former smoking (Figure 2) which included: two individual (ultimate and distal I) correlates, three social (distal I, distal II and proximal) correlates and three environmental (distal I, distal II and proximal) correlates. The factors in the social and environmental stream paths showed the strongest direct associations with former smoking. Having friends who smoke was most negatively associated with former smoking (β=-2.4, p<0.001); and having easy access to cigarettes was most positively associated with former smoking (β=0.8, p=0.005). Grade had indirect associations with all factors. As with females, tobacco health knowledge was indirectly associated with all upstream factors. Access to cigarettes had strong indirect negative associations on social benefits from smoking (β=-1.2, p<0.001) and having any friends that smoked (β=-1.1, p=0.001). Home rules restricting smoking had a strong positive indirect effect on tobacco health knowledge (β=1.5, p<0.001).

ULTIMATE　　　　　DISTAL I　　　　　DISTAL II　　　　　PROXIMAL

Individual　　Grade

$0.6_{Gr\ 10}$
$0.4_{Gr\ 11}$
$1.2_{Gr\ 12}$

$0.2_{Gr\ 11}$
$-0.4_{Gr\ 12}$

$-0.5_{Gr\ 10}$
$-0.8_{Gr\ 11}$
$-0.8_{Gr\ 12}$

$0.4_{Gr\ 11}$**
$0.2_{Gr\ 12}$**

Social　　Home Rules　-0.3　Social Benefits　0.6　Friends who smoke　-2.6　**Former Smoking**

-1.0

0.9

-0.2**

0.4

$0.1_{Gr\ 11}$*
$0.3_{Gr\ 12}$**

-0.3

0.7　0.7

Environmental　　Truancy　-1.1　Tobacco Health Knowledge
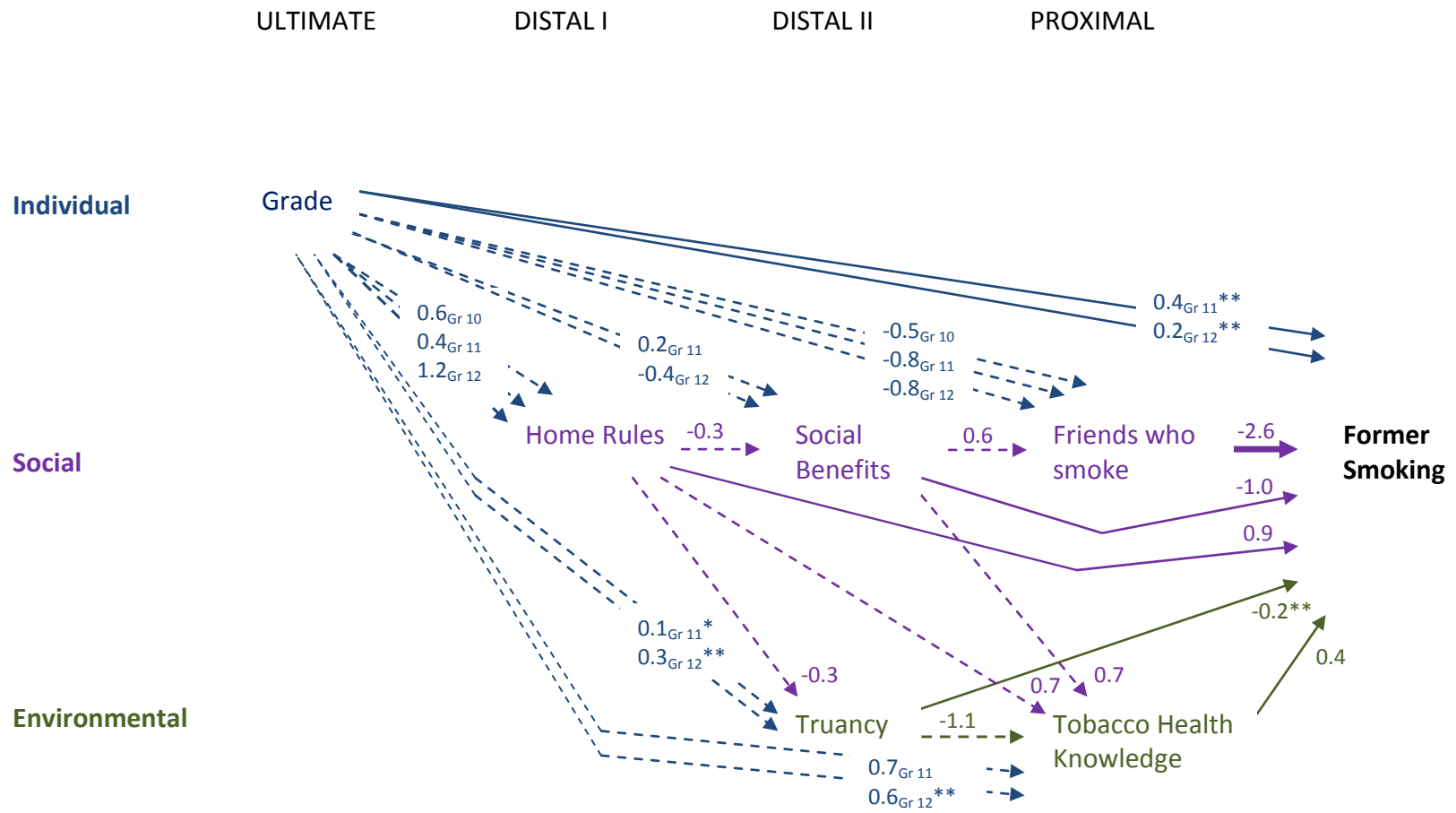
$0.7_{Gr\ 11}$
$0.6_{Gr\ 12}$**

64

Figure 2: Path model of associations between correlates of female youth smoking cessation measured by the 2008-2009 Youth Smoking Survey as organized by the Theory of Triadic Influence

All p≤0.001 except *p<0.05 and **p<0.01

ULTIMATE   DISTAL I   DISTAL II   PROXIMAL

Individual

Grade   -0.6 Gr 10   Risk Taking
         0.5 Gr 11

                                                                    -0.3 Gr 10
                                                                    -0.7 Gr 11
                                                                    0.7 Gr 12

0.2 Gr 10   0.3 Gr 10
0.4 Gr 11   0.5 Gr 11   -0.7 Gr 10   0.7   0.1
             0.6 Gr 12   -0.6 Gr 11
                              -0.1   -0.4 Gr 12

Home Rules   -0.5   Social   Friends who   -2.4   **Former**
                      Benefits   Smoke   **Smoking**
                                                     -1.1   -0.7
0.7 Gr 11   -1.2   0.5
0.6 Gr 12

0.4 Gr 10   0.4
0.7 Gr 11
1.0 Gr 11   1.3 Gr 12   0.5   -0.7
0.8 Gr 12   0.2*   -0.2   1.5   0.4
                                                                   0.2   0.8**

