ENHANCING THE EFFECTIVENESS OF SCHOOL-BASED SUBSTANCE USE PREVENTION PROGRAMS: DOES SCHOOL-CONNECTEDNESS PLAY A ROLE?

by

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DEDICATION

I dedicate this work to the souls of two wonderful human beings;

Neither of whom have received a formal education;
But both of whom have paved, through dedication and prioritization, a road for their children, and therefore, their grandchildren, to attain the highest levels of education.

My late grandmothers -
Fatma Seraaj Jamal (1927 – 2000)
Hafiza Mohammad Sadiq (1921 – 2014)

May every achievement attained be marked as a blooming flower in the gardens in which your souls rest.

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ABSTRACT

Substance use and misuse among adolescents remains a major public health concern in Canada. Numerous programs have been developed with the aim of educating young people about abstinence from substance use, reducing harms, and helping them acquire the skills necessary to resist environmental influences such as peer pressure. Many of these programs are based in schools; a feasible and appropriate setting to reach young people. Research evaluating the effectiveness of these programs has shown inconsistent results. An opportunity to enhance the influence of school-based programs seems necessary. One area of interest is the degree to which educational programs might be influenced by the level of attachment and connectedness that students feel to their school environment. The primary aim of this study was to examine whether higher levels of school connectedness are associated with better receptivity of school-based alcohol and drug educational programs, and lower levels of substance use, misuse and problems.

Data was employed from the 2012 Student Drug Use Survey in the Atlantic Provinces (SDUSAP), a cross-sectional survey from three Atlantic Provinces (Newfoundland and Labrador, New Brunswick, and Nova Scotia). The total sample included in the study was 6,786 high school students (in grade 9 and above). The SDUSAP includes a well-validated measure of student feelings of connectedness to their school environment. Unadjusted and adjusted regression models were performed to examine the association between exposure to school-based substance use education programs and levels of substance use, misuse, and problems associated with use. Stratification by levels of school connectedness (low vs. high) to reexamine the association of drug education and substance use outcomes was performed. In addition, the association between levels of school connectedness and measures of substance use were assessed. Known confounders, including age, maternal education, family's socioeconomic status, peer substance use, parental connectedness, and religiosity, were all adjusted for in the analysis. Models accounted for the complex, stratified sampling design of the SDUSAP.

The results of this study reveal four major findings. First, in terms of descriptive statistics, substance use is prevalent among high school students, in grade 9 and above, in the Atlantic Provinces of Canada. Almost half (49.4%) of the students indicate that they have used alcohol and 22.6% indicate that they have used cannabis in the past month, while around 11% report that they have used other illicit drugs in the past year. Just below two thirds (62.1%) of students received at least one class on substance use prevention education during their school year, and less than half of the students (42%) reported a high level of school connectedness. Second, after adjusting for socio-demographic factors, age, sex, school connectedness, parental connectedness, religiosity, and peer use of cannabis, students who are exposed to these substance use prevention education classes do not have a significant decrease in their risk of using alcohol, cannabis, or other illicit drugs. They also do not have a significant decrease in the incidence rate of problems associated with substance use.

Third, stratifying for school connectedness showed a picture opposite to what was expected for alcohol use, and no additional benefits for drug use. Specifically, among students with *low* levels of school connectedness, those who are exposed to three or more prevention education classes (compared to no exposure) have a significant decrease in the risk of binge drinking compared to no use (RRR= 0.55, 95% CI 0.38 – 0.79), and binge drinking compared to moderate use (RRR= 0.65, 95% CI 0.44-0.97). On the other hand, students with high levels of school connectedness who are exposed to 3 or more classes (compared to no exposure) have a significant increase in the risk of binge drinking compared to only the moderate use of alcohol (RRR= 1.69, 95% CI 1.10 – 2.63). However, for cannabis and other illicit drug use, and for the incidence of problems associated with alcohol and drug use, stratifying for school connectedness did not reveal any significant associations between exposure to classes and these outcomes. The fourth and final major finding from this study is that school connectedness and parental connectedness both have a negative association with levels of cannabis use, other illicit drug use, as well as the incidence of problems associated with both alcohol and drug use. However, a high level of school connectedness is associated with a significant increase in the risk of alcohol use and binge drinking.

In conclusion, among high school students in the Atlantic provinces of Canada school-based substance use prevention education classes do not seem to significantly decrease the risk of substance use. In addition, students with high levels of school connectedness are not more likely to gain benefit from these classes. However, the limitations of cross-sectional data analysis must still be taken into consideration when interpreting the results. In terms of the implications, stakeholders addressing substance use among adolescents from a preventive lens may need to incorporate goals that go beyond the traditional aims of school-based substance use prevention programs, such as improving school connectedness and parental connectedness, among other things, as key outcomes of their prevention programs and efforts. Improving school connectedness, per se, may also be a promising approach to consider, away from substance use prevention education. Future possible avenues of research are also suggested.

LIST OF ABBREVIATIONS USED

SDUSAP	Student Drug Use Survey in the Atlantic Provinces
HBSC	The Health Behavior in School-Aged Children Survey
YSS	Youth Smoking Survey
CCSA	Canadian Center on Substance Abuse
BC	British Columbia
AB	Alberta
MB	Manitoba
ON	Ontario
NB	New Brunswick
PEI	Prince Edward Island
NS	Nova Scotia
NL	Newfoundland and Labrador
LSD	Lysergic acid diethylamide
MDMA	3,4-methylenedioxy-methamphetamine
HIV	Human Immunodeficiency Virus
US	United States
DARE	Drug Abuse Resistance Education
CDC	Center for Disease Control and Prevention
HRSB	Halifax Regional School Board
SES	Socioeconomic status
RRR	Relative risk ratio
OR	Odds ratio
IRR	Incidence rate ratio
CI	Confidence interval

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CHAPTER 1: INTRODUCTION

Substance use among young people remains a major public health concern in Canada. Across provinces, past year use of alcohol is reported by between 46.3% and 61.8% of middle and high school students, and 19.3% to 29.7% of students reported binge drinking (i.e. drinking 5 or more drinks of alcohol on a single occasion) in the past month.(1) While these rates do not differ between males and females, the proportion increases as students get older. In the Atlantic Provinces, 48% of students reported past year use of alcohol. (2) Cannabis use is also of major concern. Nationwide, between 16.7-32.4% of students reported using cannabis in the past year, with the percentage of students reporting using cannabis daily or almost daily over the past month ranging between 2.2-5.3% across provinces.(1) In the Atlantic Provinces, around 18% of students, reported using cannabis at least once in the previous month, and 5.7% reported daily use. (2) The Health Behavior in School-Aged Children Survey (HBSC), which produced an international report based on data collected in collaboration with the World Health Organization, showed that at rates of 33% reporting lifetime use of cannabis, and 18% reporting past 30 days use of cannabis in the years 2009/2010, Canada had the highest rates of cannabis use among 15 year olds of all 44 countries across Europe and North America that were involved in the survey.(3) Similarly, researchers who compared substance use among youth in six countries found that Canada is one of the leading countries in rates of alcohol, cannabis and other drugs use.(4) In addition to cannabis, Canadian youth are using other illicit drugs. National reports showed that past month use ranged between 3.4-7.2% for ecstasy, between 2.9-5.3% for cocaine or crack, and between 2.2-4.6% for inhalants.(1) A smaller proportion of students also reported use of other drugs.(1)

Substance misuse, and not use per se, is also an important issue among Canadian youth. Although alcohol use among Canadian youth is comparable to many countries in Europe and other countries in North America, the HBSC report indicates that Canadian youth were among those with highest rate of first drunkenness at age 13

or younger. (3) Similarly, the Youth Smoking Survey (YSS), a nationwide survey in Canada, indicates that around 21% of students were found to be at high risk of substance misuse, and that this risk was significantly higher among students in grades 10 to 12 (33%) compared to those in grades 7 to 9 (10%).(5) The regular use of marijuana in adolescence has been association with serious detrimental health outcomes including poor academic achievement, higher rates of injuries, addiction, risky sexual behavior, paranoia, and psychosis with the use of marijuana in high doses, among other things. (6, 7) Also, excessive alcohol use is associated with a myriad of detrimental short and long term health outcomes including injuries, cancer, depression and anxiety.(8) Substance misuse does not only affect the user on an individual level, but also has detrimental effects on society. (8-10) Moreover, a substantial burden on the economy arises from substance misuse. In 2002, the estimated direct and indirect costs of alcohol and illicit drug use in Canada were $14.6 billion and $8.2 billion, respectively. (11)

Numerous programs have been developed with the aim of educating young people about abstinence from substance use, reducing harms, and helping them acquire the skills necessary to resist environmental influences. (12-15) Many of these programs are based in schools; a feasible and appropriate setting to reach young people. Research evaluating the effectiveness of these programs has shown inconsistent results. (12, 13, 15, 16) Researchers are unable to identify common characteristics that differentiate effective programs from those that do not show positive results. Those that use a combined approach of social competence and social influence seem to provide better results, but the effect is small nonetheless. (13) An opportunity to enhance the influence of school-based programs seems necessary. One area of interest is the degree to which educational programs might be influenced by the level of attachment and connectedness that students feel to their school environment.

School connectedness is a construct that seeks to explain the extent of adolescents' sense of belonging to their schools. (17) Across its different definitions and

measurement tools, school connectedness has repeatedly shown to be a protective factor against a range of negative outcomes among students, including risky sexual behavior (18, 19), depression (20), susceptibility to smoking (21), and drug use and misuse (18, 19, 22, 23). Despite the presence of an association between higher levels of school connectedness and lower rates of substance use, not many studies have taken the role of school connectedness into account as a potential effect modifier in the relationship between school-based substance use prevention programs and levels of substance use (14, 15).

Students who feel more connected to their schools may be more likely to actively engage in substance use prevention programs, with a higher willingness to participate in activities and a higher chance of accepting the relayed messages. As evidence suggests, more student involvement in these prevention programs, compared to passive reception of education, results in better outcomes and lower levels of substance use (15, 16). Hence, school connectedness may facilitate the effectiveness of school-based substance use prevention programs. As such, evidence showing increased receptivity to school-based substance-use prevention programs among youth with higher levels of school connectedness may point towards a promising opportunity to increase the effectiveness of such programs in schools. The primary aim of this thesis is to employ data from the 2012 Student Drug Use Survey in the Atlantic Provinces (SDUSAP)(2) , which is a cross-sectional survey of junior and senior high school students (ages 11-19) from three Atlantic Provinces (Newfoundland and Labrador, New Brunswick, and Nova Scotia), with a well-validated measure of student feelings of connectedness to their school environment, to determine whether the association between school-based substance use prevention programs and levels of substance use (namely drugs and alcohol) is modified by levels of school connectedness.

CHAPTER 2: LITERATURE REVIEW

2.1 NATIONAL PREVALENCE OF SUBSTANCE USE AMONG YOUTH IN CANADA

In this section I will provide an overview of the overall substance use habits among Canadian youth, as reported by multiple national surveys. The focus will then shift to the trends in substance use among youth in the Atlantic Provinces of Canada.

2.1.1 Alcohol use among Junior and Senior High School students (12-18 year olds) in Canada

Based on data from the Cross-Canada Report on Student Alcohol and Drug Use, a compilation of student drug use surveys in 2007-2008 from provinces across Canada, which is presented by the Canadian Center on Substance Abuse (CCSA) (1), among students 12-18 years old, between 51.6% and 70.0% reported consuming alcohol at least once *during their lifetime.* There are no differences between males and females, with an increase in reporting lifetime alcohol consumption among older students. Among students in grade 12, 77.3% to 91.0% of students reported lifetime consumption compared to only 18.1% to 34.7% of grade 7 students. *Alcohol consumption during the past year* was reported by a smaller percentage of students (46.3-61.8%). Similar to reports on lifetime consumption, the use of alcohol over the past year was reported by a significantly larger proportion of grade 12 students (75.1-83.0%) compared to grade 7 students (8.4-28.1%). A range of 19.3% to 29.7% of students reported *binge drinking* (i.e. drinking 5 or more drinks of alcohol on a single occasion) in the past month. Similar to lifetime and past-year use, no significant differences between males and females were observed. However, a much smaller proportion of younger students engaged in binge drinking. Only between 3.1% and 4.4% of grade 7 students reported binge drinking during the past month compared to around half of grade 12 students (41.1-55.1%).

Similar trends for alcohol use among students of the same age group are reported by the 2012-2013 Youth Smoking Survey (YSS). (5) The YSS is a Canadian national survey that is administered every second year and collects data on tobacco use as

well as alcohol and drug use for students in grades 7-12. In the years 2012-2013, the prevalence of alcohol use during the past month was 41%, which is slightly lower than that reported by the CCSA in 2011. However, 29% of students reported drinking five or more drinks in one occasion, which is at the upper limit of the proportion reported by the CCSA.

Trends in alcohol consumption among Canadian youth are comparable to those from other developed countries. Findings from the Health Behavior in School Aged Children Survey (HBSC) by the World Health Organization (3) showed that between 10% and 25% of 15 year olds in Europe drink alcohol at least once a week. Unlike findings from Canada, some countries in the HBSC reported higher rates of alcohol consumption among young boys. However, these findings were not consistent across all countries as many countries showed similar trends between boys and girls. The HBSC also indicated that the same trend of increased alcohol consumption with increasing age that is seen in Canadian youth was also found in European youth for both males and females.

2.1.2 Cannabis use among Junior and Senior High School students (12-18 year olds) in Canada

Based on the CCSA, the proportion of students who reported having used cannabis *in their lifetime* is between 20.9% and 36.8%. Overall, more males than females reported lifetime use but this was not statistically significant. Similar to alcohol use, the prevalence of lifetime use of cannabis increases with grade level. Only 3.1% to 6.5% of grade 7 students report lifetime use of cannabis compared to almost half of students in grade 12 (39.8-62.6%). *The use of cannabis over the past year* was reported by 16.7% to 32.4% of students. No differences were seen between males and females in all provinces in the CCSA; however, the 2012-2013 YSS found that a significantly larger proportion of males (30.0%) reported using cannabis during the past year compared to females (23.5%). The CCSA also indicates that the prevalence of past-year use of cannabis was higher among grade 12 students (30.3-53.1%) compared to grade 7 students (2.5-5.6%). *Past-month use of cannabis* was reported

by 9.2% to 17.1% of students. Compared to females, a larger proportion of males reported past-month use of cannabis in all provinces, but the difference was statistically significant in only two provinces, which are British Columbia and Prince Edward Island. Students in grade 7 had the lowest prevalence of cannabis use in the past month (1.3-3.4%) and this increased with an increase in grade. Of students in grade 12, 14.9% to 26.8% reported having used cannabis in the past month. The percentage of students reporting using cannabis daily or almost daily over the past month ranged between 2.2% to 5.3% across provinces. The proportion of males using cannabis daily or almost daily over the past month was significantly higher than females in four provinces: British Columbia, New Brunswick, Nova Scotia and Newfoundland and Labrador.

The 2012-2013 YSS indicates that in those years, 19% of Canadian students reported using cannabis in the past 12 months. This is within the range reported by the CCSA, but closer to the lower limit. Similarly, the 2012-2013 YSS indicated a decline from the 2008-2009 prevalence of cannabis use in the past 12 months, which was 27%. Synthetic cannabis use, which refers to plants coated with synthetic materials that have the same effect as the psychoactive chemical in cannabis, was reported by 1% of students.

2.1.3 Other illicit drugs use and risk of substance misuse among Junior and Senior High School Students (12-18 year olds) in Canada
In the CCSA, provincial surveys either asked about lifetime use of other drugs (BC, AB, MB and ON) or use in the past 12 months (NB, PEI, NS, and NL). The drug most commonly used after cannabis was ecstasy, with lifetime use having been reported by a range between 4.4% to 7.1% of students. Following ecstasy, inhalants were most commonly used with 2.2% to 3.8% of students having reported lifetime use. The proportion of students who reported cocaine or crack use in the past 12 months is between 2.9% and 5.3%. Estimates for lifetime use of heroin use are between 0.8-1.3%. Estimates for steroid use ranged between 1.4% and 1.7% in the past 12 months.

The 2012-2013 YSS indicates that 3% of students reported ecstasy use in the past 12 months, which is closer to the lower end of the range reported by the CCSA in 2011. Salvia use in the past 12 months was reported by 2% of students, with a higher prevalence among males (3%) compared to females (1%). The use of other drugs such as the synthetic stimulants named "BZP" and "TFMPP" which are derived from piperazine, and "bath salts" which are related to cathinone, were reported by 1% of students in the 2012-2013 YSS. The 2012-2013 YSS also indicated that following alcohol and cannabis use, the use of psychoactive pharmaceuticals to get high was the most prevalent among Canadian youth. The use of at least one prescription psychoactive pharmaceutical (i.e., stimulants, tranquilizers/sedatives, or pain relievers) to get high was reported by 4% of students. Over the counter pharmaceutical use to get high (i.e., sleeping medication and dextromethorphan) was reported by 3% of students.