Environmental   Cigarette   0.5**   Truancy   -0.5   Tobacco Health
                     Access   Knowledge
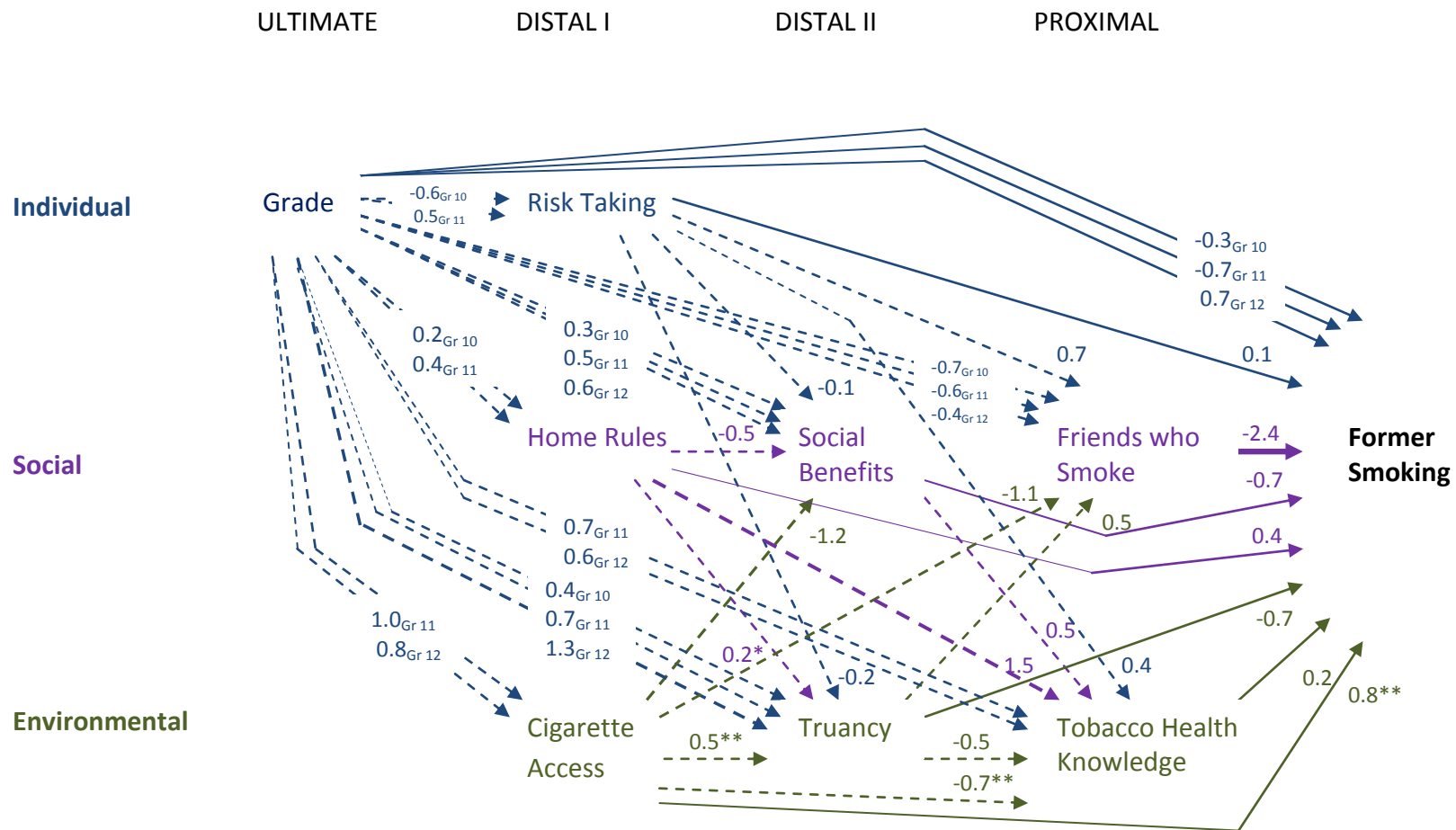   -0.7**

Figure 2: Path model of associations between correlates of male youth smoking cessation measured by the 2008-2009 Youth Smoking Survey as organized by the Theory of Triadic Influence

All p≤0.001 except *p<0.05 and **p<0.01

Discussion

Of the Canadian grade 9 to 12 students participating in the 2008-2009 YSS, 16% of female smokers and 10% of male smokers reported smoking cessation. The distribution of current and former smoking between males and females differed on all variables except for having home rules restricting smoking and having friends that smoke. Females, especially those who quit smoking, tended to have greater tobacco health knowledge and less risk taking behavior, as indicated by trying marijuana at an older age.

These findings add to the young former smoker profile by describing differences specific to sex. Males who have quit smoking tend to be in grade 12, report 'easy' access to cigarettes, are less risk-taking, skip class less often, have rules at home restricting smoking, and are less likely to have smoking friends as compared to males who continue to smoke. Females who are former smokers tend to be in grade 11 and 12, skip class less often, have rules at home restricting smoking, and are less likely to have smoking friends as compared to females who continue to smoke.

Clues to the mechanisms behind cessation can be found by examining the path models. Males had a more complex path model with two additional upstream, distal I factors: easy access to cigarettes and older age of marijuana use (as a proxy for less risk-taking) from the environmental and individual streams, respectively. These variables were strongly associated with former smoking and had indirect effects on all downstream social and environmental factors. The indirect effect of cigarette access being negatively associated with having friends that smoke is hard to explain. In the past access to tobacco purchasing has been found to be greater among females as compared to males, suggesting greater adult permissiveness for smoking among females.(36) However, reporting easy access to cigarettes was evident only among males, signifying a possible shift in greater adult permissiveness for smoking to males or that those males are more likely to access cigarettes from social sources. More information is required to determine why quitters are more likely to report 'easy' access and specifically what kind of cigarette access quitters are referring to.

The key factors in the female path model were grade and all three social factors which had strong direct effects on former smoking and significant indirect effects on all downstream social and environmental factors. The social upstream, distal I factor, having rules at home restricting smoking, an important factor for smoking cessation among females and males, may be a promising target area for smoking cessation intervention. By promoting parents to provide smoke-free homes and making their children aware of these rules at an early age may strongly support smoking cessation.

Branstetter et al.(19) found that having friends who smoke had indirect negative associations with motivation to quit, confidence in quitting, and cessation for males but not for females, while parental smoking had strong negative indirect associations for females with motivation to quit, confidence in quitting and cessation but no direct or indirect associations for males. Not having even one friend who smokes was strongly associated with former smoking for both sexes, but most strongly associated with former smoking among females; more research is required to examine whether students who stop smoking are choosing new non-smoking friends or are quitting together.

Schools may be the ideal intervention setting for cessation programs as both sexes had significant proximal and distal I level factors that can be addressed at the classroom or school level. Positive Action, an evidence-based, character education program designed for schools is recognised for improving student behaviours including tobacco control, and already uses the TTI framework for understanding health behaviour and for suggesting new approaches for health promotion.(24) Looking at the TTI path models from a health promotion perspective strategies can be identified that influence behaviour within the three streams. Population health should focus on the distal and ultimate causes of health behaviour (contextual change), where these factors influence multiple behaviours more efficiently and in a more sustained way.

Both male and female smoking cessation may be supported by public health campaigns that promote being smoke-free at home. Smoking cessation among males may also be supported by strategies that improve social competencies associated with risk-taking.(20) Influential factors for adolescents to stop smoking are largely social for both sexes. Incorporating parental support, developing communication and thinking skills to change

perceived norms regarding tobacco,(21) along with increasing tobacco health knowledge are important areas for intervention focus.

This exploratory study is subject to a number of limitations. First, the cross-sectional nature of this study does not allow conclusions about causality. Assumptions of directionality were based on the TTI model; these findings cannot verify the model and longitudinal research is necessary to examine directionality and causality. The recursive path analysis only observed downstream effects and did not include bi-direction or lateral or upstream associations, no relationship loops or reciprocal causes were examined. Second, this study used secondary data and is confined to the measures and data collection of the 2008-2009 YSS. Many correlates of smoking were not measured (e.g., academic achievement, socioeconomic status, family structure, reason for quitting, etc.) which may supersede the correlates included in this analyses. Third, these self-report responses from grade 9 to 12 students collected in the classroom setting are likely influenced by social desirability bias and recall bias, especially with regard to risk taking behaviours such as smoking.(37,38)

In addition, misclassification of smoking status likely occurred for former smoking due to the short time period (30 days) used for defining quitting and the low number of cigarettes smoked (100) used to establish smoking status. Only 28% of former smokers reported having at least one quit attempt, indicating that the majority of students in this group if asked would not identify themselves as ex-smokers. As defined, the 'former smoker' category is likely a dynamic group that includes intermittent smokers and students in the process of initiation. This misclassification would cause an underestimate of effect size when comparing to current smokers and an overestimate when comparing to never smokers. The effect observed for 'easy' cigarette access on the former smoker group may point to prevention strategies to stop initiators from progressing to more regular smoking.

Despite these limitations, the present findings provide further evidence that there are important sex differences with regard to smoking cessation, and add support for the provision of sex-tailored smoking cessation interventions at school. More research is

required to examine how these differences should be best incorporated into the design of adolescent smoking cessation interventions.

Conclusion

This investigation further demonstrates important sex differences in youth former smoking. Social factors were most largely influential in female former smoking whereas environmental and individual factors in addition to social factors were directly and indirectly associated with male former smoking. More research is required to better understand how these sex differences may be incorporated into school-based intervention design to improve cessation success rates among adolescent smokers.

References

(1) Health Canada. Canadian Tobacco Use Monitoring Survey: Annual results 2008. 2008; Available at: www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/index-eng.php (accessed 11 Mar 2012).

(2) Van Zundert RMP, Nijhof LM, Engels RCME. Testing Social Cognitive Theory as a theoretical framework to predict smoking relapse among daily smoking adolescents. Addict Behav 2009;34(3):281-286.

(3) Chassin L, Presson CC, Sherman SJ, et al. Changes in peer and parent influence during adolescence: Longitudinal versus cross-sectional perspectives on smoking initiation. Dev Psychol 1986;22(3):327-334.

(4) Turner LR, Veldhuis CB, Mermelstein R. Adolescent smoking: are infrequent and occasional smokers ready to quit? Subst Use Misuse 2005;40(8):1127-1137.

(5) Woodruff SI, Lee J, Conway TL. Smoking and quitting history correlates of readiness to quit in multiethnic adolescents. Am J Health Behav 2006;30(6):663-674.

(6) Heale R, Griffin MT. Self-efficacy with application to adolescent smoking cessation: A concept analysis. J Adv Nurs 2009;65(4):912-918.

(7) Bagot K, Heishman S, Moolchan E. Tobacco craving predicts lapse to smoking among adolescent smokers in cessation treatment. Nicotine tobacco research 2007;9(6):647-652.

(8) Kleinjan M, Engels RCME, van Leeuwe J, Brug J, van Zundert RMP, van den Eijnden,Regina J J M. Mechanisms of adolescent smoking cessation: roles of readiness to quit, nicotine dependence, and smoking of parents and peers. Drug Alcohol Depend 2009;99(1-3):204-214.

(9) Myers M, Macpherson L. Coping with temptations and adolescent smoking cessation: an initial investigation. Nicotine tobacco research 2009;11(8):940-944.

(10) Sargent JD, Mott LA, Stevens M. Predictors of smoking cessation in adolescents. Archives of pediatrics adolescent medicine 1998;152(4):388-393.

(11) Zhu SH, Sun J, Billings SC, Choi WS, Malarcher A. Predictors of smoking cessation in U.S. adolescents. Am J Prev Med 1999;16(3):202-207.

(12) Sussman S, Dent CW, Nezami E, Stacy AW, Burton D, Flay BR. Reasons for quitting and smoking temptation among adolescent smokers: gender differences. Subst Use Misuse 1998;33(14):2703-2720.

(13) Macpherson L, Myers M. Examination of a Process Model of Adolescent Smoking Self-Change Efforts in Relation to Gender. Journal of child adolescent substance abuse 2009;19(1):48-65.

(14) Paavola M, Vartiainen E, Puska P. Smoking cessation between teenage years and adulthood. Health Educ Res 2001;16(1):49-57.

(15) Aung AT, Hickman N, Moolchan E. Health and performance related reasons for wanting to quit: gender differences among teen smokers. Substance use misuse 2003;38(8):1095-1107.

(16) Laoye JA, Creswell WH, Stone DB. A cohort study of 1,205 secondary school smokers. J Sch Health 1972;42(1):47-52.

(17) Pirie PL, Murray DM, Luepker RV. Gender differences in cigarette smoking and quitting in a cohort of young adults. Am J Public Health 1991;81(3):324-327.

(18) Alexander HM, Callcott R, Dobson AJ, Hardes GR, Lloyd DM, O'Connell DL, et al. Cigarette smoking and drug use in schoolchildren: IV--factors associated with changes in smoking behaviour. Int J Epidemiol 1983;12(1):59-66.

(19) Branstetter S, Blosnich J, Dino G, Nolan J, Horn K. Gender differences in cigarette smoking, social correlates and cessation among adolescents. Addict Behav 2012;37(6):739-742.

(20) Rasmussen M, Damsgaard M, Holstein B, Poulsen L, Due P. School connectedness and daily smoking among boys and girls: the influence of parental smoking norms. Eur J Public Health 2005;15(6):607.

(21) Leatherdale ST, Manske S, Kroeker C. Sex differences in how older students influence younger student smoking behaviour. Addict Behav 2006 Aug;31(8):1308-1318.

(22) Adelman WP. Tobacco use cessation for adolescents. Adolesc Med Clin 2006 Oct;17(3):697-717; abstract xii.

(23) Flay BR, Snyder F, Petraitis J. The Theory of Triadic Influence. In: DiClemente RJ, Kegler MC, Crosby RA, editors. Emerging Theories in Health Promotion Practice and Research. 2nd ed.: Jossey-Bass; 2009. p. 451-495.

(24) Positive Action I. Positive Action: Positive development for schools, families and communities, Theoretical basis. 2012; Available at: http://www.positiveaction.net/research/index.asp?ID1=3andID2=67. Accessed 03/12, 2012.

(25) Propel Centre for Population Health Impact. Youth Smoking Survey. 2010; Available at: www.yss.uwaterloo.ca. Accessed 09/01, 2010.

(26) Elton Marshall T, Leatherdale ST, Manske SR, Wong K, Ahmed R, Burkhalter R. Research methods of the Youth Smoking Survey (YSS). Chronic diseases and injuries in Canada 2011;32(1):47-54.

(27) Propel Centre for Population Health Impact. Youth Smoking Survey 2008-2009 Microdata User Guide. 2009.

(28) Bondy SJ, Victor JC, Diemert LM. Origin and use of the 100 cigarette criterion in tobacco surveys. Tob Control 2009;18(4):317-323.

(29) Mermelstein R. Teen smoking cessation. Tob Control 2003 Jun;12 Suppl 1:i25-34.

(30) Marsh HW. Self-description Questionnaire, SDQ Manual. San Antonio: The Psychological Corporation 1998.

(31) Ford KH, Diamond PM, Kelder SH, Sterling KL, McAlister AL. Validation of scales measuring attitudes, self-efficacy, and intention related to smoking among middle school students. Psychol Addict Behav 2009 06;23(2):271-278.

(32) Petraitis J, Flay BR, Miller TQ. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. Psychol Bull 1995 01;117(1):67-86.

(33) Loewenthal KM. An introduction to psychological tests and scales. 1st ed. London: UCL Press Limited; 1996.

(34)Robins, JM, Greenland, S. Identifiability and exchangeability for direct and indirect effects. Epidemiology. 1992:3(2):143–55.

(35) StataCorp. 2009. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.

(36) DiFranza JR, Savageau JA, Aisquith BF. Youth access to tobacco: the effects of age, gender, vending machine locks, and "it's the law" programs. Am J Public Health 1996;86(2):221-224.

(37) Stanton WR, Lowe JB, Gillespie AM. Adolescents' experiences of smoking cessation. Drug Alcohol Depend. 1996;43(1-2):63-70.

(38) Stanton WR. DSM-III-R tobacco dependence and quitting during late adolescence. Addict Behav 1995;20(5):595-603.

Conclusion

Main Findings

During the 2008-2009 school year 15% of Canadian grade 9 to 12 students reported smoking at least 100 cigarettes in their lifetime; of these students 12% had quit smoking. This prevalence of adolescent former smoking is in line with what has been observed previously, although it is in the higher range.(1,2) The short period for not smoking (30 days) used to define former smoking is likely an overestimate of the number of youth that successfully quit smoking but is commonly used.(2) Only 28% of former smokers in the dataset reported having had at least one previous quit attempt, so it is difficult to label this group as successful quitters per se; the group likely contains a considerable proportion of intermittent smokers and spontaneous quitters who will start smoking again.

If successful tobacco cessation requires a quit attempt, only 3% of the adolescent smokers in the dataset successfully quit smoking. However, not including spontaneous quitting seems too conservative, and would underestimate youth smoking cessation. Including intermittent smokers in the broader former smoking definition may not be too problematic, as intermittent smokers are more likely to quit in future.(3) For these reasons the broader two rule definition for former smoking was used: i.) have smoked 100 or more cigarettes in her/his lifetime; and ii.) did not smoke in the last 30 days; this definition has commonly been used to describe successful smoking cessation among adolescents in previous research.(2,4,5)

The 2008-2009 YSS was a useful tool for measuring characteristics differentiating youth former smoking from current smoking. Multivariate multinomial models fitting the Theory of Triadic Influence (TTI) framework (Chapter 2) revealed youth who successfully quit smoking represent a distinct, often intermediary, group of students from

73

current and never smokers, and have some similarities with both groups on certain environmental measures. For most measures, former smokers exhibit characteristics that are intermediate between current and never smokers in bivariate and multivariate tests. Former smokers have the highest tobacco health knowledge, are most likely to have attended an anti-tobacco event and report being least connected to school. Most characteristics (with two exceptions: self-esteem and age first used marijuana) remained significant in the full TTI model, suggesting that the reasons for quitting and the quitting process are complex.