Substance abuse, and not just use per se, and related risky behaviors seem to also be prevalent among Canadian students. To determine the proportion of students who were at high risk of problem substance use, abuse or dependence, the 2012-2013 YSS incorporated the CRAFFT screening tool (24). Around 21% of students were found to be at high risk of substance abuse. This risk was significantly higher among students in grades 10 to 12 (33%) compared to those in grades 7 to 9 (10%). In addition, based on the CCSA, the national 2007-2008 average of students who reported driving a motor vehicle after drinking alcohol in the past year ranged between 5.3% and 7.5%. The range was highest for grade 12 students, where between 1 in 10 (11.1%) and 1 in 5 (20.0%) of students reported driving a motor vehicle after drinking alcohol. Similarly, between 5.3% and 7.0% of students reported lifetime driving after using cannabis. Again, grade 12 students had the highest rate of reporting having driven a motor vehicle under the influence of cannabis, as this ranged between 13.6% and 21.0% of students.

2.1.4 Alcohol and drug use among Canadian Junior and Senior High School Students in the Atlantic provinces of Canada

Based on the 2012 Student Drug Use Survey in the Atlantic Provinces (SDUSAP) (2), which reported rates of alcohol and drug use of a representative sample of students in grade 7,9,10 and 12 from Nova Scotia, New Brunswick and Newfoundland & Labrador, the most commonly used substances among students in the past 12 months were alcohol (48%) followed by cannabis (31.1%) and cigarettes (13.9%). The average age that students began drinking alcohol was 13.4 years. Around 27% of students reported using alcohol more than once per month, and about one in four students reported binge drinking in the past month. Moreover, about 18% of students in the Atlantic region reported using cannabis at least once in the previous month, and 5.7% reported daily use. Male and female students were equally likely to report past month use of cannabis. These rates are slightly higher than the national rates reported by the CCSA in 2011, in which the rate of students reporting cannabis use in the past month ranged between 9.2% and 17.1%, and between 2.2% and 5.3% of students reported daily or almost daily use of cannabis(1).

Similarly, 38% of students in grades 7, 9, 10 and 12 in the Atlantic Provinces reported use of any illicit drugs in the past year. This was defined as any use of the following substances in the past year: cannabis, inhalants, LSD, cocaine, MDMA, methamphetamine, psilocybin or mescaline, and non-medical use of cough syrup, tranquilizers, stimulants and opiates. No differences between male and female students in rates of use were seen, but the proportion of students using illicit drugs increased significantly by grade level. About 13.1% of grade 7 students reported illicit drug use in the past year, while 55% of grade 12 students did so. The non-medical use of pain relief medications (e.g., codeine, Oxycontin, Tylenol #3, Percodan, Percocet, and Demerol) was reported by 10.8% of students. Similar to illicit drug use, there were no differences between male and female students, but the prevalence of use increased with grade.

The SDUSAP also indicated that the most common patterns of substance use by individual students were alcohol alone, then alcohol and cannabis, followed by alcohol, cannabis and cigarettes. Patterns of use varied by province: the use of alcohol only was highest in New Brunswick; the use of alcohol and cannabis was highest in Nova Scotia; and the use of alcohol, cannabis and cigarettes was higher in Newfoundland & Labrador.

Important trends were highlighted from data collected over 18 years in the last 6 iterations of the SDUSAP. Across all three provinces, alcohol use, cannabis use, and tranquilizer use have remained constant. However, between 2002 and 2012, cigarette use and psilocybin or mescaline use have significantly decreased across the three provinces, and LSD and inhalant use have also fallen from 1998 to 2012. On the other hand, methamphetamine use has significantly increased in New Brunswick and slightly increased in Nova Scotia since 2007. However, in Newfoundland & Labrador, its use has slightly decreased. Cocaine use has slightly increased between 1996 and 2012 in Nova Scotia and Newfoundland & Labrador, and has slightly decreased in New Brunswick. Finally, between 2007 and 2012, MDMA use has slightly decreased in all three provinces.

2.2 CONSEQUENCES OF SUBSTANCE USE AND MISUSE

This section will discuss the consequences of alcohol and illicit drug use, which includes direct health impacts on both physical and mental health and indirect consequences that impact society as a whole and the economy. The health consequences of substance use can be immediate after excessive use and intoxication, and they can be more chronic with long-term use. Societal consequences involve abuse of family members, as well as deteriorating prosperity and chances of success in life. The impact on the economy takes the form of direct costs related to health care and law enforcement, and indirect costs related to losses in productivity arising from long and short term disability, as well as premature death.

2.2.1 The impact of alcohol use and misuse on health, society and the economy

Evidence indicates that there are many negative consequences on health from the excessive and long-term use of alcohol. It is estimated that 3.8% of all global deaths and 4.6% of global disability adjusted life years are attributable to alcohol use.(25) The long term health risks of excessive alcohol consumption include the development of serious health conditions including high blood pressure, cardiovascular disease, stroke, digestive problems and liver problems (8, 26-31); cancers including breast cancer, oral cancer, esophageal cancer, hepatocellular carcinoma and colorectal cancer (8, 32); dementia and learning and memory problems leading to poor school performance (8); depression and anxiety (8, 33); and alcoholism and alcohol dependence(8). Short term effects of the excessive use of alcohol include injuries like motor vehicle crashes, falls and drowning (8, 34); risky sexual behavior increasing the risk of acquiring or spreading sexually transmitted diseases including human immunodeficiency virus (HIV)(35, 36); alcohol poisoning(37); and among pregnant women, miscarriage, fetal alcohol spectrum disorders, and stillbirth(8, 35, 38, 39).

In addition to individual health risks, excessive alcohol consumption, over the long term, can lead to family problems, lost productivity and unemployment. (8-10) Moreover, excessive alcohol use and binge drinking can lead to violence including suicide, homicide, violence towards a partner and sexual assault. (8, 34, 40-42) Globally, the economic impact of alcohol use and misuse is also large. It is estimated that over 1% of the gross national product in high and middle-income countries are costs associated with alcohol, with social harm costs underlying a large proportion of the cost in addition to health costs.(25) Similarly, significant costs related to alcohol misuse impact the Canadian economy. In 2002, the per capita cost of substance abuse was $1,267, of which $463 were costs directly related to alcohol abuse. (11) In the same year, the overall economic costs related to alcohol abuse in Canada were estimated at $14.5 billion, of which $3.3 billion were direct costs related to health care, $3 billion were direct costs related to law enforcement, and $7 billion related to indirect costs resulting from productivity losses.(11) Other

costs arose from direct expenses related to prevention, research, fire and traffic damages, among other things. (11)

2.2.2 The impact of illicit drug use and misuse on health, society and the economy

Cannabis, the most frequently used illicit drug, has been associated with serious detrimental health outcomes.(6, 7) The effects of marijuana use can be categorized into consequences of short-term use and consequences of long-term or heavy use.(6) Effects of short-term use include deteriorated abilities to learn and retain information due to impaired short-term memory; increased risk of injury due to impaired motor coordination; altered judgment increasing risky sexual behavior; and paranoia and psychosis with the use of cannabis in high doses.(6) The consequences of long-term or heavy use of cannabis include addiction, poor academic outcomes including the increased risk of dropping out of school, cognitive impairment, and lower levels of life satisfaction and achievement compared to the general population. Of particular concern are research findings indicating that these effects are more strongly associated with initiation of marijuana use in early adolescence.(6) For example, of heavy and long-term users, 17% of those who began use in adolescence became addicted compared to only 9% of users overall. In addition, 25% to 50% of those who use cannabis daily develop an addiction. Also, lower IQ was strongly associated with long term and heavy users of marijuana who were frequent users during adolescence(6).

The immediate effects of cannabis use are also of importance. During intoxication, adolescents may be at risk of poor memory and perception, and poor motor function and coordination. In addition, repeated use of cannabis during adolescence can have serious and lasting changes on the brain, which may negatively affect achievements in the social, education and professional life.(6) Volkow et al. have shown that based on current evidence, the level of confidence is high for strength of association between marijuana use and the following health and well-being outcomes: addiction, diminished lifetime achievement, and motor vehicle crashes. (6)

From a social perspective, a longitudinal study from New Zealand has shown that use of cannabis between the ages of 14 to 25 is associated with higher levels of unemployment, higher levels of welfare dependence, lower income at age 25, lower educational degree attainment by age 25, lower levels of relationship satisfaction and lower levels of life satisfaction.(7) Moreover, illicit drug use creates a toll on economies. In the United States, the National Drug Intelligence Center estimated that the economic costs of illicit drug use in 2007 were $193 billion. These costs were due to health expenditures ($11 billion), crime ($61 billion) and lost productivity ($120 billion). (43) The estimated cost of illicit drug use in Canada is lower than that reported for the United States, but the cost is significant nonetheless. It is estimated that in 2002, the overall costs of illicit drug use were $8.2 billion. Around $1 billion were direct costs related to health care, $2.3 billion direct costs related to law enforcement, and $4.6 billion were indirect costs related to productivity losses. (11)

2.3 SCHOOL-BASED SUBSTANCE USE PREVENTION PROGRAMS

Many school-based substance use prevention programs have been developed with the aim of preventing and decreasing substance use among adolescents. However, many of these programs have not shown positive impacts. This section will give an example of a popular and widespread US based school drug use prevention program that is largely ineffective, then it will move on to discuss the state of the literature on the effectiveness of school-based drug and alcohol prevention programs, and what the characteristics of effective programs are. In addition, an overview of the school-based substance use prevention education given to students in the provinces of Nova Scotia, New Brunswick and Newfoundland and Labrador is presented.

2.3.1 The Drug Abuse Resistance Education (DARE) program; a largely popular largely ineffective program that has reached millions of children.

A specific example of a popular school-based substance abuse prevention program is the Drug Abuse Resistance Education (DARE) program, which has reached

millions of young people in the United States and around the world. Through its interactive school-based curriculum, which is taught by trained police officers, the program educates students about the dangers of drug use and aims to increase the number of students who decide not to use drugs. The program was first established in the United States in 1983 by joint efforts between the Los Angeles Police Department and a school district in Los Angeles. Police officers are expected to deliver 45 to 60 minute sessions once a week for a few months. According to the program's website, DARE is an extremely popular program with a presence in 75% of US school districts and over 40 countries. By 2007, more than 36 million children in the US and around the world received the program.(44) Despite its popularity and the amount of resources put into place for the program, its impact seems minimal. A meta analysis that was performed by Pan and Bai in 2009 analyzed 20 studies that assessed the effectiveness of the DARE program and showed that very minimal overall effect was seen on the levels of students' drug use across studies. (45)

2.3.2 What makes school-based substance use prevention programs effective?
Foxcroft and Tsertsvadze assessed the effectiveness of universal school-based prevention programs for alcohol misuse compared to no program through reviewing 53 randomized trials, most of which were cluster-randomized trials.(12) Types of substance use prevention programs in schools vary in scope and approach. Universal programs are delivered to an entire population within a specific setting without risk classification.(46) The risk may vary among sub-groups but the program addresses all members as sharing an overall general risk. The goal of universal programs is to delay or deter the onset of a problem by giving everyone the information and skills that are important to prevent the problem.(46) Universal alcohol prevention programs can either be specific (i.e. specifically targeting prevention or reduction of alcohol misuse) or generic (i.e. programs addressing the prevention of multiple aspects, for example: alcohol, other drug use/abuse, and antisocial behavior). When universal programs are delivered in a school setting, they are typically presented as programs on alcohol awareness and education,

normative feedback, social and peer resistance skills, or development of behavioral norms and positive peer affiliation.(12) They can be either school lessons (i.e. curricula) or classroom behavior management programs(12). In their Cochrane review, Foxcroft & Tsertsvadze found inconsistent results for both the specific and generic programs, and they were unable to recognize consistent characteristics that differentiated effective programs from those that did not show positive results.(12) However, they concluded that certain prevention programs with psychosocial and developmental focuses (e.g., teaching life and social skills, behavior norms, and peer affiliation) can be effective. More information about the types of programs reviewed by Foxcroft & Tsertsvadze, and the results found can be found in Appendix A.

Similar to findings on alcohol misuse prevention programs, drug use prevention programs show a weak impact and inconsistent results. In a recent Cochrane review, Faggiano et al. reviewed the effectiveness of school-based programs to prevent illicit drug use, compared to usual curricula or no intervention.(13) They distinguished three types of programs in addition to the knowledge-focused curricula, in which students are only given information on drugs. The first type of program is based on social competence curricula. These programs teach adolescents generic social and personal skills such as: teaching cognitive skills to enhance assertiveness, to deal with anxiety and stress, and to resist potential influences of the media and interpersonal relationships; and teaching goal setting, decision making, and problem solving. In the social competence curricula teaching takes place through instruction, demonstration, rehearsal, feedback and reinforcement, among other tactics.

The second type of program involves social norms programs. These programs concentrate on two aspects: normative education and resistance skills training. First, educating adolescents about the true rates of drug use among adults and adolescents, to correct inaccurate perceptions of higher use. Second, teaching adolescents to be conscious of high risk-situations; increasing their awareness about the influences of peers, family and the media; and finally, teaching adolescents about

refusal skills and allowing them to practice those skills.

Finally, the last type of program uses combined methods. These programs derive a mixed approach from the knowledge-focused curricula, social competence curricula and social norms approach. Researchers have found inconsistent results on the effectiveness of all types of programs.(13) However, programs that showed positive effects more commonly were the ones that used a mixed approach combining both social competence and social influence, but the effects were small nonetheless. (13) More information about the types of programs compared by Faggiano et al. can be found in Appendix A.

Other characteristics of school-based prevention programs have also been assessed. Upon reviewing studies that compared school-based drug prevention programs presented by adults to the same programs presented by peers, researchers found inconsistent results with some studies showing large positive effects for programs led by peers, while other studies found more positive results for programs led by adults. Overall, peer-led programs were found to be somewhat more effective. (16) Similar to other studies, Stigler et al. found that not all school-based interventions which aim to prevent and reduce alcohol use among adolescents are effective.(15) They identified a group of characteristics that seem to show more positive results when incorporated within a program. Some characteristics are similar to those previously mentioned, such as addressing social norms, being peer-led, teaching students the skills necessary to overcome pressure to use alcohol and having an interactive teaching approach.(15) Other characteristics that they have identified to improve results include having theory-driven interventions, including other parts of the population in the program, providing support and training to facilitators, being developmentally and culturally appropriate and finally, the program spanning in length over several sessions and ideally, many years. (15)

All reviews of the effectiveness of school-based drug and alcohol prevention programs seem to agree that the evidence indicates that education-only programs

with minimal or no opportunity for social interaction and practicing refusal skills do not work. (12-16) This may explain why a program like DARE has been largely ineffective. It is mainly focused on education with little opportunity for practicing refusal skills. Additionally, the program is only a few months in length and adult-led, both of which seem to be characteristics of less effective programs. (15)

2.3.3 Substance use prevention education in the Atlantic Provinces of Canada
Junior and senior high school students in the Atlantic provinces of Canada are exposed to substance use prevention education in their schools on varying levels. In addition to provincial-level curriculums, individual schools and school boards may choose to introduce various types of programs to their students, either in conjunction with the provincial curricula, or independently in the grades when a curriculum is not provided by the province. Below is a summary of the provincial-level substance use prevention education in the provinces of Nova Scotia, New Brunswick, and Newfoundland and Labrador. Information on school board and individual school-level programs is less readily available.

The province of Nova Scotia has a drug and alcohol education resource for teachers of junior high school students. The resource entitled "A question of influence curriculum supplement: a teacher's drug education resource for health/personal development and relationships, grades 7-9" equips teachers with learning plans, slides, and student handouts for each of the grades: 7, 8 and 9. (47) Also included are resources for teachers to understand drug influences, their risks, their effects, and detailed information about different drugs. The curriculum is given over multiple sessions. In grade 7, students learn about alcohol and cannabis, about circles of influence and about decision-making models. In grade 8, students learn more about the substances that are in the community. They also have a chance to expand their knowledge about the influences that they exert on themselves, and the influences that others, such as family members, have on them. They are provided with suggestions about how they can be proactive in dealing with the things that influence them. In grade 9, students learn about the influence of society on their

drug-use related decisions, and they learn about recognition of signs that a friend needs emergency help, as well as when to encourage a friend to seek help. In their grade 9 handouts, students learn about alcohol high-risk behavior, alcohol poisoning, and risks associated with the use of cannabis, hallucinogens, steroids, and other drugs. Currently, no health education is provided to students beyond grade 9 on the provincial level. New lesson-plans have been introduced in February 2015 in Nova Scotia, as part a voluntary section of the current health education curriculum. However, they do not directly pertain to this study because they have been introduced after the collection of data.

In the province of New Brunswick, topics related to drug education are addressed in age-appropriate methods from the early age of Kindergarten through grade 10. (48) The Health Curriculum for grades K-8 identifies learning outcomes that are organized around the following themes: Personal Wellness, Protecting Yourself, Growth and Development, Your Family and Your Community, and Use, Misuse, and Abuse of Materials. In grade 7, the learning outcomes for students are to identify and describe negative effects of drugs and alcohol; to identify and practice refusal skills; and to identify and analyze influences on their health-related behaviors, such as influences exerted by peers, the media, and promotions. In grade 8, students learn about addiction and its destructive impact on oneself; they practice positive decision-making; and they learn about social norms (i.e. that most adolescents don't engage in activities that are unhealthy). In grades 9 and 10, drug education is addressed as part of the Health/Physical Education Curriculum. Students learn concepts and develop skills that influence decision-making and behavior through the Personal Development and Career Planning Curricula. The learning outcomes are for students to explain the effects of substances on the body and to explain the consequences of substance misuse. The types of drugs covered include: tobacco, alcohol, cannabis, stimulants, depressants, hallucinogens, and anabolic steroids. On a provincial level, no drug education is provided to grade 11 and 12 students.

The province of Newfoundland and Labrador exposes students to alcohol and drug education in the grades 7 and 8. (49) In grade 7, students learn about the effects of

alcohol use, personal responsibilities related to alcohol use, and the influence of the media on drinking. In grade 8, students learn about the effects of alcohol-related problems on physical and mental health, on society, on relationships and on the risk of accidents and death. Students are given opportunities to consider values related to alcohol use, to recognize alternatives to drinking, and to think about the influence of advertising on drinking habits. In regards to drug use, students are presented with information about illicit drugs including: cannabis, cocaine, LSD, heroin; and licit drugs including: prescription narcotics, morphine, codeine, sleeping pills, tranquilizers and anti-depressants. Students learn about the factors influencing drug use, and the effects of drug use on health and general wellbeing. In addition, in grade 8 and 9, students are given the opportunity to develop decision-making skills, coping skills and peer-support. In Newfoundland and Labrador, students are not provided with any further alcohol and drug prevention education on the provincial level.

2.4 SCHOOL CONNECTEDNESS AS A POTENTIAL EFFECT MODIFIER IN THE RELATIONSHIP BETWEEN SCHOOL-BASED SUBSTANCE USE PREVENTION PROGRAMS AND LEVELS OF SUBSTANCE USE

The inconsistent effects of school-based substance use prevention programs in achieving the sought results show that there is room for improvement. The degree to which students' levels of attachment and connectedness to their schools may affect such programs is of interest. This section discusses the definition of school connectedness, its protective role in adolescents' lives, the theory explaining how the protective role is exerted, whether levels of school connectedness can be modified or increased, and finally, its potential role in enhancing the effectiveness of school-based substance use prevention programs.

2.4.1 What is school connectedness?

School connectedness is a construct that seeks to explain the extent to which adolescents feel a sense of belonging to their schools.(17) It is difficult to find consistent definitions of school connectedness, as the literature shows as many as

eleven different terms reflecting the construct. These include school connection, school attachment, school bonding, school climate and orientation to school.(17) However, an overarching definition was presented in the Wingspread Declaration on School Connections in 2003.(50) An interdisciplinary group of education leaders based the declaration on in-depth discussions and a detailed review of research. The declaration defines school connection as "the belief by students that adults in the school care about their learning as well as about them as individuals". In 2009, the Center for Disease Control and Prevention (CDC) in the United States released a report entitled School Connectedness: Strategies for Increasing Protective Factors Among Youth.(51) In their report, they expanded the definition to include peer influence in addition to adult influence. This is based on evidence showing the critical role of social relations with peers at school for maintaining a high level of school connectedness.(19, 52) School connectedness has not been measured in a uniform way across studies. Some studies have relied on one item measures (53) and others used scales as long as 72 items.(54) Nonetheless, across the different definitions and measurement tools, school connectedness has repeatedly been shown to be a protective factor against a range of risky behaviors and other health related factors among students.

2.4.2 School connectedness as a protective factor for adolescents' health and wellbeing

Higher levels of school connectedness are associated with a number of positive outcomes. These include higher academic achievement (55) and a later onset of sexual activity. (18, 19) Similarly, lower levels of school connectedness, especially among boys, are associated with risky sexual behavior.(22) Moreover, school connectedness acts as a protective factor against risk of depression in both boys and girls (20) and against susceptibility to smoking. (21) Of particular relevance to my study are findings showing that higher levels of school connectedness are associated with lower drug use. (18, 19, 23) Data from over 44,000 youth in Canada also showed that school connectedness was associated with reduced misuse of prescription drugs.(56) Similarly, lower levels of school connectedness increase the

risk of substance use. A temporal relationship between poor school connectedness and subsequent marijuana use and alcohol use has been supported by longitudinal evidence.(23) Boys with lower school connectedness may also be at a higher risk of involvement in high-risk sexual behavior due to substance use. (22)

The role that school connectedness (also termed school bonding) plays in shaping adolescents' health behavior and outcomes has been investigated by researchers. (57, 58) Catalano et al. have attempted to explain prosocial and antisocial behavior through the Social Development Model. They hypothesize that children learn patterns of behavior from socializing agents of family, school and other community institutions. They argue that four constructs lead to children's socialization: (a) the opportunities that children perceive are available for them for involvement in activities and interacting with others; (b) the degree to which they actually are involved and interact with others; (c) the skills they need to participate in the involvements and interactions; and (d) the rewards and reinforcement that they view as a result of such involvement and interaction. Catalano et al. further explain that when these processes are consistent, a child develops a social bond with the socializing agent such as that present in school. The establishment of such bonds affects behavior by leading to an informal control on future behavior, such that an individual feels that they have a 'stake' in adhering to the values and norms of the unit (e.g. school values). They may feel like the bond may be threatened if they do not adhere to the norms. Therefore, if the values and norms in a school reflect a trend towards less substance use and misuse, if the teachers and administration have high expectations of students and hold them in esteem, then students who have strong bonds with school (i.e. higher connectedness to school) may choose to be less involved with substance use and misuse. (57, 58)

2.4.3 Levels of school connectedness can be improved

From a strategic prevention point of view, the value of school connectedness lies in the fact that its levels are malleable; they can be changed or improved. Currently, evidence suggests that many adolescent students don't feel very attached to school.

For example, based on the Health Behavior in School-Aged Children International Report, only 19% of 15 year old boys and 24% of 15 year old girls in Canada in 2009-2010 indicated that they "like school a lot". (3) Age and gender seem to influence how likely students are to report liking school. More girls across all age groups reported liking school, and as age increased a decreasing proportion of both boys and girls reported liking school a lot. Compared to only 19% of boys and 24% of girls at the age of 15 years who reported liking school a lot, 27% of boys and 40% of girls who were 11 years old indicated they do. (3) However, socioeconomic factors like family affluence did not show strong associations to levels of liking school. (3) Strategies that are supported by evidence have been developed to increase school connectedness among youth. More than fifty specific actions have been suggested. (51)

A report by the CDC presents six strategies to increase levels of school connectedness among students. (51) Each strategy has specific actions that can be adopted by administrators, teachers, other school staff, and parents to enhance school connectedness. The first strategy addresses the need to create decision-making processes that empower staff, enhance academic achievement, and help in engaging students, their families and the community. Specific actions that are suggested to achieve this goal include reaching out to community partners to provide a range of services that students and their families need; and creating a shared vision of high standards for behavior and learning. The second strategy aims to increase the opportunities for families to be involved in their children's school and academic life. Specific actions that can help in achieving this goal include giving parents the opportunity to attend workshops that provide them with the skills necessary to improve their management of their children's behavior; and communicating the school's academic and behavioral expectations through conferences, websites, or newsletters, all the while encouraging parents to enforce the same expectations at home.

The third strategy is to help students gain the social, emotional and academic skills necessary for them to be able to participate actively in school. This goal can be achieved by actions such as giving students the opportunity to improve their interpersonal skills, teaching them refusal and resistance skills, and correcting misperceptions they may have about normal behavior. The fourth strategy addresses the need to foster positive learning environments, while the fifth strategy suggests providing teachers and other school staff with the professional development support they need to meet the diverse social, emotional and cognitive needs of students. Finally, the sixth strategy aims to promote and foster open communication between students, teachers, families, administration, other school staff and the community.

The extent of feasibility of carrying out the necessary changes to increase school connectedness depends largely on the nature of the change. Some changes can be easily implemented and achieved in the short term; while other actions may require administrative and budget changes that need a longer time to achieve. (51) Regardless of the complexity of the actions required, they can still be achieved with appropriate goal setting and prioritizing from schools and school districts.

2.4.4 The potential role of school connectedness in improving the effectiveness of school-based substance use prevention programs

Despite the presence of an association between school connectedness and substance use, studies examining the effectiveness of school-based substance use prevention programs do not take the role of school connectedness into account as a potential effect modifier in the relationship. (14, 15) This could be due to the lack of measurement of the construct 'school connectedness' in most of the studies. It is possible that students who feel more connected to their schools are more likely to actively engage in these programs, with a higher willingness to participate in activities and a higher chance of accepting the relayed messages. As evidence suggests, more student involvement in these prevention programs, compared to passive reception of education, results in better outcomes and lower levels of

substance use (14-16). Hence, higher levels of school connectedness may facilitate the effectiveness of school-based substance prevention programs.

As such, the primary aim of this study is to investigate whether students who receive school-based substance use educational programs and have high levels of school connectedness are more likely to show better substance use habits compared to those with low levels of school connectedness. Findings from this study may point towards a promising opportunity in increasing the effectiveness of such programs in schools. Moreover, the modifiable nature of school connectedness means that the environmental dimensions and influencing factors that shape it can be improved. This can, in turn, potentially facilitate better uptake of educational programs.

CHAPTER3: OBJECTIVES AND RESEARCH QUESTIONS

The objectives of this secondary data analysis study are:

1. To determine whether exposure to school-based substance use prevention education programs is associated with lower levels of substance use, misuse, and related problems.
2. To examine whether the association is modified by a student's level of school connectedness.

The proposed research questions are:

1. In Atlantic Canada, do high school students who receive school-based substance use prevention classes report lower levels of substance use, misuse, and related problems?
2. Does the relationship between the exposure to school-based substance use prevention classes and substance use differ by levels of school connectedness, such that students who report higher levels of school connectedness demonstrate a stronger association between school-based education programs and lower substance use, misuse and related problems?

CHAPTER 4: METHODS

4.1 Overview of methods

To answer the research questions, I utilized data from the 2012 Student Drug Use Survey in the Atlantic Provinces (SDUSAP), which is a survey of substance use and health among students in grades 7, 9, 10, and 12 from three provinces in Atlantic Canada. (2) The survey gives me the advantage of having a large sample size (9,229 students), and thus sufficient statistical power to test the relationships across many different sub-categories of the student population. Using cross sectional data is a feasible and appropriate method to test these associations and to generate research questions that can be evaluated in future studies with longitudinal and experimental designs.

4.2 Data and population

The study is based on data from the 2012 Student Drug Use Survey in the Atlantic Provinces (SDUSAP).(2) This survey is a cross-sectional standardized survey carried out in collaboration with three provinces: Nova Scotia, New Brunswick and Newfoundland and Labrador. It is conducted on junior and senior high school students in grades 7, 9, 10 and 12 in the public school system (ages 11-19 years). The final sample for the survey was 9,229 students. The 2012 survey is its fifth application, and in this iteration, Prince Edward Island did not participate. The survey was first conducted in 1996 following a standard protocol, which was developed in 1994.(59, 60) Three more waves of the survey took place; in 1998, 2002 and 2007.(61-65) As will be discussed below, a representative random sample of eligible students was obtained by a two-stage stratified cluster design.

The SDUSAP employs a self-report questionnaire. Students provided answers to all questions directly on a computer scannable form. The survey was made up of 106 multiple-choice questions and one open-ended question. Questions asked about socio-demographic indicators, school and community involvement, substance use, problems related to substance use including driving under the influence, sexual and other risk behavior, mental health, gambling, help seeking, and school drug-

education. The 2012 version included a number of first time questions that covered: the use of energy drinks; the use of cough medicine to get high; the use of mephodrone; the use of salvia divinorum; and driving under the influence of pain medications.

Validity of the questionnaire

The questionnaire was validated prior to its initial use in 1996. (59) Evidence for the validity, reliability and minimized under-reporting of the standardized survey include a high rate of coverage of the student population, assurance of anonymity and confidentiality, estimates of drug use that are comparable to those in similar surveys, low non-response rates for questions on drug use and high rates of consistency between selected items. These measures have all been replicated at each implementation of the survey, including in 2012.

4.3 Sampling

Eligibility for enrollment

The survey was an Atlantic-based survey of students in grades 7,9,10 and 12 in the public school system. Students in both English and French schools were eligible to be chosen in the sample. Students at private schools, and at schools on reserve, as well as street-youth, school-leavers, and absent students on the designated day of the survey, were all excluded.

Sample design

A representative random sample of eligible students was obtained by a two-stage stratified cluster sample of randomly selected classes in each of the Shared Services Areas within each of the three participating provinces. Individual classes were selected from grades 7, 9, 10 and 12 and must have had at least 20 students to have the chance of being selected. An approximate proportional representation of each province, within each shared service area (or health district), within each grade was allowed by the sample design. Additionally, the sample was allocated

proportionately according to school size. Probability weights were used to adjust for the stratified disproportionate cluster sample design and non-response rates.

4.4 Response Rates

Nova Scotia

Survey administration was conducted in 176 randomly selected classes within 75 schools across Nova Scotia. Of the 4,475 students enrolled in the classes selected to participate, 3189 students participated in the survey. Those who did not complete the survey were either absent or did not consent to participation. Within the Shared Service Areas that do not require active permission (active parental/guardian consent) the response rate was between 96.5% and 98.4% for students who were present on the day of the survey. However, within the Shared Service Areas where active parental/guardian consent is required, the response rate was 59.0%. This rate is similar to response rates for other drug use surveys held in recent years in Canada, in which active parental consent was also required. For example, although the Health Canada's 2010 school-based Youth Smoking Survey had a response rate of 65% in Nova Scotia, the percentage was only 33% for the Halifax Regional School Board (HRSB), which is the only region requiring active parental consent. Similarly, the 2011 Ontario Student Drug Use Survey had a response rate of 62%. The overall response rate within Nova Scotia was 88.1% of students present on survey day and 71.3% of all students enrolled on survey day.

New Brunswick

Survey administration was conducted in 193 randomly selected classes within 99 schools across New Brunswick. Of the 4,195 students enrolled in the classes selected to participate, 3510 students participated in the survey. The overall response rate within New Brunswick was 94.1% of students present on survey day and 83.7% of all students enrolled on survey day.

Newfoundland & Labrador

Survey administration was conducted in 126 randomly selected classes within 72 schools across Newfoundland & Labrador. Of the 3278 students enrolled in the classes selected to participate, 2530 students participated in the survey. The overall response rate within Newfoundland & Labrador was 92.2% of students present on survey day and 77.2% of all students enrolled on survey day.

Overall Response Rate

The overall response rate for the SDUSAP in all three provinces was 89.9% of students present on survey day and 77.2% of all students enrolled on survey day.

4.5 Procedure

Ethics approval and consent

Ethics approval was obtained from the Dalhousie University Health Sciences Research Ethics Board. The SDUSAP obtained ethics approval from the same board prior to survey administration, as well as each participating school board. Parental consent was obtained for all students who participated in the survey. Depending on the school board requirements, parental consent was either passive or active. In both cases, two weeks prior to administering the survey, an information package was sent home to the parents. Active parental consent meant that a signed consent form must have been sent to the school in order for the student to participate, whereas passive parental consent meant that parents were requested to contact the school only if they did not want their child to participate. Additionally, all students who participated in the survey gave individual consent. Since the SDUSAP was anonymous, completion of the survey implied student consent.

The difference in parental consent protocol between school boards (active vs. passive) is significant for two reasons. First, it explains the variation in response rates between regions, as the regions under school boards requiring active consent yielded lower response rates. Second, differences in type of consent may influence provincial and overall variable estimates. This concern has been addressed in the

2007 SDUSAP analysis report. The impact of type of consent on variable estimates was tested by multivariate analysis. Type of consent did not have a significant influence on variable estimates across provinces. (63) Weighting was used to adjust for nonresponse.

4.6 Variables

The variables that are included in the analysis are all collected on the level of the individual respondent, except the variable 'region' which is collected on the school level. All the variables that are included in the analysis are presented in Appendix B.

Dependent/outcome variables:

The outcome variables of interest are indicators of substance use. The substances of interest are: Alcohol; cannabis; and other illicit drugs, namely: LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; and methamphetamine. These substances will be considered at three levels – past 30 days use of alcohol and cannabis (differentiating between those who don't use them, those who use them moderately, and heavy users (i.e. those involved in binge drinking or daily use of cannabis), past 12 months use of hard drugs, and finally, problems associated with use (captured by two scales, one for alcohol-related problems and one for drug use-related problems).