Social and environmental factors play the most important roles in differentiating former smokers from current smokers. These results confirm previous findings regarding social determinants associated with youth smoking cessation including having non-smoking parents and friends;(6-10) perceived positive mood effects and social benefits of quitting (11) and higher tobacco health knowledge.(8,10-14) Similarly, truancy and poor parental monitoring have been previously associated with substance use (including smoking) among students.(15) This profile of the young former smoker relative to never and current smoking youth mimics that which has been previously observed in a small comparative study that identified differences on individual (sex and grade), social (having parents and peers who smoke, perceived social acceptability and positive mood effects of smoking) and environmental (tobacco health knowledge) determinants.(8)

Discrepancies with findings from previous studies occurred for self-esteem, cigarette access, sex and grade. Successful quitters had higher self-esteem than current smokers in the bivariate test, a finding reported in other studies;(6,9) but this factor did not remain significant in the full model. Another study reported no significant effect of sex or age with respect to being a former smoker,(7) however, former smokers were more likely to be female and in higher grades as compared to both current and never smokers. Lower cigarette availability has previously been reported to be associated with not smoking among youth,(16) alternatively youth who successfully quit smoking were more likely to report 'easy' rather than 'difficult' access to cigarettes which may reflect having access to social sources through friends who have remained smokers.

With the exception of sex and grade, former smokers and current smokers did not differ much on individual factors. In comparison to never smokers, former and current smokers can be described as a senior female student (grades 10-12), who exhibits risk-taking behaviour such as first trying marijuana at a younger age, has lower self-esteem and more weekly spending money; this profile provides a useful target for youth cessation interventions. Future research examining why females decide to quit and how they are more successful in doing so would be worthwhile.

Because there was a significant effect by sex on former smoking status, differences between males and females were examined based on correlates used in the TTI model comparing former and current smoking. Multivariate and path regression models were examined for each sex using the TTI framework with the goal of better informing smoking cessation intervention design (Chapter 3). Descriptive statistics showed females significantly differed from males on all correlates except for having friends that smoked and for having rules at home restricting smoking.

Examining the indirect and direct associations between correlates in the TTI path models for both males and females showed that females had a less complex path model that was most influenced by social factors. The male path model included 'easy' access to cigarettes and older age of first marijuana use, a proxy for less risk-taking. These upstream, distal I factors had significant indirect effects on lower environmental and social factors. 'Easy' cigarette access was strongly associated directly with successful smoking cessation among males. Having friends who smoked was most strongly negatively associated with former smoking, and all social factors remained in the path models for both sexes.

These findings add sex-specific traits to the young former smoker profile previously described. Males who have stopped smoking tend to be in grade 12, are less risk-taking, report 'easy' access to cigarettes and are less likely to perceive positive social benefit effects from smoking. They skip class less often, have rules at home restricting smoking, and do not have friends who smoke as compared to males that continue smoking. Females tend to be in grade 11 or 12; they skip class less often, have rules at home

75

restricting smoking, are less likely to perceive social benefits from smoking, and do not have friends who smoke as compared to females who continue smoking.

Recommendations

Based on study findings it appears that cessation occurs at a greater regularity among students in older grades (11 and 12). While tobacco programs directed at youth are largely oriented towards prevention,(17,18) the adoption of school based smoking cessation support should be made available to senior students in addition to ongoing prevention programs. Cessation is clearly an issue for young people,(2,19) particularly older youth, yet only limited resources exist to address it.

The TTI model can facilitate pinpointing intervention areas that will specifically address these aspects of the student smoker's life; this method has been found to be effective for improving health behaviours, including tobacco control, in schools.(20) Schools are an ideal setting for intervention as they are easily accessible to youth and cessation programs delivered in the classroom setting and in school-based health clinics have shown to be effective.(21) Even interventions reformatted to be implemented in the school setting have shown successful results.(22) Positive Action, an evidence-based, character education program designed for schools is recognised for improving student behaviours including tobacco control, and already uses the TTI framework for understanding health behaviour and for suggesting new approaches for health promotion.(20)

Looking at the TTI models from a health promotion perspective strategies can be identified that influence behaviour within the three streams. Population health should focus on the distal and ultimate causes of health behaviour (contextual change), where these factors influence multiple behaviours more efficiently and in a more sustained way. Public health campaigns that promote being smoke-free at home may have a large impact on supporting youth smoking cessation. In addition, significant social (smoking friends and social benefits of smoking) and environmental factors (tobacco health knowledge and truancy), at the proximal and distal I levels relating to school in the TTI were associated with former smoking for both males and females. Increasing student skills and

knowledge about smoking would be beneficial to include in tobacco cessation programming, and has been found to be successful in other developed interventions.(23)

In addition, these findings suggest cessation strategies should be made available to senior students and include small peer focused groups with objectives to change perceived norms regarding tobacco (social acceptability, social benefit effects and positive mood effects of smoking), increase tobacco health knowledge and incorporate anti-tobacco events as important components for a successful school-based smoking cessation intervention. The strong social correlates identified suggest the importance of family and peer support for quitting. Parents should be included to provide anti-tobacco support at home and be connected with adult smoking cessation interventions. Not having even one friend who smokes was the strongest correlate with former smoking, thus school based interventions must provide room for peer support and participation.

Females and males present distinct characteristics; it is likely that sex-specific tobacco cessation strategies would be most effective. Males may be more receptive than females to interventions delivered to broader audiences, such as public health campaigns to better restrict cigarette sales to minors and to improve social competencies associated with risk-taking.(24) Influential factors for adolescents to stop smoking are largely social for both sexes, thus incorporating parental education to promote smoke-free homes, developing communication and thinking skills to change perceived norms,(25) along with providing peer support and participation are important areas for intervention focus. Parents can be included through additional education to provide cessation support at home and be connected with adult smoking cessation interventions, methods which have reduced youth smoking.(26)

To a large extent, measures from the Youth Smoking Survey were useful in describing successful quitting with correlates representing a broad range of types (environmental, social and individual) at different levels (from individual to population) as organized by the TTI. However, some dimensions were not represented. Socioeconomic status, family structure, depressive symptoms, quit self-efficacy and academic achievement are some additional measures that may be useful to include for a more complete profile. It would

also be useful having information regarding reasons for quitting, perceived difficulty of quitting and reasons for relapse.

Strengths

This is the first study to examine a broad range of correlates with youth smoking cessation guided by a conceptual framework. The use of a conceptual framework (the TTI) in combination with a school-based intervention framework (Positive Action) proven to improve a variety of student health behaviours, including tobacco control,(20) lends merit to the recommendations put forward. In addition, this study examined a large, nationally representative sample of Canadian school students with a reasonable participation rate of 73% which reflects population rates. Findings from this study add valuable insight into the adolescent profile of tobacco cessation with additional descriptors specific to sex.

Limitations

This study is subject to a number of limitations. First, the cross-sectional nature of this study limits conclusions to those of association only and no conclusions of causality can be made. Assumptions of directionality were based on the TTI model, and the findings cannot verify the model. Longitudinal research is necessary to examine directionality and causality. Second, only students enrolled in Canadian high schools were sampled; those youth who do not attend high school were not included, therefore findings cannot be generalised to all adolescents.

Third, this study used secondary data and is confined to the measures and data collection of the 2008-2009 YSS. Many correlates of smoking were not measured (e.g., depressive symptoms, socioeconomic status, family structure, reason for quitting, self-efficacy etc.) which may supersede the correlates included in this analyses. Fourth, self-report responses from grade 9 to 12 students collected in the classroom setting is likely influenced by social desirability and recall bias, especially with regard to deviant behaviours such as smoking history.(27,28)

Fifth, misclassification of smoking status likely occurred for former smoking due to the short time period (30 days) used for defining quitting and the low number of cigarettes smoked (100) used to establish smoking status. Only 28% of former smokers reported having at least one quit attempt, indicating that the majority of students in this group if asked would not identify themselves as ex-smokers. As defined, the 'former smoker' category is likely a dynamic group that includes intermittent smokers and students in the process of initiation. This misclassification would cause an underestimate of effect size when comparing to current smokers and an overestimate when comparing to never smokers. The effect observed for 'easy' cigarette access on the former smoker group may better point to prevention strategies to stop initiators from progressing to more regular smoking.

Sixth, a recursive path analysis was used by sex assuming unidirectional downstream causalities from the TTI model, bi-directional or lateral or upstream associations were not tested, therefore loops or reciprocal relationships were not examined. Lastly, some measures from the YSS (social acceptability, positive mood effects and social benefits of smoking) have not been intrinsically validated or tested for reliability with the YSS, and may not be suitable operational measures.