Levels of substance use over the past 30 days are of particular importance in my study analysis. This is because the question about school-based substance use education asks about attending such classes in the current school year. Consequently, measures of substance use in the past 30 days may be more reliable than measures of substance use in the past 12 months when assessing the association of these programs with levels of substance use. In addition, problem use is an important outcome to give a more meaningful understanding of the consequences of substance use among students.

a. Alcohol use

Past 30 days use (alcohol use and misuse)

Levels of alcohol use over the past 30 days are determined by data from the following question in the SDUSAP: *in the past 30 days, how many times have you had five or more drinks of alcohol on the same occasion?* For analysis, alcohol consumption in the past 30 days is categorized into: did not drink alcohol (reference category), drank alcohol but did not binge drink, and was involved in binge drinking.

Problems associated with alcohol use

The SDUSAP asks about problems associated with alcohol use in 11 separate questions asking about the frequency of occurrence of alcohol-related incidents over the past 12 months. I use these 11 questions as a scale reflecting problems associated with alcohol use.

These questions are: *has drinking affected your school work or exams so that you did not do as well as you could?; has your drinking caused tension or disagreement with family or friends?; have you been in trouble with the police as a result of your drinking?; has the cost of alcohol caused you to give up buying other things?; have you consumed alcohol before or instead of breakfast?; have you damaged things after having drunk alcohol?; has your drinking caused you to injure yourself?; how often have you been drinking in a bar, tavern, beverage room, or lounge?; how often have YOU driven a motor vehicle within an hour of drinking two or more drinks of alcohol?; have you been in a motor vehicle accident with YOU as the driver, after drinking in the two previous hours?; how often were you a PASSENGER in a vehicle with a driver who has too much to drink?* For analysis, I create a single count variable reflecting problems associated with alcohol use with a possible score ranging from 0-11. First, every question is categorized into a dichotomous variable (no=0/yes=1). Then, all questions are summed up to give a score for the count variable. Each student has a score for the number of reported alcohol use associated problems.

b. Cannabis

Past 30 days use (cannabis use and excessive use)

Level of cannabis use over the past 30 days is captured in the SDUAP using the following question: *in the past 30 days, how often did you use cannabis?* For analysis, past 30 days use of cannabis is categorized as: did not use cannabis (reference category), used cannabis but not daily, and used cannabis daily or almost daily.

c. Other illicit drugs

Past 12 months use of other illicit drugs

Levels of other illicit drug use, namely: LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; or methamphetamine over the past 12 months are captured in the SDUAP using the following questions: *In the past 12 months have you used/how often did you use 'substance name'?* For analysis, I create a new variable reflecting use of any of these drugs (i.e. combine all drugs into one category). This is a dichotomous variable with the following categories: no use (reference category), and used any of the drugs at least once.

Problems associated with illicit drug use (cannabis and others)

The SDUSAP asks about problems associated with illicit drug use in 9 separate questions asking about the frequency of occurrence of illicit drug use-related incidents and risky behaviors over the past 12 months. I use these questions as a 9-item scale.

The questions are: *has your drug use affected your school work or exams so that you did not do as well as you could?; has your drug use (other than alcohol) caused tension or disagreement with family or friends?; have you been in trouble with the police as a result of your drug use?; has the cost of drugs (other than alcohol) caused you to give up buying other things?; have you damaged things after having used drugs (other than alcohol)?; has your drug use (other than alcohol) caused you to injure yourself?; how often have YOU driven a motor vehicle within an hour of using cannabis?; how often were you a PASSENGER in a car or other vehicle driven by someone who had been*

using cannabis?; and how often have you driven a vehicle within an hour of using a prescription pain relief pill such as "names of drugs"? For analysis, I will create a single count variable reflecting problems associated with drug use with a possible score ranging from 0-9. First, every question is categorized into a dichotomous variable (no=0/yes=1). Then, the 9 questions are summed up to give a score for the count variable. Each student has a score for the number of reported drug use associated problems.

Independent variables:

School-based substance use education

School-based substance use education is the main independent variable of interest. School-based substance use education is measured in SDUSAP by the following question, *"how many classes did you have in this school year that talked about decision-making, peer pressure, assertiveness or refusal skills?"* Responses are categorized into three categories: none (reference category), one or two classes, and three or more classes. The same categories are used for the analysis of this study.

School connectedness

School connectedness is analyzed as a potential effect modifier in the association between school-based substance use education and levels of substance use. In addition, school connectedness is entered into a full multivariable model to asses its independent association with substance use outcomes, after controlling for all other factors. Data on school connectedness is collected within the SDUSAP survey by a group of questions, which are adapted from a longer scale that measures school connectedness. This scale is first described by Resnick et al. in the National Longitudinal Study of Adolescent Health, which took place in the United States. (19) The original scale is 6 items long, and it uses a sum of items to generate a final score. It has a Cronbach's alpha level of 0.75. It has been widely used in research to measure school connectedness. The scale I use in this study is the adapted scale that was used the SDUSAP, which is 3-items long. In it, students were asked to choose how much they agree or disagree with the following statements*: I feel safe in my*

school; I feel close to people at my school; and I feel happy at my school. For each of the statements the answer is categorized as (strongly agree, somewhat agree, somewhat disagree and strongly disagree). The internal consistency of this 3-item scale has been measured by Azagba et al. and has a Cronbach's alpha score of 0.74. (66)

For analysis, I first considered using a data driven cutoff point. I gave a score of 4 for the response (strongly agree), 3 for the response (somewhat agree), 2 for the response (somewhat disagree), and 1 for the response (strongly disagree). I then summed up these scores to create a continuous measure of school connectedness, with a higher score indicating higher connection to school. The continuous score was dichotomized into two categories, lower and higher school connectedness, with the cutoff point being set at one standard deviation below the mean score. Other researchers have used similar scoring systems for adapted 5-item and 3-item scales. (21, 22, 67, 68)

However, although researchers have used this scoring system in the past, I explored different options for the cutoff point. Given the large role that the variable school connectedness plays in my objectives and analysis, I was mainly interested in looking at a theoretically driven cutoff point. Therefore, I explored a cutoff point at which any student who indicates that he or she 'somewhat agrees' or 'strongly agrees' to all three statements of the school-connectedness scale would be considered a student with a high level of school connectedness. Any student with a lower score would be considered a student with a low level of school connectedness. This categorization yielded 42.2% weighted percentage of students in the high school connectedness category. I compared this to a data driven categorization in which a cutoff point was set at 1SD above the mean, so that any student with a score above this cutoff point would be considered to have a high level of school connectedness. This categorization yielded 24.6% weighted percentage of students in the high school connectedness category. Thus, around 17% of the students who are considered to have high school connectedness by the theoretically driven cutoff

point are missed by the data driven cutoff point. Therefore, the cutoff point used in this study is the theoretically driven cutoff point.

Co-variables:

Socio-demographic variables

Known confounders are controlled for in the multivariable analysis. Age, parental education, low levels of parental connectedness, and socioeconomic status have all been shown to increase the risk of drug use and abuse in adolescents.(69) *Socioeconomic status* is measured in the SDUSAP using a validated scale (70) that asks students to rate where they think their family in positioned on a scale from 10 (best off- most money, most education and jobs that bring the most respect) to 1 (worst off- least money, little education, no jobs or jobs that no one wants). Similar to previous studies (71), I re-categorize the variable into low SES (scores of 1-4), middle SES (scores 5-7), and high SES (scores 8-10).

Parental connectedness is captured in the SDUSAP by asking students to indicate on a 5-point Likert scale whether they agreed or disagreed with three statements: *"my parent(s) or guardian(s) usually know where I am when I am not at home", "my parent(s) or guardian(s) usually know who I am with when I am not at home", and "it is important that I do not let down or disappoint my parent(s) or guardian(s)."* I convert the answers to these statements into one variable reflecting the level of a student's connectedness to parents with a possible score ranging from 3-15. The internal consistency of the scale has been measured by Asbridge et al. and shows a Cronbach's alpha score of 0.74. (71)

Religiosity (i.e. personal views on importance of religion) is also controlled for in the analysis. Studies indicate that religiosity is associated with decreased drug and alcohol use in male and female high school students (72), as well as being a protective factor against low levels of school connectedness among middle and high school students of both genders. (66) To measure religiosity, I create a dichotomous variable (low vs. high religiosity) that uses students' answers to the following

question: *how important would you say religion is to you? (with 4 possible answers ranging from not important at all to very important, coded 1-4).*

Finally, because evidence has shown that youth can be vulnerable to peer pressure and affected by peer substance use(73), I control for the variable 'peer use of marijuana' (the most prevalent drug used among adolescents) by using the categories measured by the question: *how many of your friends use Cannabis?* For the analysis, levels of peer cannabis use are categorized as none, a few, and half or more.

In summary, the variables that are controlled for are: age in years (as a continuous variable); gender (female (reference), or male); mother's level of education (categorized as unknown, did not graduate high school (reference category), graduated high school and graduated college/trade school/ university); student perception of own family's socioeconomic status (SES) (categorized as low (reference category), middle and high); parental connectedness (possible score 3-15, with a higher score indicating higher parental connectedness), level of religiosity (low vs. high), and peer use of cannabis. Finally, province will be used in the analysis as a dummy variable.

4.7 Analysis

Descriptive analysis

I provide a summary of the continuous and categorical variables included in the analysis. I also give a descriptive overview of exposure to school-based substance use prevention education and levels of school connectedness across socio-demographic and other indicators. Finally, I provide a descriptive overview of levels of substance use, misuse, and problems across grade levels and for both genders.

Regression models

I provide below an objectives-specific analysis plan. Different regression models are used based on the nature of the outcome that is being investigated. I adjust for

known confounders, including age, maternal education, family's socioeconomic status, peer substance use, parental connectedness, and religiosity. As previously discussed, all these factors have been shown to be risk factors for substance use. All models account for the complex, stratified sampling design of the SDUSAP.

Objective #1: To determine whether exposure to school-based substance use prevention programs is associated with lower levels of substance use, misuse, and related problems.

To determine the association between exposure to school-based substance use prevention education (none=0, one to two classes=1, three or more classes=2) and alcohol use and misuse (i.e. binge drinking) in the past 30 days: (did not drink alcohol=0, drank alcohol but did not binge drink=1, and was involved in binge drinking=2) and cannabis use in the past 30 days: (did not use cannabis=0, used cannabis but not daily=1, and used cannabis daily or almost daily=2): I use a multinomial logistic regression model. First I run an unadjusted model and then I adjust for all co-variables in a multivariable model. I first set the category 'did not drink alcohol/did not use cannabis) as the base (i.e. reference) category and run the model, then I set the category drank alcohol but did not binge drink/ used cannabis but not daily as the base category and run the model. This allows me to report three relative risk ratios (RRRs) comparing levels of substance use and misuse based on level of exposure to school-based substance use education.

To determine the association between exposure to school-based substance use prevention education (none=0, one to two classes=1, three or more classes=2) and levels of other illicit drug use (no use=0, used any of the drugs at least once=1), I use a logistic regression model. First I run an unadjusted model and then I adjust for all co-variables in a multivariable model. This allows me to report odds ratios (OR) comparing the odds of having been exposed to school-based

substance use prevention education for students who report the use of drugs compared to those who report no use.

To determine the association between exposure to school-based substance use prevention education (none=0, one to two classes=1, three or more classes=2) and problems associated with substance use (count variable with a possible range from 0-11 for alcohol-related problems and 0-9 for drug-related problems), I use a negative binomial regression model. First I run an unadjusted model and then I adjust for all co-variables in a multivariable model. This allows me to report incidence rate ratios (IRR) that reflect the unit increase in problems-associated with substance use as a function of exposure to school-based education. I report the average effect of exposure.

Objective #2: To examine whether the association is modified by a student's level of school connectedness.

To determine whether the association between exposure to school-based substance use education and substance use, misuse and problems is modified by a student's level of school connectedness, I re-run the multivariable adjusted models for each outcome stratified by level of school connectedness. If school connectedness is an effect modifier, the stratum specific estimates (RRR, OR, or IRR) will differ significantly from each other.

It is important to note that in the association between my exposure and outcomes of interest, there is a possibility that school connectedness plays a confounding role independently of, or in addition to, playing a role as an effect modifier. A confounding role could be present if, for example, schools that are more likely to invest in exposing their students to more substance use prevention education are also schools that have students who feel more connected and attached to the school environment (i.e. an overall positive school climate with many risky behavior prevention strategies).

Therefore, taking the estimated OR for levels of 'illicit drug use' as an example, if after stratification for school connectedness the stratum specific ORs are significantly different from each other, then effect modification is present. If there is no difference between the stratum specific ORs, but they are both significantly different from the crude OR, then confounding is present. If the stratum specific ORs are significantly different from each other *and* the crude OR lies outside the range between those stratum specific ORs (i.e. crude OR < both stratum specific ORs, or crude OR > both stratum specific ORs) then both confounding and effect modification are present. (74) All these considerations are taken into consideration in my interpretation of the results.

4.8 Sample size calculations

The final sample for the SDUSAP was 9,229 junior and senior high school students. The SDUSAP 2012 report indicates that 68.1% of students reported that they received classes on substance use education. This represents approximately 6,285 students who were exposed. The ratio of unexposed to exposed is approximately 1:2. Based on previous studies, 'any drug use' was reported by approximately 9.2% of students who did not receive school-based substance abuse prevention programs, and 7% of those who did. (13) Table 1 shows the sample sizes needed at different confidence and power levels. These calculation are made using the Fleiss with Continuity Correction formula (75) from OpenEpi, Version 3, open source calculator. (76)

Table 1: Sample size calculations

Two-sided confidence level	Power	Ratio (unexposed: exposed)	% outcome in unexposed group	% outcome in exposed group	Odds Ratio	Relative Risk	Minimum sample size required
95%	80%	1:2	9.2	7	0.74	0.76	5411
95%	90%	1:2	9.2	7	0.74	0.76	7230
99%	80%	1:2	9.2	7	0.74	0.76	7917
99%	90%	1:2	9.2	7	0.74	0.76	10103

This study is restricted to high school students in grade 9 and above, as students in grade 7 and younger largely abstain from substance use as indicated by a

preliminary look at the data. In addition, students who do not give reliable answers in the survey, as indicated by giving a positive answer to the use of a fictitious drug 'quabaline', are also excluded from the analysis. Therefore, the study sample included in the analysis is 6,786. Based on the above calculations, at 80% power and a two-sided confidence level of 95%, this sample size is sufficient to detect a minimal odds ratio of 0.74 and risk ratio of 0.76.

CHAPTER 5: RESULTS

5.1 Descriptive analysis:

Descriptive statistics are calculated for all the variables included in the study. Continuous variables are presented as means and 95% confidence intervals (CI). Categorical variables are presented as percentages with 95% CI. These results are **shown in Table 2 and 3**.

Approximately half of the students are female (50.5%). Age ranges between 11 and 19 years old, with a mean age of 15.9 years. The percentage of students in each of grades 9, 10 and 12 range between 31% and 34%. The majority of students (approximately 55%) indicate that they come from families of middle socioeconomic class. Overall, the largest proportion of students (48.5%) report receiving 1-2 classes of substance use prevention education in the current school year (of survey distribution), followed by receiving no education (38%), and finally, receiving 3 or more classes (13.6%). A smaller proportion of students are found to have high levels of school connectedness (42.4%), compared to low levels.

The percentage of students reporting substance use differed based on the type of substance being used. The highest rates are for alcohol use, followed by cannabis, then other illicit drugs. The use of alcohol without binge drinking in the past month is less prevalent among students, compared to binge drinking (15.2% and 34.2%, respectively). Cannabis use in the past month is reported by 15.3% of students, and the daily use of cannabis is reported by 7.3%. The use of any of the following drugs: (LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; or methamphetamine) in the past year is reported by approximately 11% of students. The mean number of reported problems associated with alcohol use in the past year among alcohol drinkers is 1.18 (range of possible number of problems= 0-11, median= 1), and problems associated with drug use among cannabis and other illicit drug users is 0.97 (range of possible number of problems= 0-9, median= 0).

Table 4 presents cross-tabulations of the prevalence of the exposure to school-based substance use prevention education (i.e. classes) and levels of school connectedness, by socio-demographic characteristics, as well as by levels of substance use. Exposure to substance use prevention classes differs significantly by grade (P <0.001), age (P <0.001), mother's level of education (P=0.004), family's socioeconomic status (P <0.001), religiosity (P <0.001), and parental connectedness (P <0.001). The prevalence of high levels of school connectedness also differs significantly by mother's level of education (P <0.001), family's socioeconomic class, (P <0.001), religiosity (P <0.001), parental connectedness (P <0.001), and peer use of cannabis (P <0.001).

Differences in the prevalence of cannabis use, other illicit drug use, and problems associated with substance use are seen between students reporting high and low levels of school connectedness. The prevalence of recreational cannabis use and the daily use of cannabis is significantly higher among students with low levels of school connectedness (17.2% and 9.1%, respectively), compared to students with high levels of school connectedness. Around 13% of students with high levels of school connectedness report recreational cannabis use, and 4.7% report daily use (P< 0.001). In addition, while over 1 in 10 students with low levels of school connectedness report the use of other illicit drugs in the past year, only 6.5% of students with high levels of school connectedness report so (P<0.001). The mean number of reported problems associated with alcohol and drug use are also higher among students with low levels of school connectedness compared to those with high levels of school connectedness (P<0.001). No significant differences are seen in the prevalence of alcohol use between students with high and low levels of school connectedness.