Future research

These findings identify important correlates of youth smoking cessation which should be examined further. Not having even one friend who smokes was most strongly associated with former smoking, longitudinal research is required to examine whether students who stop smoking are choosing new friends who do not smoke or choose to quit together. With regard to student access to tobacco, in the past access tobacco purchases have been found to be greater among females as compared to males suggesting greater adult permissiveness for smoking among females.(29) However, reporting easy access to cigarettes was evident only among males in this study, suggesting there may have been a shift in greater adult permissiveness for smoking to males or that males are more likely to access cigarettes from social sources. Alternatively, they may have more unwanted social cigarette sources more than females. This would be an interesting qualitative question to explore further.

More information is needed to help uncover the reasons adolescents quit smoking as this is an important part in developing motivational strategies in cessation interventions. Some quantitative studies suggest the primary reason adolescents wish to quit smoking is for future health reasons.(30-33) Concerns about physical appearance,(32,34) the cost of cigarettes,(6,32) and athletic performance,(31,32) especially among males,(31) have also been reported to be important motivators by young smokers. As more senior female students are successful quitters, perhaps females change friends as they prepare for post-secondary education, or they may be more likely to 'grow out of smoking' at an earlier age.

The present findings provide further evidence that there are important sex differences with regard to smoking cessation, and add support for sex-tailored smoking cessation interventions at school. More research is required to examine how these differences should be best incorporated into the design of adolescent smoking cessation interventions. In addition to examining why and how female senior students tend to be more successful quitting smoking, more research to examine additional measures such as socioeconomic status, depressive symptoms and family structure may be helpful in providing a more complete profile. Longitudinal studies are required to observe the transition to former smoking over a longer time period, to test determinants as predictors of successful quitting and to examine intermittent smoking.

Summary

More resources are needed to support smoking cessation for young people. School-based interventions may increase awareness for smoking cessation support programs and may be ideal access points for youth. Adolescents who successfully quit smoking are distinctly different from current smokers. Targeting senior students in peer focused groups, with the aim of changing perceived norms regarding tobacco and increasing tobacco health knowledge, promoting anti-smoking activities, as well as receiving anti-tobacco support from home may be important strategies to include in youth cessation program development.

The TTI was a useful framework to organize the measures from the YSS to develop a useful profile for targeted interventions. In comparisons with never and current smokers, successful quitters exhibit distinct characteristics from and are generally more similar to current smokers with respect to individual factors (self-esteem, risk taking and spending money). Youth who successfully quit smoking tend to be female in senior grades often exhibiting traits intermediate between never and current smokers, with two exceptions, they are most likely to report 'easy' access to cigarettes and have the highest tobacco health knowledge.

In addition, the TTI was useful to provide recommendations of important areas for intervention focus based on the associations observed. School, family and friend networks are important environmental and social influences that must be considered to support successful smoking cessation. Specifically, school-based smoking cessation programs should aim to provide tobacco education to students and their parents, promote anti-tobacco events, encourage peer support and participation and focus on changing perceived norms regarding tobacco.

Further research is required to determine why young smokers quit and how they do so. Longitudinal research is necessary to examine the quitting process of young smokers. Questionnaires need to include a broad range of correlates by type and level of influence associated with quitting and be tailored to assess the reasons for quitting, the duration of remaining smoke-free and reasons for relapse. Examining sex differences is crucial for providing more targeted strategies.

This investigation profiles adolescent smoking cessation and further demonstrates important sex differences in youth former smoking. Social factors were most influential in successful cessation among females whereas environmental and individual factors in addition to social factors were directly and indirectly associated with successful cessation among males. More research is needed to better understand how these sex differences may be incorporated into school based tobacco cessation intervention design to improve cessation success rates among adolescent smokers.

References

(1) Buttross LS, Kastner JW. A brief review of adolescents and tobacco: What we know and don't know. Am J Med Sci 2003 Oct;326(4):235-237.

(2) Mermelstein R. Teen smoking cessation. Tob Control 2003 Jun;12 Suppl 1:i25-34.

(3) Tindle H, Shiffman S. Smoking cessation behavior among intermittent smokers versus daily smokers. Am J Public Health 2011;101(7):e1-e3.

(4) Bondy SJ, Victor JC, Diemert LM. Origin and use of the 100 cigarette criterion in tobacco surveys. Tob Control 2009;18(4):317-323.

(5) Zhu SH, Sun J, Billings SC, Choi WS, Malarcher A. Predictors of smoking cessation in U.S. adolescents. Am J Prev Med 1999;16(3):202-207.

(6) Eissenberg T, Balster RL. Initial tobacco use episodes in children and adolescents: current knowledge, future directions. Drug Alcohol Depend 2000;59 Suppl 1:S41-S60.

(7) Fritz DJ. Adolescent smoking cessation: how effective have we been? J Pediatr Nurs 2000 Oct;15(5):299-306.

(8) Adlaf EM, Ivis FJ, Smart RG. Ontario student drug use survey 1977-1997. Toronto: Addiction Research Foundation, 1997.

(9) O'Loughlin J, Gervais A, Dugas E, Meshefedjian G. Milestones in the process of cessation among novice adolescent smokers. Am J Public Health 2009 Mar;99(3):499-504.

(10) Pallonen UE, Prochaska JO, Velicer WF, Prokhorov AV, Smith NF. Stages of acquisition and cessation for adolescent smoking: An empirical integration. Addict Behav 1998 05;23(3):303-324.

(11) O'Rourke T, Nolte AE, Smith BJ. Improving anti-smoking education: profiling the ex-smoker. J Drug Educ 1985;15(1):7-22.

(12) McNeill A. The development of dependence on smoking in children. 1991;86:589.

(13) Rose JS, Chassin L, Presson CC, Sherman SJ. Prospective predictors of quit attempts and smoking cessation in young adults. Health Psychol 1996 Jul;15(4):261-268.

(14) Skinner WF, Massey JL, Krohn MD, Lauer RM. Social influences and constraints on the initiation and cessation of adolescent tobacco use. J Behav Med 1985 12/01;8(4):353-376.

(15) Sussman S, Sun P. Youth tobacco use cessation: 2008 update. Tobacco induced diseases 2009;5:3-3.

(16) Engels RC, Knibbe RA, de Vries H, Drop MJ. Antecedents of smoking cessation among adolescents: who is motivated to change? Prev Med 1998;27(3):348-357.

(17) Grimshaw GM, Stanton A. Tobacco cessation interventions for young people. Cochrane database of systematic reviews 2006(4):CD003289-CD003289.

(18) Shah CP. Public Health and Preventive Medicine in Canada. http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php ed. Toronto, Ontario: Elsevier Saunders; 2003.

(19) Bancej C, O'Loughlin J, Platt RW, Paradis G, Gervais A. Smoking cessation attempts among adolescent smokers: a systematic review of prevalence studies. Tob.Control 2007 Dec;16(6):e8.

(20) Positive Action I. Positive Action: Positive development for schools, families and communities, Theoretical basis. 2012; Available at: http://www.positiveaction.net/research/index.asp?ID1=3andID2=67. Accessed 03/12, 2012.

(21) Sussman S. Effects of sixty six adolescent tobacco use cessation trials and seventeen prospective studies of self-initiated quitting. Tob Induc Dis. 2002 Jan 15;1(1):35-81

(22) Joffe A, McNeely C, Colantuoni E, An M, Wang W, Scharfstein D. Evaluation of school-based smoking-cessation interventions for self-described adolescent smokers. Pediatrics 2009;124(2):e187-e194.

(23) Health Canada. Evaluation of the Quit4Life Youth Cessation Demonstration Project. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/quit-cesser-progeval/index-eng.php#a8. Accessed 07/15, 2012.

(24) Altman DG, Wheelis AY, McFarlane M, Lee H, Fortmann SP. The relationship between tobacco access and use among adolescents: a four community study. Soc Sci Med 1999 Mar;48(6):759-775.

(25) Sowden AJ, Stead LF. Community interventions for preventing smoking in young people. 2003(1).

(26) Otten R, Bricker J B, Liu J, Comstock B A, Peterson A V. Adolescent psychological and social predictors of young adult smoking acquisition and cessation: A 10-year longitudinal study. Health psychology 2011;30(2):163-170.

(27) Stanton WR, Lowe JB, Gillespie AM. Adolescents' experiences of smoking cessation. Drug Alcohol Depend. 1996;43(1-2):63-70.