Cross-tabulations of the prevalence of alcohol, cannabis and other illicit drug use, as well as problems associated with substance use by age and grade are presented in **Table 5**. Substance use differs by sex. More female students (18%), compared to male students (12.6%) report alcohol use without binge drinking, while more male

students (35%) report binge drinking compared to female students (33.3%). Also, more male students (approximately 9%) report daily cannabis use, than females (5.5%). However, at approximately 11% reporting use in both sexes, no differences are seen in the rate of other illicit drug use. Significant differences are seen in levels of substance use by grade. The prevalence of binge drinking, recreational and daily use of cannabis, the use of other illicit drugs, and problems associated with the use of alcohol or drugs, all significantly increase as grade increases.

5.2 The association between the exposure to school-based substance use prevention education, school connectedness, and levels of alcohol use and binge drinking among students

Table 6 shows results from the unadjusted and adjusted multinomial regression models of alcohol use and binge drinking (past 30 days) regressed on exposure to substance use education, level of school connectedness, and other key social and demographic variables. The unadjusted regression models do not show significant associations between the exposure to 1-2 classes on substance use prevention education and levels of alcohol use or binge drinking. However, exposure to 3 or more classes of substance use education is associated with a decrease in the relative risk of alcohol use and binge drinking compared to no exposure to classes. Specifically, students who are exposed to 3 or more classes of substance use prevention education have a 31% decrease in the relative risk of alcohol use, and 43% decrease in the relative risk of binge drinking compared to students who do not receive any education. After adjusting for all the co-variables, however, the association is no longer significant. In other words, students who are exposed to 1-2 classes or 3 or more classes of substance use prevention education in their schools do not have a significantly lower relative risk of alcohol use or binge drinking, nor do they have a significantly lower relative risk of binge drinking compared to only moderate alcohol use.

Results from the adjusted regression model show that after controlling for exposure to substance use education and other risk and protective factors related to

substance use, school connectedness has a significant positive association with alcohol use and binge drinking (i.e. a significant increase in the relative risk of alcohol use and binge drinking). Compared to students with low school connectedness, students who have high levels of school connectedness have a 33% increase in their relative risk of alcohol use, and a 21% increase in the relative risk of binge drinking compared to no use of alcohol. The estimates of association are RRR= 1.33 (95% CI 1.10-1.62) for alcohol use compared to no use, and RRR=1.21 (95% CI 1.10 – 1.62) for binge drinking compared to no use. However, students with high levels of school connectedness do not have a significantly higher relative risk of binge drinking compared to the moderate use of alcohol, RRR= 0.99 (0.74 – 1.33).

The adjusted model also identifies other factors that have significant positive associations with alcohol use and binge drinking. These are: older age, being from middle or high SES compared to low SES, and reporting having friends who use cannabis. Being male is also positively associated with binge drinking compared to only moderate use, RRR= 1.54 (95% CI 1.22 – 1.94). All estimates can be seen in **Table 6**.

Table 7 shows the results of the adjusted multinomial regression model stratified by level of school connectedness. For the overall sample of students, no significant associations are seen between exposure to substance use prevention education and alcohol use or binge drinking. However, stratifying for school connectedness shows that a significant negative association is present between exposure to 3 or more classes and binge drinking compared to no use, RRR=0.55 (0.38 – 0.79), and binge drinking compared to only moderate alcohol use RRR=0.65 (0.44-0.97) among the group of students with *low* school connectedness. In other words, students with low school connectedness who are exposed to 3 or more classes of substance use prevention education have a decrease in their relative risk of binge drinking per se, as well as binge drinking compared to only the moderate use of alcohol. The model also shows that students with *high levels* of school connectedness who receive 3 or more classes on substance use prevention education compared to those who receive

no education, have 1.69 times the risk of binge drinking, compared to only moderate alcohol use, RRR=1.69 (95% CI 1.10 – 2.63). In other words, while exposure to a lot of substance use education (3+ classes) in school is associated with a decrease in the relative risk of misusing alcohol among students with low school connectedness, it is associated with an increase in the relative risk among students with high school connectedness.

In summary, although the unadjusted regression model shows a significant decrease in the relative risk of alcohol use and binge drinking with the exposure to three or more classes on substance use prevention education in schools, the association is no longer significant after controlling for important social and demographic indicators. However, after stratifying for school connectedness, differences in the effect of exposure to substance use prevention education on alcohol misuse are seen. Finally, independent of all other factors, higher levels of school connectedness is positively associated with alcohol use and binge drinking. Other important factors showing significant positive and negative associations with alcohol use and binge drinking are also identified by the model, and are presented in **Table 6.**

5.3 The association between exposure to school-based substance use prevention education, school connectedness, and the recreational and daily use of cannabis among students.

Table 8 shows results from the unadjusted and adjusted multinomial regression models of recreational and daily cannabis use (in the past 30 days) on exposure to substance use education, level of school connectedness, and other social and demographic variables. No significant associations are seen between exposure to substance use prevention classes and cannabis use in the unadjusted or adjusted models. In other words, students who are exposed to educational classes do not have a decrease in the relative risk of recreational or daily cannabis use compared to students who are not exposed to such classes, even after adjusting for school connectedness, sex, mother's levels of education, family's SES, peer use of cannabis,

parental connectedness and religiosity. **Table 9** shows that this insignificant association does not change even after stratifying for school connectedness.

When examining the independent role of school connectedness on cannabis use in the adjusted model, results in **Table 8** show that compared to students with low levels of school connectedness, students who report having high levels of school connectedness have a 32% decreased relative risk of daily cannabis use compared to no use (P<0.05).

Other factors in the adjusted model which are associated with cannabis use are: higher levels of parental connectedness and high perceived importance of religiosity, both of which are associated with a decrease in the relative risk of both the recreational use and daily use of cannabis. Having a mother with post-secondary education, compared to only high school or less, also shows a significant negative association with daily cannabis use, compared to no use. On the other hand, the adjusted model reveals that some factors are positively associated with cannabis use. These include: peer use of cannabis, age and being male. Specifically, as age increased by 1 year, students have a 25% increase in the relative risk of daily cannabis use compared to no use, and have a 16% increase in the relative risk of daily cannabis use compared to recreational use only. In addition, compared to female students, male students have a significant increase in their relative risk of daily cannabis use compared to no use, and compared to recreational use only, RRR= 1.89 (95% CI 1.36 – 2.62), and RRR= 1.80 (95%CI 1.31 – 2.46), respectively.

In summary, based on results from the regression models in this study, the exposure to school-based substance use prevention education does not have significant negative associations with the use of cannabis among high school students. The stratification for levels of school connectedness does not alter this non-significant association. However, independent of other factors, having high levels of school connectedness is associated with a significant decrease in the relative risk of daily

cannabis use. Other factors that have significant negative and positive associations with cannabis use are identified.

5.4 The association between exposure to school-based substance use prevention classes, school connectedness, and other illicit drug use among students.

The results of the unadjusted and adjusted logistic regression models for other illicit drug use based on exposure to classes, level of school connectedness, and other factors are presented in **Table 10**. No significant associations are seen between exposure to substance use prevention education and the use of other illicit drugs in either the unadjusted or adjusted models. In other words, students who are exposed to substance use prevention education do not have a significant decrease in the odds of other illicit drug use. Stratification by school connectedness does not alter this non-significant association (**Table 11**).

In terms of the effect of school connectedness on other illicit drug use, results of the adjusted logistic regression model, seen in **Table 10**, show that school connectedness is negatively associated with the use of other illicit drugs. Specifically, students with high school connectedness have 41% decreased odds of other illicit drug use compared to students with low levels of school connectedness, after adjusting for exposure to substance use education, age, sex, province, mother's education, family's SES, peer cannabis use, parental connectedness and perceived importance of religiosity, OR=0.56 (95% CI 0.45 – 0.78).

Other factors that show significant negative associations to the use of other illicit drugs are: a higher education level of the student's mother, being from middle or high SES compared to low SES, having higher levels of connectedness to parents, and higher perceived importance of religion. Factors that are positively associated with the use of other illicit drugs among students are older age and more peers using cannabis. All estimates can be seen in **Table 10**.

In summary, the regression analysis results of this study show that exposure to school-based substance use prevention education is not significantly associated with levels of other illicit drug use among students. This non-significant association is not altered after stratifying for levels of school connectedness. After adjusting for all other factors, higher levels of school connectedness are associated with a significant decrease in the odds of other illicit drug use among students. Other factors that have significant positive and negative associations with the use of other illicit drugs are identified.

5.5 The association between exposure to school-based substance use prevention classes, school connectedness, and problems associated with alcohol and drug use.

Based on results from the unadjusted and adjusted models (**Table 12**), no significant associations are seen between having problems associated with alcohol or drug use and the exposure to substance use prevention classes. In other words, students who are exposed to substance use prevention education in their schools do not have a decrease in the incidence rate of problems associated with alcohol or drug use. After stratification for levels of school connectedness, the association remains non-significant (**Table 13**).

Results of the adjusted regression model (**Table 12**) show that school connectedness has a significant negative association with problems associated with alcohol and drug use. Compared to students with low levels of school connectedness, students with high levels of school connectedness have a 12% decrease in the incidence rate of problems associated with alcohol use (IRR= 0.88 (95% CI 0.80 – 0.96)) over the past year, and a 23% decrease in the incidence rate of problems associated with drug use (IRR= 0.77 (95% CI 0.65 – 0.92)), after adjusting for all other factors. Another important factor, which shows a significant negative association with problems associated with alcohol use (P<0.001) and drug use (P<0.001) is parental connectedness. Also, the incidence rate of problems associated with alcohol use significantly increases with age. Finally, compared to students who

don't have any friends who use cannabis, students who report that all their friends use cannabis have a significant increase in their incidence rate of problems associated with alcohol use (IRR= 3.44 (95% CI 2.65 – 4.47) and problems associated with drug use (IRR= 7.51 (95% CI 2.72 – 20.7), after controlling for all other factors. All estimates can be seen in **Table 12**.

Table 2: Summary of the continuous/count variables included in the analysis (un-weighted and weighted means, with 95% CIs in parenthesis). (n=6786)

Variable	Range	Un-weighted mean (95% CI)	Weighted mean (95%CI)
Age (n=6767)	**(11 -19)**	15.9 (15.7 – 15.9)	15.9 (15.9 – 16.0)
Parental connectedness level (n= 6786)	**(3-15)**	12.5 (12.4 – 12.5)	12.5 (12.4 – 12.6)
Problems associated with alcohol use among drinkers (n=4159)	**(0-11)**	1.18 (1.13 – 1.23)	1.20 (1.14 – 1.27)
Problems associated with drug use among drug users (n=2482)	**(0-9)**	0.97 (0.92 – 1.03)	1.02 (0.93 – 1.10)

Table 3: Summary of the categorical variables included in the analysis, un-weighted frequencies and weighted percentages with 95% CI in parenthesis. (n=6786)

Variable	Level	Un-weighted frequency	Weighted percentage (95% CI)
Sex	Female	3,409	50.5 (48.5 – 52.5)
	Male	3,234	47.3 (45.4 – 49.3)
	Not indicated	143	2.18 (1.77 – 2.7)
Grade	9	2,150	31.8 (28.7 – 34.9)
	10	2,413	33.8 (30.5 – 37.2)
	12	2,223	34.5 (31.0 – 38.2)
Mother's levels of education	High school or less	1,730	25.0 (23.3 – 26.8)
	Post-secondary education	3,833	58. (55.7 – 60.6)
	No mother/don't know/ not indicated	1,223	16.8 (15.4 – 18.3)
Family's socioeconomic status	Low	412	5.60 (4.88 – 6.43)
	Middle	3,632	54.8 (53.0 – 56.5)
	High	2,368	34.3 (32.3 – 36.3)
	Not indicated	374	5.35 (4.63 – 6.17)
Religiosity	Low importance	4,355	64.6 (63.0 – 66.2)
	High importance	2,431	35.4 (33.8 – 37.0)
Exposure to substance use prevention classes	None	2,667	37.9 (34.5 – 40.5)
	1-2 classes	3,206	48.5 (46.0 – 51.0)
	3+ classes	913	13.6 (12.3 – 15.0)
Level of school connectedness	Low	3,825	57.6 (55.7 – 59.5)
	High	2,961	42.40 (40.55 – 44.28)
Peer use of cannabis	None	1,454	19.5 (17.9 – 21.2)
	A few	3,041	42.4 (40.6 – 44.2)
	Half or more	2,235	38.1 (35.9 – 40.4)
Alcohol use in the past 30 days	None	3,269	50.6 (48.4 – 52.7)
	Used but did not binge drink	1,083	15.2 (14.0 – 16.5)
	Binge drinking	2,434	34.2 (32.4 – 36.1)
Cannabis use in the past 30 days	None	5,395	77.4 (75.7 – 79.1)
	Used but not everyday	966	15.3 (14.2 – 16.5)
	Used everyday or almost everyday	425	7.3 (6.16 – 8.52)
Other illicit drug use* in the past year	No	6,119	89.1 (87.7 – 90.3)
	Yes	667	10.9 (9.72 – 12.3)

* Other illicit drugs: at least one of the following drugs (LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; and methamphetamine).

Table 4: Exposure to school-based substance use prevention programs and levels of school connectedness based on socio-demographic indicators and levels of substance use and problems associated with use. Proportions are in weighted % with 95% CI in parenthesis, continuous variables are weighted means with 95% CI in parenthesis. (n=6786)

Variable	Level	Exposure to school-based substance use prevention				Level of school connectedness		
		No classes (n=2,667)	1-2 classes (n=3,206)	3+ classes (n=913)	p-value	Low (n=3,825)	High (n=2,961)	p-value
Sex	**Female**	48.6	52.8	47.7	0.071	51.3	49.4	0.523
		(45.5 – 51.7)	(50.2 – 55.3)	(43.9 – 51.6)		(48.6 – 54.0)	(46.4 – 52.4)	
	Male	48.9	45.4	50.1		46.5	48.5	
		(46.0 – 51.8)	(42.8 – 47.9)	(46.4 – 53.8)		(43.8 – 49.1)	(45.6 – 51.5)	
	Not indicated	2.52	1.89	2.24		2.27	2.06	
		(1.92 – 1.89)	(1.33 – 2.68)	(1.26 – 3.95)		(1.74 – 2.95)	(1.47 – 2.87)	
Grade	**9**	20.0	32.1	63.4	<0.001	32.3	31.0	0.478
		(16.6 – 23.9)	(28.3 – 36.2)	(58.0 – 68.5)		(28.7 – 36.1)	(27.7 – 34.5)	
	10	36.2	35.7	20.0		34.2	33.2	
		(31.8 – 40.8)	(31.1 – 40.7)	(16.2 – 24.5)		(30.6 – 38.0)	(29.4 – 37.3)	
	12	43.8	32.2	16.5		33.5	35.8	
		(39.1 – 48.7)	(28.0 – 36.6)	(12.8 – 21.1)		(29.8 – 37.5)	(31.6 – 40.1)	
Age (11-19)		16.3	15.9	15.3	<0.001	15.9	16.00	0.781
		(16.1 – 16.4)	(15.7 – 16.0)	(15.2 – 15.4)		(15.8 – 16.0)	(15.9 – 16.1)	
Mother's levels of education	**High school or less**	23.8	25.5	26.7	0.004	27.0	22.3	<0.001
		(21.3 – 26.4)	(23.1 – 28.1)	(22.9 – 30.9)		(24.7 – 29.4)	(20.1 – 24.7)	
	Post-secondary education	57.4	60.1	53.6		54.5	63.2	
		(53.7 – 61.0)	(57.2 – 63.0)	(49.0 – 58.1)		(51.3 – 57.6)	(60.6 – 65.8)	
	No mother/ don't know/ not indicated	18.9	14.4	19.7		18.5	14.4	
		(16.6 – 21.3)	(12.8 – 16.1)	(16.5 – 23.3)		(16.6 – 20.6)	(12.7 – 16.4)	
Family's socioeconomic status	**Low**	5.72	5.66	5.08	<0.001	6.85	3.91	<0.001
		(4.65 – 7.02)	(4.61 – 6.94)	(3.46 – 7.40)		(5.82 – 8.06)	(3.13 – 4.86)	
	Middle	52.7	55.9	56.6		59.1	48.9	
		(50.3 – 55.1)	(53.3 – 58.5)	(51.9 – 61.1)		(56.9 – 61.2)	(46.4 – 51.4)	
	High	33.9	34.3	35.4		28.7	41.9	
		(31.4 – 36.5)	(31.5 – 37.1)	(31.3 – 39.7)		(26.5 – 31.1)	(39.1 - 44.7)	
	Not indicated	7.66	4.20	2.98		5.37	5.31	
		(6.13 – 9.54)	(3.36 – 5.24)	(1.98 – 4.45)		(4.40 – 6.54)	(4.35 – 6.48)	
Religiosity	**Low importance**	67.4	64.4	57.7	<0.001	67.3	61.0	<0.001
		(64.6 – 70.1)	(62.2 – 66.5)	(53.5 – 61.8)		(65.2 – 69.2)	(58.9 – 63.1)	
	High importance	32.6	35.6	42.3		32.7	39.0	
		(29.9 – 35.5)	(33.5 – 37.8)	(38.2 – 46.6)		(30.8 – 34.7)	(36.9 – 41.1)	
Exposure to substance use prevention classes	**None**	-	-	-	-	38.8	36.8	0.471
						(35.9 – 41.7)	(35.5 – 40.5)	
	1-2 classes	-	-	-		48.0	49.2	
						(45.2 – 50.9)	(46.0 – 52.3)	
	3+ classes	-	-	-		13.2	14.0	
						(11.7 – 14.8)	(12.1 – 16.2)	

		Exposure to school-based substance use prevention				Level of school connectedness		
Variable	Level	No classes (n=2,667)	1-2 classes (n=3,206)	3+ classes (n=913)	p-value	Low (n=3,825)	High (n=2,961)	p-value
Level of school connectedness	Low	58.8 (55.9 – 61.7)	57.0 (54.6- 59.4)	56.1 (51.5 – 60.7)	0.471	-	-	-
	High	41.1 (38.3 – 44.1)	43.0 (40.6 – 45.4)	43.9 (39.3 – 48.5)		-	-	
Peer use of cannabis	None	18.6 (16.4 – 21.0)	19.2 (17.0 – 21.7)	22.9 (19.5 – 26.8)	0.172	17.3 (15.6 – 19.1)	22.5 (20.0 – 25.3)	<0.001
	A few	41.6 (39.0 – 44.3)	42.8 (40.4 – 45.2)	43.0 (38.1 – 48.1)		40.6 (38.4 – 42.8)	44.8 (42.2 – 47.5)	
	Half or more	39.8 (36.7 – 42.9)	38.0 (35.3 – 40.8)	34.1 (29.5 – 38.9)		42.2 (39.5 – 44.9)	32.6 (29.8 – 35.6)	
Parental connectedness (3-15)		12.4 (12.3 – 12.5)	12.6 (12.5 – 12.7)	12.5 (12.3 – 12.7)	<0.001	12.1 (12.0 – 12.2)	13.0 (12.8 – 13.1)	<0.001
Alcohol use in the past 30 days	None	48.1 (45.1 – 51.1)	49.6 (46.5 – 52.8)	60.6 (56.2 – 64.8)	<0.001	50.6 (48.2 – 53.0)	50.5 (47.5 – 53.5)	0.134
	Used but did not binge drink	15.3 (13.5 – 17.3)	15.7 (14.0 – 17.5)	13.3 (10.8 – 16.3)		14.3 (12.8 – 15.9)	16.5 (14.6 – 18.6)	
	Binge drinking	36.6 (33.9 – 39.3)	34.7 (31.7 – 37.8)	26.1 (22.9 – 29.7)		35.1 (32.9 – 37.5)	33.0 (30.4 – 35.7)	
Cannabis use in the past 30 days	None	77.7 (75.6 – 79.7)	76.9 (74.1 – 79.4)	78.8 (75.1 – 82.0)	0.650	73.7 (71.4 – 75.9)	82.5 (80.4 – 84.4)	<0.001
	Used but not everyday	15.3 (13.6 – 17.2)	15.3 (13.5 – 17.4)	15.4 (13.0 – 18.1)		17.2 (15.7 – 18.8)	12.7 (11.0 – 14.7)	
	Used everyday or almost everyday	7.00 (6.0 – 8.4)	7.83 (5.88 – 10.4)	5.88 (4.13 – 8.30)		9.10 (7.73 – 10.7)	4.73 (3.61 – 6.19)	
Other illicit drug use* in the past year	No	89.3 (87.5 – 90.8)	88.5 (86.5 – 90.2)	90.5 (87.5 – 92.9)	0.429	85.8 (84.0 – 87.5)	93.5 (92.0 – 94.7)	<0.001
	Yes	10.8 (9.20 – 12.5)	11.5 (9.79 – 13.5)	9.49 (7.12 – 12.5)		14.2 (12.5 – 16.0)	6.54 (5.31 – 8.04)	
Problems associated with alcohol use among drinkers (0-11)	-	1.18 (1.07 – 1.28)	1.23 (1.15 – 1.32)	1.18 (1.01 – 1.36)	0.630	1.33 (1.25 – 1.42)	1.02 (0.93 – 1.11)	<0.001
Problems associated with drug use among drug users (0-9)	-	1.02 (0.89 – 1.16)	1.03 (0.91 – 1.16)	0.92 (0.74 – 1.10)	0.905	1.14 (1.03 – 1.26)	0.80 (0.67 – 0.94)	<0.001

*Other illicit drugs: at least one of the following drugs (LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; and methamphetamine).

Table 5: Substance use levels and problems associated with use by sex and age, proportions are in weighted % with 95% CI in parenthesis, count variables are in means with 95% CI in parenthesis. (n=6786)

		Sex				Grade			
		Female (n= 3,409)	Male (n=3,234)	Not indicated (n=143)	Peason's chi-squared p-value	9th (n=2,150)	10th (n=2413)	12th (n=2223)	Peason's chi-squared p-value
Variable	**Level**								
Alcohol use in the past 30 days	None	48.6 (45.4 – 51.8)	52.3 (49.6 – 55.0)	57.0 (47.6 – 65.9)	<0.001	65 (61.7 – 68.2)	50.9 (47.4 – 54.5)	36.8 (33.6 – 40.3)	<0.001
	Used but did not binge drink	18.0 (16.2 – 20.0)	12.6 (11.0 – 14.2)	12.6 (11.0 – 14.2)		15.6 (13.6 – 17.9)	15.0 (12.9 – 17.4)	15.0 (13.1 – 15.2)	
	Binge drinking	33.3 (30.7	35.1 (32.5 – 37.9)	35.1 (32.5 – 37.9)		19.4 (17.1 – 21.9)	34.0 (30.9 – 37.3)	48.1 (44.9 – 37.3)	
Cannabis use in the past 30 days	None	79.0 (77.1 – 80.8)	75.8 (73.2 – 78.2)	75.9 (65.8 – 83.7)	0.002	83.3 (80.6 – 85.7)	77.3 (74.4 – 80.1)	72.2 (69.0 – 75.1)	<0.001
	Used but not everyday	15.5 (14.0 – 17.1)	15.1 (13.4 – 17.0)	16.0 (9.37 – 25.7)		12.2 (10.4 – 14.2)	14.9 (16.6 – 16.9)	18.6 (13.0 – 20.9)	
	Used everyday or almost everyday	5.50 (4.26 – 7.08)	9.07 (7.67 – 10.7)	8.25 (4.37 – 15.1)		4.53 (3.27 – 6.24)	7.82 (6.03 – 10.1)	9.21 (7.05 – 11.9)	
Other illicit drug use* in the past year	No	89.3 (87.3 – 91.1)	89.0 (87.3- 90.5)	85.0 (77.6 – 90.2)	0.449	92.3 (90.1 – 94.0)	89.3 (87.4 – 91.0)	85.9 (83.0 – 88.3)	<0.001
	Yes	10.7 (8.94 – 12.7)	11.0 (9.53 – 12.8)	15.0 (9.77 – 22.4)		7.73 (6.01 – 9.89)	10.7 (9.05 – 12.6)	14.15 (11.7 – 17.0)	
Problems associated with alcohol use (0-11)	-	1.20 (1.11 – 1.29)	1.20 (1.11 – 1.30)	1.42 (0.93 – 1.92)	<0.001	0.97 (0.87 – 1.08)	1.11 (1.01 – 1.22)	1.40 (1.29 – 1.50)	<0.001
Problems associated with drug use (0-9)	-	1.00 (0.88 – 1.12)	1.02 (0.90 – 1.14)	1.34 (0.75 – 1.94)	0.193	0.91 (0.75 – 1.07)	1.03 (0.87 – 1.18)	1.07 (0.93 – 1.20)	<0.001

* Other illicit drugs: at least one of the following drugs (LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; and methamphetamine).

Table 6: Unadjusted and adjusted# multinomial regression models of alcohol use and binge drinking (past 30 days) on exposure to substance use education, level of school connectedness, and other social and demographic variables (RRR presented with 95% CI's in parenthesis). (n=6786)

	UNADJUSTED			ADJUSTED		
Variables	**Alcohol use vs. no use**	**Binge drinking vs. no use**	**Binge drinking vs. alcohol use**	**Alcohol use vs. no use**	**Binge drinking vs. no use**	**Binge drinking vs. alcohol use**
Classes						
None	1.00	1.00	1.00	1.00	1.00	1.00
1-2	0.99	0.92	0.93	1.01	1.06	1.05
	(0.80 – 1.22)	(0.75 – 1.12)	(0.73 – 1.16)	(0.81 – 1.26)	(0.85 – 1.33)	(0.82 – 1.34)
3+	0.69 *	0.57 **	0.82	0.78	0.77	0.99
	(0.51 – 0.93)	(0.45 – 0.71)	(0.63 – 1.10)	(0.56 – 1.10)	(0.59 – 1.02)	(0.74 – 1.33)
School connectedness						
Low	1.00	1.00	1.00	1.00	1.00	1.00
High	1.16	0.94	0.81 *	1.33 *	1.21 *	0.91
	(0.96 – 1.40)	(0.81 – 1.09)	(0.66 – 1.00)	(1.10 – 1.62)	(1.01 – 1.45)	(0.72 – 1.15)
Province						
NS	1.00	1.00	1.00	1.00	1.00	1.00
NB	0.98	0.86	0.88	1.51	1.18	1.03
	(0.77 – 1.25)	(0.70 – 1.06)	(0.71 – 1.10)	(0.88 – 1.50)	(0.95 – 1.47)	(0.81 – 1.29)
NF&L	1.14	1.38 *	1.21	1.30	1.83 **	1.41 *
	(0.86 – 1.52)	(1.10 – 1.76)	(0.89 – 1.63)	(0.97 – 1.75)	(1.40 – 2.40)	(1.16 – 1.37)
Age	1.19 **	1.51 **	1.27 **	1.12 *	1.41 **	1.26 **
	(1.09 – 1.29)	(1.40 – 1.62)	(1.17 – 1.37)	(1.02 – 1.23)	(1.30 – 1.52)	(1.16 – 1.37)
Sex						
Female	1.00	1.00	1.00	1.00	1.00	1.00
Male	0.65 **	0.98	1.51 **	0.59 **	0.91	1.54 **
	(0.53 – 0.79)	(0.81 – 1.18)	(1.22 – 1.88)	(0.48 – 0.74)	(0.74 – 1.22)	(1.22 – 1.94)
Not indicated	0.36 *	0.91	2.54 *	0.41	1.12	2.74 *
	(0.15 – 0.87)	(0.61 – 1.35)	(1.01 – 6.53)	(0.14 – 1.17)	(0.66 – 1.87)	(1.04 – 7.23)
Mother's education						
High school or less	1.00	1.00	1.00	1.00	1.00	1.00
Post-secondary education	1.11	0.94	0.84	1.15	1.07	0.93
	(0.87 – 1.42)	(0.78 – 1.12)	(0.66 – 1.08)	(0.91 – 1.45)	(0.87 – 1.32)	(0.71 – 1.23)
No mother/don't know/ not indicated	0.76 *	0.55 **	0.73 *	0.88	0.69 *	0.78
	(0.58 – 0.99)	(0.45 – 0.68)	(0.55 – 0.95)	(0.67 – 1.16)	(0.53 – 0.89)	(0.59 – 1.03)
Family's SES						
Low	1.00	1.00	1.00	1.00	1.00	1.00
Middle	1.37	1.10	0.79	1.56 *	1.48 *	0.94
	(0.91 – 2.10)	(0.79 – 1.49)	(0.52 – 1.22)	(10.1 – 2.4)	(1.02 – 2.15)	(0.60 – 1.51)
High	1.44	1.11	0.77	1.71 *	1.95 **	1.14
	(0.94 – 2.21)	(0.82 – 1.51)	(0.50 – 1.19)	(1.07 – 2.72)	(1.32 – 2.87)	(0.72 – 1.82)
Not indicated	0.96	0.80	0.83	1.34	1.44	1.10
	(0.52 – 1.77)	(0.52 – 1.25)	(0.45 – 1.57)	(0.69 – 2.63)	(0.80 – 2.61)	(0.54 – 2.13)
Peer use of cannabis						
None	1.00	1.00	1.00	1.00	1.00	1.00
A few	2.91 **	6.74 **	2.32 **	2.8 **	5.60 **	1.99 **
	(2.26 – 3.75)	(5.24 – 8.68)	(1.72 – 3.12)	(2.15 – 3.69)	(4.28 – 7.30)	(1.47 – 2.70)
Half or more	3.81 **	20.21 **	5.30 **	3.40 **	14.10 **	4.14 **
	(2.85 – 5.10)	(15.28 – 26.73)	(3.86 – 7.27)	(2.49 – 4.65)	(10.40 – 19.10)	(2.96 – 5.79)
Parental connectedness	0.88 **	0.76 **	0.86 **	0.90 **	0.81 **	0.91 **
	(0.85 – 0.92)	(0.73 – 0.79)	(0.82 – 0.89)	(0.86 – 0.94)	(0.78 – 0.85)	(0.86 – 0.95)
Religiosity						
Low importance	1.00	1.00	1.00	1.00	1.00	1.00
High importance	0.78 *	0.60 **	0.77 *	0.79 *	0.72 *	0.91
	(0.65 – 0.94)	(0.51 – 0.71)	(0.61 – 0.96)	(0.65 – 0.95)	(0.58 – 0.89)	(0.71 – 1.17)

* P value <0.05
** P value <0.001
# Adjusted for: province, school connectedness, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

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Table 7: Adjusted# multinomial regression models of alcohol use and binge drinking (past 30 days) on exposure to substance use prevention classes, stratified by school connectedness (RRR presented with 95% CI's in parenthesis). (n=6786)

Classes	Alcohol use vs. no use			Binge drinking vs. no use			Binge drinking vs. alcohol use		
	Overall	Low SC	High SC	Overall	Low SC	High SC	Overall	Low SC	High SC
None	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1-2	1.02 (0.82 – 1.27)	1.08 (0.83 – 1.40)	0.99 (0.71 – 1.38)	1.07 (0.85 – 1.33)	1.02 (0.78 – 1.33)	1.12 (0.79 – 1.60)	1.05 (0.82 – 1.34)	0.95 (0.70 – 1.28)	1.13 (0.76 – 1.69)
3+	0.79 (0.56 – 1.10)	0.84 (0.57 – 1.25)	0.74 (0.46 – 1.18)	0.78 (0.59 – 1.03)	0.55 * (0.38 – 0.79)	1.25 (0.80 – 1.94)	0.99 (0.74 – 1.33)	0.65 * (0.44 – 0.97)	1.69 * (1.10 – 2.63)

* P value <0.05
** P value <0.001
# Adjusted for: province, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

Table 8: Unadjusted and adjusted# multinomial regression models of cannabis use and daily or almost daily use (past 30 days) on exposure to substance use education, level of school connectedness, and other social and demographic variables (RRR presented with 95% CI's in parenthesis). (n=6786)