(28) Stanton WR. DSM-III-R tobacco dependence and quitting during late adolescence. Addict Behav 1995;20(5):595-603.

(29) Centers for Disease Control and Prevention. Youth tobacco surveillance—United States, 2000. MMWR CDC Surveill Summ 2001;50:1-84.

(30) Barnett TA, Gauvin L, Lambert M, O'Loughlin J, Paradis G, McGrath JJ. The influence of school smoking policies on student tobacco use. Arch Pediatr Adolesc Med 2007 Sep;161(9):842-848.

(31) Murnaghan DA, Leatherdale ST, Sihvonen M, Kekki P. A multilevel analysis examining the association between school-based smoking policies, prevention programs and youth smoking behavior: evaluating a provincial tobacco control strategy. Health Educ Res 2008;23(6):1016-1028.

(32) Norman CD, Maley O, Li X, Skinner HA. Using the internet to assist smoking prevention and cessation in schools: a randomized, controlled trial. Health Psychol 2008 Nov;27(6):799-810.

(33) Rojas NL, Killen JD, Haydel KF, Robinson TN. Nicotine dependence among adolescent smokers. Arch Pediatr Adolesc Med 1998;152(2):151.

(34) Colby SM, Tiffany ST, Shiffman S, Niaura RS. Are adolescent smokers dependent on nicotine? A review of the evidence. Drug Alcohol Depend 2000;59 Suppl 1:S83-S95.

BIBLIOGRAPHY

Abroms L, Simons-Morton B, Haynie DL, Chen R. Psychosocial predictors of smoking trajectories during middle and high school. Addiction 2005 Jun;100(6):852-861.

Adelman WP. Tobacco use cessation for adolescents. Adolesc Med Clin 2006 Oct;17(3):697-717; abstract xii.

Adlaf EM, Ivis FJ, Smart RG. Ontario student drug use survey 1977-1997. Toronto: Addiction Research Foundation, 1997.

Akers RL, Lee G. A longitudinal test of social learning theory: adolescent smoking. J.Drug Iss. 1996 03/01;26(2):317-343.

Alexander HM, Callcott R, Dobson AJ, Hardes GR, Lloyd DM, O'Connell DL, et al. Cigarette smoking and drug use in schoolchildren: IV--factors associated with changes in smoking behaviour. Int J Epidemiol 1983;12(1):59-66.

Altman DG, Wheelis AY, McFarlane M, Lee H, Fortmann SP. The relationship between tobacco access and use among adolescents: a four community study. Soc Sci Med 1999 Mar;48(6):759-775.

Alwan H, Viswanathan B, Rousson V, Paccaud F, Bovet P. Association between substance use and psychosocial characteristics among adolescents of the Seychelles. BMC pediatrics 2011;11:85-85.

Aung AT, Hickman NJ,3rd, Moolchan ET. Health and performance related reasons for wanting to quit: Gender differences among teen smokers. Subst Use Misuse 2003;38(8):1095-1107.

Avenevoli S, Merikangas KR. Familial influences on adolescent smoking. Addiction 2003 05;98(1):1-20.

Backinger C, McDonald P, Ossip-Klein D, et al. Improving the future of youth smoking cessation. Am J Health Behav 2003;27(Suppl 2):S170-S184.

Bagot K, Heishman S, Moolchan E. Tobacco craving predicts lapse to smoking among adolescent smokers in cessation treatment. Nicotine tobacco research 2007;9(6):647-652.

Balch GI. Exploring perceptions of smoking cessation among high school smokers: Input and feedback from focus groups. Prev Med 1998;27(5 Pt 3):A55-63.

Bancej C, O'Loughlin J, Platt RW, Paradis G, Gervais A. Smoking cessation attempts among adolescent smokers: a systematic review of prevalence studies. Tob.Control 2007 Dec;16(6):e8.

Barnett TA, Gauvin L, Lambert M, O'Loughlin J, Paradis G, McGrath JJ. The influence of school smoking policies on student tobacco use. Arch.Pediatr.Adolesc.Med. 2007 Sep;161(9):842-848.

Battistich V, Hom A. The relationship between students' sense of their school as a community and their involvement in problem behaviors. Am J Public Health 1997 December 1;87(12):1997-2001.

Bauman KE, Fisher LA, Bryan ES, Chenoweth RL. Antecedents, subjective expected utility, and behavior: a panel study of adolescent cigarette smoking. Addict.Behav. 1984;9(2):121-136.

Becklake MR, Ghezzo H, Ernst P. Childhood predictors of smoking in adolescence: a follow-up study of Montreal schoolchildren. CMAJ 2005 Aug 16;173(4):377-379.

Bondy SJ, Victor JC, Diemert LM. Origin and use of the 100 cigarette criterion in tobacco surveys. Tob Control 2009;18(4):317-323.

Bonny AE, Britto MT, Klostermann BK, Hornung RW, Slap GB. School disconnectedness: Identifying adolescents at risk. Pediatrics 2000 November 1;106(5):1017-1021.

Branstetter S, Blosnich J, Dino G, Nolan J, Horn K. Gender differences in cigarette smoking, social correlates and cessation among adolescents. Addict Behav 2012;37(6):739-742.

Burt RD, Peterson AV,Jr. Smoking cessation among high school seniors. Prev.Med. 1998 May-Jun;27(3):319-327.

Buttross LS, Kastner JW. A brief review of adolescents and tobacco: what we know and don't know. Am.J.Med.Sci. 2003 Oct;326(4):235-237.

Carriere G. Weekly work hours and health-related behaviours in full-time students. Health Rep. 2005 Jun;16(4):11-22.

Centers for Disease Control and Prevention. Youth tobacco surveillance—United States, 2000. MMWR CDC Surveill.Summ. 2001;50:1-84.

Chassin L, Presson CC, Sherman SJ, Montello D, McGrew J. Changes in peer and parent influence during adolescence: Longitudinal versus cross-sectional perspectives on smoking initiation. Dev.Psychol. 1986 05/01;22(3):327-334.

Chassin L, Presson CC, Sherman SJ. Cognitive and social influence factors in adolescent smoking cessation. Addict Behav 1984 01/01;9(4):383-390.

Chassin L, Presson CS, SS, Corty E, Olshavsky R. Predicting the onset of cigarette smoking in adolescents: A longitudinal study. J.Appl.Soc.Psychol. 1984 05/01;14(3):224-243.

Chatterjee S PB editor. Regression Analysis by Example. 2nd edn ed. New York: Wiley; 1991.

Christophi CA, Savvides EC, Warren CW, Demokritou P, Connolly GN. Main determinants of cigarette smoking in youth based on the 2006 Cyprus GYTS. Prev Med 2009;48(3):232-236.

Colby SM, Tiffany ST, Shiffman S, Niaura RS. Are adolescent smokers dependent on nicotine? A review of the evidence. Drug Alcohol Depend. 2000;59 Suppl 1:S83-S95.

Collins RL, Ellickson PL. Integrating four theories of adolescent smoking. Subst.Use Misuse 2004 Jan;39(2):179-209.

Conrad KM, Flay BR, Hill D. Why children start smoking cigarettes: predictors of onset. Br.J.Addict. 1992 12;87(12):1711-1724.

DiFranza JR, Savageau JA, Aisquith BF. Youth access to tobacco: the effects of age, gender, vending machine locks, and "it's the law" programs. Am J Public Health 1996;86(2):221-224.

DiFranza JR. Hooked from the first cigarette. J.Fam.Pract. 2007 Dec;56(12):1017-1022.

Doll R, Peto R, Boreham J, Sutherland I. Mortality in relation to smoking: 50 years' observations on male British doctors. BMJ 2004 Jun 26;328(7455):1519.

Eissenberg T, Balster RL. Initial tobacco use episodes in children and adolescents: current knowledge, future directions. Drug Alcohol Depend. 2000;59 Suppl 1:S41-S60.

Elton Marshall T, Leatherdale ST, Manske SR, Wong K, Ahmed R, Burkhalter R. Research methods of the Youth Smoking Survey (YSS). Chronic diseases and injuries in Canada 2011;32(1):47-54.

Engels RC, Knibbe RA, de Vries H, Drop MJ. Antecedents of smoking cessation among adolescents: who is motivated to change? Prev.Med. 1998;27(3):348-357.

Faulkner GEJ, Adlaf EM, Irving HM, Allison KR, Dwyer J. School Disconnectedness: Identifying Adolescents at Risk in Ontario, Canada. J Sch Health 2009;79(7):312.