Variables	UNADJUSTED RRR (95% CI)			ADJUSTED RRR (95% CI)		
	Cannabis use vs. no use	Daily or almost daily cannabis use vs. no use	Daily or almost daily cannabis use vs. cannabis use	Cannabis use vs. no use	Daily or almost daily cannabis use vs. no use	Daily or almost daily cannabis use vs. cannabis use
Classes						
None	1.00	1.00	1.00	1.00	1.00	1.00
1-2	1.01	1.13	1.12	1.14	1.43	1.25
	(0.83 – 1.24)	(0.77 – 1.67)	(0.71 – 1.77)	(0.92 – 1.42)	(0.91 – 2.24)	(0.77 – 2.03)
3+	0.99	0.83	0.84	1.31	1.25	0.96
	(0.77 – 1.27)	(0.55 – 1.24)	(0.54 – 1.29)	(0.97 – 1.75)	(0.78 – 2.00)	(0.62 – 1.49)
School connectedness						
Low	1.00	1.00	1.00	1.00	1.00	1.00
High	0.66 **	0.46 **	0.70 *	0.86	0.68 *	0.79
	(0.54 – 0.81)	(0.35 – 0.61)	(0.50 – 0.98)	(0.68 – 1.10)	(0.51 – 0.90)	(0.57 – 1.09)
Province						
NS	1.00	1.00	1.00	1.00	1.00	1.00
NB	0.67 **	0.73	1.08	0.94	1.01	1.07
	(0.54 – 0.83)	(0.50 – 1.06)	(0.73 – 1.61)	(0.76 – 1.18)	(0.69 – 1.49)	(0.72 – 1.58)
NF&L	0.74 *	0.81	1.09	0.82	0.87	1.06
	(0.59 – 0.93)	(0.49 – 1.33)	(0.69 – 1.72)	(0.63 – 1.10)	(0.50 – 1.52)	(0.68 – 1.67)
Age	1.20 **	1.33 **	1.11	1.08	1.25 *	1.16 *
	(1.12 – 1.28)	(1.16 – 1.52)	(0.98 – 1.25)	(0.99 – 1.17)	(1.10 – 1.45)	(1.02 – 1.32)
Sex						
Female	1.00	1.00	1.00	1.00	1.00	1.00
Male	1.02	1.72 **	1.69 **	1.05	1.89 **	1.80 **
	(0.84 – 1.22)	(1.30 – 2.27)	(1.24 – 2.30)	(0.84 – 1.30)	(1.36 – 2.62)	(1.32 – 2.46)
Not indicated	1.07	1.56	1.46	1.16	1.45	1.25
	(0.57 – 1.99)	(0.75 – 3.24)	(0.57 – 3.74)	(0.60 – 2.25)	(0.57 – 3.72)	(0.41 – 3.78)
Mother's education						
High school or less	1.00	1.00	1.00	1.00	1.00	1.00
Post-secondary education	0.73 *	0.48 **	0.64 *	0.88	0.63 *	0.72
	(0.60 – 0.94)	(0.37 – 0.62)	(0.46 – 0.88)	(0.66 – 1.17)	(0.47 – 0.84)	(0.51 – 1.02)
No mother/don't know/ not indicated	0.61 **	0.79	1.30	0.76	0.99	1.31
	(0.45 – 0.82)	(0.55 – 1.14)	(0.82 – 2.10)	(0.53 – 1.10)	(0.65 – 1.52)	(0.81 – 2.10)
Family's SES						
Low	1.00	1.00	1.00	1.00	1.00	1.00
Middle	0.81	0.61 *	0.75	0.98	0.79	0.81
	(0.56 – 1.18)	(0.38 – 0.98)	(0.42 – 1.33)	(0.67 – 1.45)	(0.42 – 1.50)	(0.43 – 1.51)
High	0.65 *	0.32 **	0.49 *	1.02	0.70	0.69
	(0.44 – 0.97)	(0.19 – 0.52)	(0.27 – 0.87)	(0.67 – 1.54)	(0.36 – 1.36)	(0.34 – 1.37)
Not indicated	0.74	0.73	0.99	1.16	1.10	0.95
	(0.41 – 1.32)	(0.39 – 1.37)	(0.45 – 2.19)	(0.60 – 2.22)	(0.46 – 2.61)	(0.39 – 2.30)
Peer use of cannabis						
None	1.00	1.00	1.00	1.00	1.00	1.00
A few	85.18 **	5.77 *	0.07 *	66.91 **	3.84	0.06 *
	(23.99 – 302.40)	(1.26 – 26.43)	(0.01 – 0.49)	(18.81 – 238.10)	(0.83 – 17.85)	(0.01 – 0.42)
Half or more	523.15 **	184.37 **	0.35	362.30 **	106.13 **	0.29
	(148.79 – 1839.43)	(42.38 – 802.12)	(0.05 – 2.50)	(102.38 – 1282.10)	(24.14 – 466.55)	(0.04 – 2.10)
Parental connectedness	0.75 **	0.65 **	0.87 **	0.83 **	0.74 **	0.89 **
	(0.71 – 0.78)	(0.62 – 0.69)	(0.82 – 0.93)	(0.78 – 0.87)	(0.69 – 0.79)	(0.83 – 0.95)
Religiosity						
Low importance	1.00	1.00	1.00	1.00	1.00	1.00
High importance	0.53 **	0.41 **	0.78	0.64 **	0.60 *	0.95
	(0.42 – 0.66)	(0.29 – 0.59)	(0.52 – 1.18)	(0.51 – 80)	(0.38 – 0.93)	(0.60 – 1.49)

* P value <0.05
** P value <0.001
# Adjusted for: province, school connectedness, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

Table 9: Adjusted# multinomial regression models of cannabis use and daily or almost daily use (past 30 days) on exposure to substance use prevention classes, stratified by school connectedness (RRR presented with 95% CI's in parenthesis). (n=6786)

Classes	Cannabis use vs. no use			Daily or almost daily cannabis use vs. no use			Daily or almost daily cannabis use vs. cannabis use		
	Overall	Low SC	High SC	Overall	Low SC	High SC	Overall	Low SC	High SC
None	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1-2	1.14 (0.91 – 1.42)	1.97 (0.90 – 1.59)	1.05 (0.73 – 1.50)	1.43 (0.91 – 2.26)	1.24 (0.83 – 1.87)	2.26 (0.96 – 5.29)	1.26 (0.77 – 2.04)	1.04 (0.63 – 1.70)	2.15 (0.98 – 4.74)
3+	1.30 (0.96 – 1.74)	1.37 (0.92 – 2.05)	1.19 (0.78 – 1.81)	1.24 (0.78 – 1.97)	1.06 (0.60 – 1.90)	2.24 (0.92 – 5.44)	0.95 (0. 61 - 1.48)	0.77 (0.46 – 1.34)	1.88 (0.81 – 4.40)

* P value <0.05
** P value <0.001
\# Adjusted for: province, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

Table 10: Unadjusted and adjusted# logistic regression models of other illicit drug use (past 12 months) on exposure to substance use education, level of school connectedness, and other social and demographic variables (OR presented with 95% CI's in parenthesis). (n=6786)

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Classes		
None	1.00	1.00
1-2	1.08	1.24
	(0.87 – 1.33)	(0.98 – 1.57)
3+	0.87	1.22
	(0.62 – 1.23)	(0.80 – 1.84)
School connectedness		
Low	1.00	1.00
High	0.42 **	0.59 **
	(0.34 – 0.54)	(0.45 – 0.78)
Province		
NS	1.00	1.00
NB	0.91	1.30
	(0.68 – 1.22)	(0.94 – 1.80)
NF&L	0.99	1.16
	(0.71 – 1.40)	(0.82 – 1.65)
Age	1.29 **	1.20 *
	(1.15 – 1.45)	(1.06 – 1.36)
Sex		
Female	1.00	1.00
Male	1.04	1.03
	(0.82 – 1.32)	(0.81 - 1.30)
Not indicated	1.48	1.37
	(0.86 – 2.55)	(0.62 – 3.00)
Mother's education		
High school or less	1.00	1.00
Post-secondary education	0.49 **	0.61 *
	(0.35 – 0.68)	(0.43 – 0.88)
No mother/don't know/ not indicated	0.48 **	0.52 *
	(0.33 – 0.70)	(0.34 – 0.81)
Family's SES		
Low	1.00	1.00
Middle	0.46 **	0.57 *
	(0.31 – 0.69)	(0.37 – 0.88)
High	0.27 **	0.50 *
	(0.18 – 0.40)	(0.32 – 0.79)
Not indicated	0.40 **	0.55
	(0.22 – 0.70)	(0.27 – 1.11)
Peer use of cannabis		
None	1.00	1.00
A few	15.52 **	10.79 **
	(6.64 – 36.32)	(4.55 – 25.53)
Half or more	173.96 **	97.80 **
	(75.24 – 402.25)	(0.72 – 0.80)
Parental connectedness	0.68 **	0.76 **
	(0.66 – 0.71)	(0.72 – 0.80)
Religiosity		
Low importance	1.00	1.00
High importance	0.49 **	0.73 *
	(0.37 – 0.64)	(0.54 – 0.98)

* P value <0.05
** P value <0.001
# Adjusted for: province, school connectedness, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

Table 11: Adjusted# logistic regression models of other illicit drug use (past 12 months) on exposure to substance use prevention classes, stratified by school connectedness (OR presented with 95% CI's in parenthesis).

Classes	Overall	Low SC	High SC
None	1.00	1.00	1.00
1-2	1.25 (0.99 – 1.59)	1.24 (0.91 – 1.71)	1.30 (0.77 – 2.19)
3+	1.21 (0.80 – 1.83)	1.29 (0.78 – 2.12)	1.13 (0.58 - 2.23)

* P value <0.05
** P value <0.001
\# Adjusted for: province, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

Table 12: Unadjusted and adjusted# negative binomial regression models of problems associated with alcohol use and drug use (past 12 months) on exposure to substance use education, level of school connectedness, and other social and demographic variables (IRR presented with 95% CI's in parenthesis).

Variables	UNADJUSTED		ADJUSTED	
	Problems associated with alcohol use among drinkers (n=4518)	Problems associated with drug use among drug users (n=2481)	Problems associated with alcohol use among drinkers (n= 4138)	Problems associated with drug use among drug users (n=2466)
Classes				
None	1.00	1.00	1.00	1.00
1-2	1.05	1.01	1.09	1.01
	(0.94 – 1.17)	(0.85 – 1.20)	(0.99 – 1.20)	(0.87 – 1.18)
3+	1.01	0.90	1.10	1.02
	(0.84 – 1.21)	(0.70 – 1.15)	(0.93 – 1.30)	(0.81 – 1.28)
School connectedness				
Low	1.00	1.00	1.00	1.00
High	0.76 **	0.70 **	0.88 *	0.77 *
	(0.69 – 0.84)	(0.58 – 0.85)	(0.80 – 0.96)	(0.65 - 0.92)
Province				
NS	1.00	1.00	1.00	1.00
NB	0.83 *	0.93	0.94	0.96
	(0.73 – 0.94)	(0.76 – 1.13)	(0.84 – 1.06)	(0.80 – 1.15)
NF&L	1.09	0.87	1.16 *	0.88
	(0.96 – 1.24)	(0.71 – 1.06)	(1.03 – 1.30)	(0.72 – 1.08)
Age	1.10 **	1.05	1.12 **	1.07
	(1.04 – 1.17)	(0.98 – 1.13)	(1.08 – 1.16)	(1.00 – 1.14)
Sex				
Female	1.00	1.00	1.00	1.00
Male	1.00	1.02	0.99	1.05
	(0.91 – 1.11)	(0.86 – 1.20)	(0.90 – 1.08)	(0.89 – 1.23)
Not indicated	1.19	1.34	1.11	1.18
	(0.83 – 1.70)	(0.83 – 2.17)	(0.72 – 1.70)	(0.70 – 2.00)
Mother's education				
High school or less	1.00	1.00	1.00	1.00
Post-secondary education	0.93	0.97	1.02	1.02
	(0.83 – 1.05)	(0.82 – 1.17)	(0.91 – 1.14)	(0.86 – 1.19)
No mother/don't know/ not indicated	0.79 *	0.86	0.81 *	0.81 *
	(0.67 – 0.94)	(0.69 – 1.06)	(0.69 – 0.94)	(0.66 – 0.99)
Family's SES				
Low	1.00	1.00	1.00	1.00
Middle	0.65 **	0.79	0.77 *	0.92
	(0.52 – 0.80)	(0.59 – 1.06)	(0.62 – 0.95)	(0.70 – 1.21)
High	0.60 **	0.69 *	0.83	0.92
	(0.48 – 0.74)	(0.51 – 0.93)	(0.67 – 1.02)	(0.69 – 1.21)
Not indicated	0.53 **	0.86	0.68 *	0.93
	(0.38 – 0.74)	(0.55 – 1.32)	(0.49 – 0.96)	(0.63 – 1.39)
Peer use of cannabis				
None	1.00	1.00	1.00	1.00
A few	3.32 **	2.87 *	2.02 **	2.59
	(1.79 – 3.01)	(0.98 – 8.41)	(1.56 – 2.61)	(0.94 – 7.18)
Half or more	4.53 **	9.21 **	3.44 **	7.51 **
	(3.48 – 5.89)	(3.16 – 26.86)	(2.65 – 4.47)	(2.72 – 20.7)
Parental connectedness	0.86 **	0.86 **	0.89 **	0.88 **
	(0.84 – 0.88)	(0.84 – 0.89)	(0.89 – 0.91)	(0.85 – 0.91)
Religiosity				
Low importance	1.00	1.00	1.00	1.00
High importance	0.86 *	0.87	0.97	0.99
	(0.78 – 0.95)	(0.72 – 1.05)	(0.87 – 1.08)	(0.84 – 1.18)

* P value <0.05
** P value <0.001
# Adjusted for: province, school connectedness, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, religiosity.

Table 13: adjusted# logistic regression models of problems associated with alcohol use and problems associated with drug use (past 12 months) on exposure to substance use prevention classes, stratified by school connectedness (IRR presented with 95% CI's in parenthesis).

Classes	Problems associated with alcohol use among drinkers			Problems associated with drug use among drug users		
	Overall (n=4138)	Low SC (n=2401)	High SC (n=1737)	Overall (n=2466)	Low SC (n=1543)	High SC (n=923)
None	1.00	1.00	1.00	1.00	1.00	1.00
1-2	1.09 (0.99 – 1.19)	1.97 (0.95 – 1.21)	1.14 (0.97 – 1.33)	1.01 (0.87 – 1.18)	0.98 (0.82 – 1.17)	1.13 (0.87 – 1.47)
3+	1.10 (0.93 – 1.29)	1.11 (0.90 – 1.35)	1.14 (0.84 – 1.54)	1.01 (0.80 – 1.26)	1.04 (0.79 – 1.39)	1.05 (0.75 – 1.47)

* P value <0.05
** P value <0.001
# Adjusted for: province, age, sex, mother's levels of education, family's socioeconomic status, peer use of cannabis, parental connectedness, and religiosity.

CHAPTER 6: DISCUSSION

6.1 Discussion of the results

The purpose of this study was to explore students' levels of school connectedness as a possible factor that may impact the effectiveness of school-based substance use prevention education in reducing substance use levels and related harms among high school students. Researchers who reviewed the most recent evidence on school-based substance use prevention programs have highlighted that it still remains unclear which components of these programs are responsible for effectiveness and how they exert their effect either independently or in combination with other factors. (13) Examining the possible role of school connectedness, in combination with different levels of exposure to school-based substance use prevention education was performed in this study. The independent role of school connectedness on substance use, misuse, and related problems was also explored.

There are four major findings from this study. First, in terms of descriptive statistics, substance use is prevalent among high school students, in grade 9 and above, in the Atlantic Provinces of Canada. Almost half (49.4%) of the students indicate that they have used alcohol and 22.6% indicate that they have used cannabis in the past month, while around 11% report that they have used other illicit drugs in the past year. Just below two thirds (62.1%) of students received at least one class on substance use prevention education during their school year, and less than half of the students (42%) reported a high level of school connectedness. Second, after adjusting for socio-demographic factors, age, sex, school connectedness, parental connectedness, religiosity, and peer use of cannabis, students who are exposed to these substance use prevention education classes do not have a significant decrease in their risk of using alcohol, cannabis, or other illicit drugs. They also do not have a significant decrease in the incidence rate of problems associated with substance use.

Third, stratifying for school connectedness showed a picture opposite to what was expected for alcohol use, and no additional benefits for drug use. Specifically, among

students with *low* levels of school connectedness, those who are exposed to three or more prevention education classes (compared to no exposure) have a significant decrease in the risk of binge drinking compared to no use (RRR= 0.55, 95% CI 0.38 – 0.79), and binge drinking compared to moderate use (RRR= 0.65, 95% CI 0.44-0.97). On the other hand, students with high levels of school connectedness who are exposed to 3 or more classes (compared to no exposure) have a significant increase in the risk of binge drinking compared to only the moderate use of alcohol (RRR= 1.69, 95% CI 1.10 – 2.63). However, for cannabis and other illicit drug use, and for the incidence of problems associated with alcohol and drug use, stratifying for school connectedness did not reveal any significant associations between exposure to classes and these outcomes. The fourth and final major finding from this study is that school connectedness and parental connectedness both have a negative association with levels of cannabis use, other illicit drug use, as well as the incidence of problems associated with both alcohol and drug use. However, a high level of school connectedness is associated with a significant increase in the risk of alcohol use and binge drinking.

The number of classes that students reported being exposed to in the current school year differed significantly by grade. The highest proportion of students who report having three or more classes are in grade 9, followed by grade 10, then, the smallest proportion are in grade 12. The opposite is seen for students reporting not attending any classes related to substance use prevention, as the highest proportion are grade 12 students. The variation in exposure to substance use prevention education classes among students across the different grade levels, as well as within the same grade, may be driven by differences in provincially provided substance use education. Currently, in Nova Scotia, these classes are presented to students up to grade 9, while in New Brunswick they are presented to students up to grade 10. In Newfoundland and Labrador, on the other hand, no provincially provided education is presented to high school students. (47-49) When these classes are not provided to students on the provincial level, individual schools or school boards may choose to present these classes to their students independently of other schools in the

province. In addition, the possibility that classes were presented later in the school year (i.e. after they SDUSAP was administered), or that some students failed to identify these classes as being 'drug prevention classes' is a plausible explanation for the variation seen.