Fisher KJ, Stanton WR, Lowe JB. Healthy behaviors, lifestyle, and reasons for quitting smoking among out-of-school youth. J Adolescent Health 1999;25(4):290-297.

Flay BR, Hu FB, Richardson J. Psychosocial predictors of different stages of cigarette smoking among high school students. Prev Med 1998 09/30;27(5):A9-18.

Flay BR, Snyder F, Petraitis J. The Theory of Triadic Influence. In: DiClemente RJ, Kegler MC, Crosby RA, editors. Emerging Theories in Health Promotion Practice and Research. 2nd ed.: Jossey-Bass; 2009. p. 451-495.

Flay BR. Youth tobacco use: Risk patterns and control. In: Slade J, Orleans CT, editors. Nicotine addiction: Principles and management New York: Oxford University Press; 1993. p. 653-661.

Ford KH, Diamond PM, Kelder SH, et al. Validation of scales measuring attitudes, self-efficacy, and intention related to smoking among middle school students. Psychol Addict Behav 2009;23(2):271-278.

Ford KH, Diamond PM, Kelder SH, Sterling KL, McAlister AL. Validation of scales measuring attitudes, self-efficacy, and intention related to smoking among middle school students. Psychol Addict Behav 2009 06;23(2):271-278.

Fritz DJ. Adolescent smoking cessation: how effective have we been? J.Pediatr.Nurs. 2000 Oct;15(5):299-306.

Greene, William H., Econometric Analysis, fifth edition, Prentice Hall, 1993: 720-723.

Grimshaw GM, Stanton A. Tobacco cessation interventions for young people. Cochrane database of systematic reviews 2006(4):CD003289-CD003289.

Hammond D. Smoking behaviour among young adults: beyond youth prevention. Tob.Control 2005 Jun;14(3):181-185.

Heale R, Griffin MT. Self-efficacy with application to adolescent smoking cessation: A concept analysis. J Adv Nurs 2009;65(4):912-918.

Health Canada. A National Strategy. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/ns-sn/index-eng.php. Accessed 11/25, 2009.

Health Canada. Canadian Tobacco Use Monitoring Survey: Annual results 2008. 2008; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_ctums-esutc_2008/ann_summary-sommaire-eng.php. Accessed 12/06, 2009.

Health Canada. Canadian Tobacco Use Monitoring Survey: data for 2007 (Cycle 1 – February to June). 2007; Available at: http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/ctums/index.html. Accessed 11/11, 2009.

Health Canada. Evaluation of the Quit4Life Youth Cessation Demonstration Project. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/quit-cesser-progeval/index-eng.php#a8. Accessed 07/15, 2012.

Health Canada. Federal Tobacco Control Strategy. 2009; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php. Accessed 11/25, 2009.

Health Canada. Summary of results for the 2006-07 Youth Smoking Survey. Tobacco Use Statistics. Ottawa, Ontario: Health Canada. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_survey-sondage_2006-2007/result-eng.php. Accessed 11/11, 2009.

Health Canada. Youth Smoking in Canada. 2007; Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/_ctums-esutc_fs-if/2000-youth-eng.php. Accessed 10/15, 2010.

Hill AJ, Boudreau F, Amyot E, Dery D, Godin G. Predicting the stages of smoking acquisition according to the theory of planned behavior. Journal of Adolescent Health 1997;21(2):107-115.

Hirschman R. The development of smoking behavior: conceptualization and supportive cross-sectional survey data. 1984;14:184.

Hooshmand S, Willoughby T, Good M. Does the direction of effects in the association between depressive symptoms and health-risk behaviors differ by behavior? A longitudinal study across the high school years. Journal of adolescent health 2012;50(2):140-147.

Hoving C, Reubsaet A, de Vries H. Predictors of smoking stage transitions for adolescent boys and girls. Prev Med 2007 Jun;44(6):485-489.

Jessor R, Jessor SL. Problem Behavior and Psychosocial Development. New York: Academic Press; 1977.

Joffe A, McNeely C, Colantuoni E, An M, Wang W, Scharfstein D. Evaluation of school-based smoking-cessation interventions for self-described adolescent smokers. Pediatrics 2009;124(2):e187-e194.

Karp I, O'Loughlin J, Paradis G, Hanley J, Difranza J. Smoking trajectories of adolescent novice smokers in a longitudinal study of tobacco use. Ann Epidemiol 2005 Jul;15(6):445-452.

Kaufman AR, Augustson EM. Predictors of regular cigarette smoking among adolescent females: does body image matter? Nicotine Tob Res 2008 Aug;10(8):1301-1309.

Kleinjan M, Engels RCME, van Leeuwe J, Brug J, van Zundert RMP, van den Eijnden,Regina J J M. Mechanisms of adolescent smoking cessation: roles of readiness to quit, nicotine dependence, and smoking of parents and peers. Drug Alcohol Depend 2009;99(1-3):204-214.

Koval JJ, Pederson LL, Chan SS. Psychosocial variables in a cohort of students in grades 8 and 11: a comparison of current and never smokers. Prev Med 2004 Nov;39(5):1017-1025.

Koval JJ, Pederson LL, Zhang X, Mowery P, McKenna M. Can young adult smoking status be predicted from concern about body weight and self-reported BMI among adolescents? Results from a ten-year cohort study. Nicotine Tob.Res. 2008 Sep;10(9):1449-1455.

Langille D, Curtis L, Hughes J, Murphy G. Association of socio-economic factors with health risk behaviours among high school students in rural Nova Scotia. Canadian Journal of Public Health 2003;94(6):442-447.

Laoye JA, Creswell WH, Stone DB. A cohort study of 1,205 secondary school smokers. J Sch Health 1972;42(1):47-52.

Leatherdale ST, Brown KS, Cameron R, McDonald PW. Social modeling in the school environment, student characteristics, and smoking susceptibility: a multi-level analysis. J.Adolesc.Health 2005 Oct;37(4):330-336.

Leatherdale ST, Cameron R, Brown KS, McDonald PW. Senior student smoking at school, student characteristics, and smoking onset among junior students: a multilevel analysis. Prev Med 2005 Jun;40(6):853-859.

Leatherdale ST, Manske S, Kroeker C. Sex differences in how older students influence younger student smoking behaviour. Addict Behav 2006 Aug;31(8):1308-1318.

Leatherdale ST, Manske S. The relationship between student smoking in the school environment and smoking onset in elementary school students. Cancer Epidemiol Biomarkers Prev 2005 Jul;14(7):1762-1765.

Leatherdale ST, McDonald PW, Cameron R, Brown KS. A multilevel analysis examining the relationship between social influences for smoking and smoking onset. Am.J.Health Behav. 2005 Nov-Dec;29(6):520-530.

Leatherdale ST, McDonald PW. What smoking cessation approaches will young smokers use? Addict.Behav. 2005 Sep;30(8):1614-1618.

Leatherdale ST, Wong SL, Manske SR, Colditz GA. Susceptibility to smoking and its association with physical activity, BMI, and weight concerns among youth. Nicotine Tob.Res. 2008 Mar;10(3):499-505.

Lloyd-Richardson E. Differentiating stages of smoking intensity among adolescents: Stage-specific psychological and social influences. J Consult Clin Psychol 2002;70(4):998.

Loewenthal KM. An introduction to psychological tests and scales. 1st ed. London: UCL Press Limited; 1996.

Macpherson L, Myers M. Examination of a Process Model of Adolescent Smoking Self-Change Efforts in Relation to Gender. Journal of child adolescent substance abuse 2009;19(1):48-65.

Marsh HW. Self-description Questionnaire, SDQ Manual. San Antonio: The Psychological Corporation 1998.

Mayhew KP, Flay BR, Mott JA. Stages in the development of adolescent smoking. Drug Alcohol Depend 2000 5/1;59 Suppl 1:61-81.

McGee R. A longitudinal study of reasons for smoking in adolescence. Addiction 1993;88(2):265.

McNeill A. The development of dependence on smoking in children. 1991;86:589.

Mermelstein R. Teen smoking cessation. Tob Control 2003 Jun;12 Suppl 1:i25-34.

Murnaghan DA, Leatherdale ST, Sihvonen M, Kekki P. A multilevel analysis examining the association between school-based smoking policies, prevention programs and youth smoking behavior: evaluating a provincial tobacco control strategy. Health Educ.Res. 2008;23(6):1016-1028.

Myers M, Macpherson L. Coping with temptations and adolescent smoking cessation: an initial investigation. Nicotine tobacco research 2009;11(8):940-944.

Norman CD, Maley O, Li X, Skinner HA. Using the internet to assist smoking prevention and cessation in schools: a randomized, controlled trial. Health Psychol. 2008 Nov;27(6):799-810.

O'Brien R. A Caution Regarding Rules of Thumb for Variance Inflation Factors. Qual Quant 2007;41:673-690.

O'Loughlin J, Gervais A, Dugas E, Meshefedjian G. Milestones in the process of cessation among novice adolescent smokers. Am.J.Public Health 2009 Mar;99(3):499-504.

Orleans CT, Arkin E, Backinger C, Best A, Crossett L, Grossman D, et al. Youth Tobacco Cessation Collaborative and National Blueprint for Action. Am.J.Health Behav. 2003;27 Suppl 2:S103-S119.

O'Rourke T, Nolte AE, Smith BJ. Improving anti-smoking education: profiling the ex-smoker. J Drug Educ 1985;15(1):7-22.

Otten R, Bricker J B, Liu J, Comstock B A, Peterson A V. Adolescent psychological and social predictors of young adult smoking acquisition and cessation: A 10-year longitudinal study. Health psychology 2011;30(2):163-170.

Paavola M, Vartiainen E, Puska P. Smoking cessation between teenage years and adulthood. Health Educ Res 2001;16(1):49-57.

Pallonen UE, Prochaska JO, Velicer WF, Prokhorov AV, Smith NF. Stages of acquisition and cessation for adolescent smoking: An empirical integration. Addict.Behav. 1998 05;23(3):303-324.

Peters EN, Hughes JR, Callas PW, Solomon LJ. Goals indicate motivation to quit smoking. Addiction 2007 Jul;102(7):1158-1163.

Petraitis J, Flay BR, Miller TQ. Reviewing theories of adolescent substance use: Organizing pieces in the puzzle. Psychol Bull 1995 01;117(1):67-86.

Pierce JP, Gilpin E. How long will today's new adolescent smoker be addicted to cigarettes? Am J Public Health 1996;86(2):253-256.

Pinilla J, Gonzlez B, Barber P, Santana Y. Smoking in young adolescents: an approach with multilevel discrete choice models. J Epidemiol Community Health 2002;56(3):227-232.

Pirie PL, Murray DM, Luepker RV. Gender differences in cigarette smoking and quitting in a cohort of young adults. Am J Public Health 1991;81(3):324-327.

Positive Action I. Positive Action: Positive development for schools, families and communities, Theoretical basis. 2012; Available at: http://www.positiveaction.net/research/index.asp?ID1=3andID2=67. Accessed 03/12, 2012.

Prokhorov A, de Moor C, Hudmon K, Hu S, Kelder S, Gritz E. Predicting initiation of smoking in adolescents: evidence for integrating the stages of change and susceptibility to smoking constructs. Addict.Behav. 2002;27(5):697-712.

Propel Centre for Population Health Impact. Youth Smoking Survey 2008-2009 Microdata User Guide. 2009.

Propel Centre for Population Health Impact. Youth Smoking Survey. 2010; Available at: www.yss.uwaterloo.ca. Accessed 09/01, 2010.

Rasmussen M, Damsgaard M, Holstein B, Poulsen L, Due P. School connectedness and daily smoking among boys and girls: the influence of parental smoking norms. Eur J Public Health 2005;15(6):607.

Resnick MD, Bearman PS, Blum RW, Bauman KE, Harris KM, Jones J, Tabor J, et al. Protecting adolescents from harm. Findings from the National Longitudinal Study on Adolescent Health. JAMA. 1997;278(10):823-832.

Reynolds C. Personality and behavioral correlates of cigarette smoking: one-year follow-up. Psychol.Rep. 1976;38(1):251.

Riedel BW, Robinson LA, Klesges RC, McLain-Allen B. What motivates adolescent smokers to make a quit attempt? Drug Alcohol Depend. 2002 Oct 1;68(2):167-174.

Robins, JM, Greenland, S. Identifiability and exchangeability for direct and indirect effects. Epidemiology. 1992:3(2):143–55.

Rojas NL, Killen JD, Haydel KF, Robinson TN. Nicotine dependence among adolescent smokers. Archives of pediatrics adolescent medicine 1998;152(2):151.

Rose JS, Chassin L, Presson CC, Sherman SJ. Prospective predictors of quit attempts and smoking cessation in young adults. Health Psychol 1996 Jul;15(4):261-268.

Sargent JD, Dalton M. Does parental disapproval of smoking prevent adolescents from becoming established smokers? Pediatrics 2001;108(6):1256-1262.

Sargent JD, Mott LA, Stevens M. Predictors of smoking cessation in adolescents. Archives of pediatrics adolescent medicine 1998;152(4):388-393.

Shah CP. Public Health and Preventive Medicine in Canada. http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/about-apropos/role/federal/strateg-eng.php ed. Toronto, Ontario: Elsevier Saunders; 2003.

Skinner WF, Massey JL, Krohn MD, Lauer RM. Social influences and constraints on the initiation and cessation of adolescent tobacco use. J.Behav.Med. 1985 12/01;8(4):353-376.

Sowden AJ, Stead LF. Community interventions for preventing smoking in young people. 2003(1).

Stanton WR, Lowe JB, Gillespie AM. Adolescents' experiences of smoking cessation. Drug Alcohol Depend. 1996;43(1-2):63-70.

Stanton WR. DSM-III-R tobacco dependence and quitting during late adolescence. Addict Behav 1995;20(5):595-603.

StataCorp. 2009. Stata Statistical Software: Release 12. College Station, TX: StataCorp LP.

Stone SL, Kristeller JL. Attitudes of adolescents toward smoking cessation. Am J Prev Med 1992;8(4):221-225.

Sussman S, Dent CW, Nezami E, Stacy AW, Burton D, Flay BR. Reasons for quitting and smoking temptation among adolescent smokers: gender differences. Subst Use Misuse 1998;33(14):2703-2720.

Sussman S, Dent CW, Severson H, Burton D, Flay BR. Self-initiated quitting among adolescent smokers. Prev Med 1998 09/30;27(5):A19-28.

Sussman S, Sun P. Youth tobacco use cessation: 2008 update. Tobacco induced diseases 2009;5:3-3.

Sussman S. Effects of sixty six adolescent tobacco use cessation trials and seventeen prospective studies of self-initiated quitting. Tob Induc Dis. 2002 Jan 15;1(1):35-81.

Thomas R, Perera R. School-based programmes for preventing smoking. The Cochrane database of systematic reviews 2006;3:CD001293-CD001293.

Todd QM, Robert JV. Family relationships and adolescent cigarette smoking: Results from a national longitudinal survey. Journal of Drug Issues; Tallahassee 2002 06/01;32(3):945-972.

Turner K, Gordon J, Young R. Cigarette access and pupil smoking rates: a circular relationship? Health Promot Internation 2004;19(4):428-436.

Turner LR, Veldhuis CB, Mermelstein R. Adolescent smoking: are infrequent and occasional smokers ready to quit? Subst Use Misuse 2005;40(8):1127-1137.

Tyc VL, Hadley W, Allen D, Varnell S, Ey S, Rai SN, et al. Predictors of smoking intentions and smoking status among nonsmoking and smoking adolescents. Addict Behav 2004 Aug;29(6):1143-1147.

U.S. Department of Health and Human Services. Preventing tobacco use among young people: A report of the Surgeon General. 1994.

Van De Ven M, Greenwood P, Engels R, Olsson C, Patton G. Patterns of adolescent smoking and later nicotine dependence in young adults: a 10-year prospective study. Public Health 2010;124(2):65-70.

Van Zundert RMP, Nijhof LM, Engels RCME. Testing Social Cognitive Theory as a theoretical framework to predict smoking relapse among daily smoking adolescents. Addict.Behav. 2009 3;34(3):281-286.

Winter AL, de Guia NA, Ferrence R, Cohen JE. The relationship between body weight perceptions, weight control behaviours and smoking status among adolescents. Can J Public Health 2002 Sep-Oct;93(5):362-365.

Woodruff SI, Lee J, Conway TL. Smoking and quitting history correlates of readiness to quit in multiethnic adolescents. Am.J.Health Behav. 2006 Nov-Dec;30(6):663-674.

Zhu SH, Sun J, Billings SC, Choi WS, Malarcher A. Predictors of smoking cessation in U.S. adolescents. Am J Prev Med 1999;16(3):202-207.