Approximately 42% of students are found to have high levels of school connectedness in this study. This proportion is higher than that reported in the Health Behavior in School-Aged Children study, in which only 24% of girls and 19% of boys aged 15 indicated that they 'like school a lot'. (3) However, a direct comparison cannot be made because the HBSAC survey asked students to indicate how much they liked school on a scale from 'I don't like it at all' to 'I like it a lot', but only the most positive extreme is reported. On the other hand, in this study, we categorized students as having high school connectedness if they indicate that they 'strongly agree' on at least one of the statements in the school connectedness scale, in addition to indicating that they at least 'agree' on the two others. In addition, the scale used in this study incorporates feelings of being happy, safe, and connected to others in school, which makes a direct comparison with feeling of only 'liking' school difficult. A study of grade 7 to 12 students in PEI and New Brunswick used a longer version of the scale than that which was used in this study. (77) The study found that from a possible range between 0-15 on the measure of school connectedness, students in PEI had an average score of 9.71 and students in NB, 9.76. Another study, which assessed levels of school connectedness among grade 10-12 students from a rural community in southwestern Nova Scotia found that from a possible range between 6-30, with a higher score indicating higher school connectedness, boys had an average score of 20.7, and girls had an average score of 21.0. Despite the differences in measurement tools being used, the results of our study and those from previous studies all indicate that there is room to improve levels of school connectedness among high school students enrolled in schools in Atlantic Canada.

Similar to national trends, this study shows that substance use levels are higher among older students. (1, 5) The proportions of students reporting binge drinking,

recreational cannabis use, the daily use of cannabis, and the use of other illicit drugs steadily increase as age progresses (i.e. higher grade). However, an equal proportion of students in all grades report drinking alcohol, without binge drinking.

The main results of this study show that after adjusting for known confounders including age, sex, family's socioeconomic status, mother's level of education, peer cannabis use, religiosity and parental connectedness, school-based substance use education is not associated with a significant decrease in the risk of alcohol, cannabis, or other illicit drug use, neither as use per se, nor the heavy use in the form of binge drinking or the daily use of cannabis. These findings are in keeping with many previous studies which have examined the impact of school-based substance use education on substance use levels among students. (12, 13) Less often, programs have shown positive results. (12) Certain school-based alcohol prevention programs, which teach psychosocial and life skills, were found to be effective in reducing alcohol use. (78) A recent meta-analysis by Hennessey and Tanner-Smith suggests that individually-delivered brief alcohol interventions in schools may be more effective than group-delivered programs. (79)

In terms of illicit drug use prevention, which includes cannabis and other illicit drugs, Fiaggiano et al. have categorized prevention programs into three groups: programs based on social competence, programs based on social influence, and programs based on a combination of methods from the previous two program types. (13) The question inquiring about substance use education in the SDUSAP asked students about exposure to classes teaching about: decision-making, peer pressure, assertiveness or refusal skills. (2) These may be viewed as classes resembling the social competence curricula, in which adolescents are taught about generic personal and social skills through instruction, demonstration, feedback, reinforcement, and other methods. These programs, in general, seem to occupy the majority of school-based drug use prevention programs internationally.

Evidence shows that these programs, when compared to usual curricula, show a common tendency towards improving knowledge about drugs, reducing intentions to use and reducing actual use, but seldom are the effects statistically significant. (13) It is worth noting that results from the adjusted regression models in this study show that the exposure to three or more classes is associated with a 31% *increased* relative risk of using cannabis, and 21% *increased* risk of daily use of cannabis, and 22% *increased* risk of the use of other illicit drugs, although the results are not statistically significant. Adverse effects for drug prevention education, in the form of increased substance use, have been documented in past studies. (80, 81) Researchers have found that drug prevention programs can lead to an increase in alcohol use, cannabis use, and multiple drug use. (81) These negative effects were more commonly seen for drug prevention programs compared to alcohol prevention programs. Given the cross-sectional nature of the data analyzed in this study, a higher likelihood of reporting using drugs from students who are exposed to three or more classes could also alternatively reflect that schools with students who use drugs frequently choose to expose their students to more substance use prevention education. Inferences about temporality cannot be made.

Stratifying for levels of school connectedness in the regression analysis of this study showed that for cannabis and other illicit drug use, high school connectedness does not alter the effect of substance use prevention classes. In other words, compared to students with low levels of school connectedness, students with high levels of school connectedness are not more likely to show a decrease in their risk of substance use when exposed to these classes. However, for alcohol use, *lower* levels of school connectedness in combination with being exposed to three or more classes, compared to no exposure to classes, was associated with statistically significantly lower levels of binge drinking compared to no use (RRR= 0.55 (95% CI 0.38 – 0.79), and binge drinking compared to moderate alcohol use (RRR= 0.65 (95%CI 0.44-0.97). In addition, higher levels of school connectedness are associated with higher levels of alcohol consumption in two ways. First, a positive association is seen between the exposure to three or more classes on substance use prevention

education and binge drinking, compared on only moderate use of alcohol, among students who report high levels of school connectedness. Second, students who report higher levels of school connectedness have a significantly increased risk of alcohol drinking and binge drinking compared to students with low levels of school connectedness, after controlling for all other factors.

Higher levels of school connectedness, especially as measured by the SDUSAP, may reflect stronger relations to peers and higher communication skills (i.e. pro-social behavior), which seem to be associated with a significantly higher likelihood of alcohol initiation among youth.(82-84) Longitudinal studies suggest that greater identification with peers is a significant predictor of onset of drinking (82), and that students who report greater levels of drinking among their friends are more likely to become drinkers than those who do not.(84) The mere presence of a high prevalence of alcohol use among peers has been shown to predict onset of alcohol use among teenage abstainers. (85, 86) Sociability could also play a role in alcohol use initiation. Fleming et al. found that a delayed onset of alcohol use in adolescence among African-American girls, and to a lesser degree, boys, was predicted by teacher ratings of lack of sociability and shyness in grade 1. (87) Drinking alcohol is, to a large extent, a social activity. Adolescents often don't drink alone, and some studies have attributed the largest influence on drinking habits to close friends. (88) In addition, it is suggested that adolescent boys and girls at some points during their development select their peers based on similar drinking habits. (89) It has been proposed that even through prevention programs, when the construct of communication skills is improved, an iatrogenic effect on alcohol consumption may follow. (88) Other aspects of school connectedness, such as connectedness to adults and teachers in the school, or the extent of involvement in extracurricular activities, could show different associations with alcohol use. However, these aspects have not been measured in the scale used in this study.

While discussing what factors lead to more alcohol consumption among adolescents, it is worth mentioning that some early researches have suggested that

for certain groups of students, particularly adolescent boys, alcohol drinking within a culture of socialization can have positive effects on their future. (91, 92) Matza suggested that less serious subcultural involvements, such as drinking and partying, might benefit adolescent boys in two ways. First, these involvements may deter boys from getting involved in more deviant inclinations. Second, participation in these "party subcultures" can play a role in the sex-role socialization of young boys, and build foundations for future adult network ties. Such activities may yield substantial rewards in future network-building activities that reflect directly on work success and status attainment. (91) In addition, John Hagan has shown through his research that the involvement of adolescent boys in the 'party subculture', which includes activities like drinking, gambling, and other less reputable pleasures, can have positive outcomes for boys in adulthood. Specifically, after controlling for the commonly seen adverse effects of partying on students' educational attainment in the analysis, Hagan's results demonstrated that boys who are involved in the party subculture do achieve higher status attainment in adulthood. However, this association is class-specific, and only seen for boys who come from non-working-class families. (92) These theories may highlight some of the unconscious motives underlying the choice to drink among adolescents.

The finding that a higher risk of drinking is associated with higher levels of connectedness and sociability has not always been consistent in the literature, as some studies show opposing findings. In their study 'Protecting Adolescents from Harm' Resnick et al. showed a significant decrease in the risk of alcohol drinking for students with higher levels of school connectedness. (19) School connectedness was a measure of closeness to others in school and of feeling part of school, and that teachers treat students fairly in school. (19) Similarly, a study from New Zealand shows that 15-year-old students who report higher levels of school engagement do have a significantly lower risk of binge drinking. However, school engagement in the study from New Zealand was a reflection of students' perception about their relationship with the adults and teachers in school, and not their peers. Taking a look at the findings of this study and comparing it with previous work raises the

methodological question: are all the researchers reporting on school connectedness actually measuring the same thing? A measure of the construct 'school connectedness' which explicitly inquires about relationships with adults and teachers in the school, about relationships with peers, and about the extent of involvement in school activities as separate factors may give a more complete and accurate picture. (93)

A different, more favorable, picture emerges when examining the results of school connectedness and drug use. The adjusted multinomial regression model shows that a higher level of school connectedness is significantly negatively associated with the daily use of cannabis and the use of other illicit drugs among students. Students who report high school connectedness have a 32% decreased risk of daily cannabis use, and a 41% decrease in the odds of other illicit drug use, when compared to students with low school connectedness. However, when it comes to examining the association between school connectedness and the recreational use of cannabis, and the daily use of cannabis compared to only recreational use, we can see that the risk is decreased for both, but the association is not statistically significant. Overall, previous studies have repeatedly shown a protective effect for school connectedness on drug use,. (18, 19, 23, 56) It is possible that the protective effect of high school connectedness on the heavy use of cannabis and the use of other illicit drugs, but not the recreational use of cannabis, that is observed in this study may be influenced by the 'normalization' of the recreational use of cannabis that has emerged in recent years.

Some researchers have argued that while social connectedness may increase the risk of substance use among young people (94), school connectedness may buffer that effect to act as a protective factor. (23) For example, Bond et al. examined the effect of school and social connectedness of 8th graders on their substance use levels 2 years later. They found that students who were socially connected but not connected to school at baseline were more likely to use cannabis. No such increase in risk was seen for students with good school and poor social connectedness. (23)

Another study from New Zealand shows that students who reported high levels of school engagement had a 55% reduction in the odds of using cannabis 3 or more times in the past month. (18) Resnick et al. also demonstrated that compared to other students, students with higher school connectedness used cannabis significantly less frequently. (19)

Similar to the effect of school connectedness on alcohol use, the question on what the construct 'school connectedness' is actually measuring in each of the studies is raised again. Perhaps an answer to this methodological question can be found in the work presented by McNeely and Falci in 2004. (93)In their study, the original six-questions scale of school connectedness that was presented in the National Longitudinal Study of Adolescent Health was analyzed in relation to substance use habits as two separate dimensions; one reflecting perceived teacher support (as measured by the three statements assessing teacher fairness, support, and how well the student gets along with his/her teachers), and the other reflecting social belonging (as measured by three statements assessing the student's closeness to people at school, sense of belonging to school, and level of happiness at school). They have found that these two dimensions exert different effects on the initiation of health-risk behaviors including drinking to the point of getting drunk, and marijuana use. Specifically, students who report higher levels of teacher support were less likely to initiate these habits. On the other hand, students who score high on the indicators of social belonging were *not* less likely to initiate marijuana use or drinking to the point of getting drunk. (93)

Catalano et al. present a possible explanation through their Social Development Model for the argument that students' behavior could be directly influenced by the bonds that they create with school.(57, 58) They suggest that children learn patterns of behavior from the socializing agents around them, including those present in school. When the consistent presence of social opportunities is coupled with equipping children with the necessary socializing skills and the right amount of awards and reinforcement, they create social bonds to the agents around them that,

subsequently, exert a controlling effect on their behavior. Motivated by a fear of losing the bond, students who feel attached to the socializing agent (i.e. school) will choose to adhere to the values and norms of the school.(57, 58) As previously discussed, school connectedness in this study may be a measure reflecting, in whole or in part, bonding to peers. Therefore, as suggested by the Social Development Model, the influence that higher levels of school connectedness may exert on substance use habits (lower daily cannabis use, lower other illicit drug use, but higher alcohol use and binge drinking) may reflect social norms in substance use habits among peers in Canadian high school students. Following the same argument, McNeely and Falci argued that if the school connectedness bond is created between student and teacher (who most likely promotes pro-social and anti-substance use behaviors), and not student and peer (who could promote social norms within that age group, including pro-alcohol and recreational cannabis use), then a protective effect on substance use may be seen with higher levels of school connectedness.

In light of the evidence indicating a largely non-significant association between school-based substance use prevention education, as measured in the current study, and levels of substance use, the potential positive role that school connectedness may play in this relationship can be viewed as encouraging. Perhaps instead of focusing much of the resources in schools on educational programs, schools could considers creating an inclusive culture in their schools and an opportunity for students to improve their connectedness to their school environment. Another possible approach is to continue presenting school-based substance use prevention programs, but to incorporate improving levels of school connectedness among students as a primary goal of these programs. The promising aspect of school connectedness is that it is modifiable in nature. Multiple factors that can help improve its levels among students have been identified.   School boards and individual schools can adopt short and long-term strategies to improve levels of school connectedness. (51, 95) In their report on improving school connectedness, the CDC has suggested six main strategies and over sixty different ways that the goal can be achieved. (51) These strategies include: implementing a process of decision

making that empowers staff and helps in engaging students, their families and their communities; helping students gain the social, emotional, and academic skills that they need to participate and engage with other in school; and increasing the opportunities for parents to get involved in the school and academic life of their children, among other things. An intervention combining teacher training, parent education and social-competence training for children that was delivered to elementary school children was assessed in a US-based study for its long term effects. (96) At the age of 18, students who had been exposed to the intervention in elementary school exhibited significantly higher commitment and attachment levels to their schools. Such findings support the notion that school connectedness is a malleable construct, and that certain actions can increase its levels among students.

Another important finding in this study is that higher parental connectedness is a factor that is negatively associated with all forms of substance use and abuse, after controlling for many social, demographic and educational factors. The regression model shows that as levels of parental connectedness improve, significant decreases in the risk of alcohol use, binge drinking , recreational cannabis use , daily cannabis use , and the use of other illicit drugs is observed. In addition, the risk of binge drinking when compared to only the moderate use of alcohol, and the risk of daily cannabis use when compared to only the recreational use of cannabis, both significantly decrease as levels of parental connectedness improve. The incidence of problems associated with alcohol and drug use also significantly decreases as parental connectedness improves..

Similar to the findings in this study, previous studies have reported protective associations between parental connectedness and substance use in adolescence. In their landmark study 'protecting adolescents from harm' Resnick et al. found that high levels of connectedness to parents and family was associated with less frequent cannabis and alcohol use. On the other hand, ease of access to alcohol and cannabis within the home were significant predictors of more frequent cannabis and alcohol use. (19) Researchers have proposed and tested many theoretical frameworks to

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predict alcohol use among adolescents. The theories underlying many of these frameworks share common themes that allow one to expect a higher likelihood of alcohol use initiation among teenagers who don't have close relationships with their parents, among adolescents whose behavior is not monitored by their parents, and among those who have parents who drink or use illicit drugs. (92)

Parental and family connectedness has been measured to reflect different constructs in different studies. For example, while some studies measure parental connectedness as a reflection of emotional closeness to parents (18, 19), other studies report parental connectedness as a measure of parental monitoring of adolescents' life. (93) These measures are used independently or in combination. The parental connectedness scale used in the SDUSAP is made up of statements which reflect the degree to which parents monitor the student, and the degree to which not disappointing parents is important to the student. These statements are: 'my parent(s) or guardian(s) usually know where I am when I am not at home', 'my parent(s) or guardian(s) usually know who I am with when I am not at home', and 'it is important that I do not let down or disappoint my parent(s) or guardian(s)'.

It is possible that the monitoring component is more effective in preventing substance use among adolescents. Fosco et al. have demonstrated that over time, parental monitoring of youth results in lower engagement in problem behaviors, including substance use. (93) A recent study has also shown that students who report lower parental monitoring of their whereabouts, a major component of the SDUSAP parental connectedness scale, also show a significant increase in their odds of co-morbid substance use, which was defined as cannabis use, tobacco use and binge drinking in the past month. (94) Along the same lines, studies have shown that perceived parental approval of teen drinking and higher permissive parental attitudes in general, and specifically towards adolescent drinking, are factors that predict alcohol use initiation among adolescents. (82, 94) If the role of the family in the prevention of substance use and misuse is crucial, should measures be taken to increase parental involvement in school-based substance use prevention programs?

Kumpfer et al. have suggested that family interventions have two to nine times the effect size of child-only interventions, and that programs that combine both approaches produce the largest effect sizes. (100)

Other researchers however, have shown different findings. Carter et al. present findings showing that students with high family connectedness were not at a lower risk of binge drinking or using cannabis in the past month, compared to students with low family connectedness. However, in this study, family connectedness was measured as an indicator of emotional support to the adolescent. (18) Kosterman et al. highlight through their research the distinction between the association of parental monitoring with levels of substance use, and the association of parental emotional connectedness with levels of substance use among adolescents. Specifically, proactive family management and clear family standards were important factors in delaying the onset of alcohol and cannabis use, despite how close the bond was between a child and his or her mother. (94)

A factor that significantly increases the risk of substance use is peer use. This study shows that compared to students who don't have any friends using cannabis, students who report having friends who use cannabis are at a much greater risk of using alcohol, cannabis and other illicit drugs. They also have a significantly increased risk of having problems associated with substance use. Similarly, a study of 9th and 10th graders who were followed up for two years showed that onset of drinking alcohol was associated with higher levels of peer use of legal and illegal drugs. (92) Even among younger students, peer use of marijuana is a significant predictor of initiation of alcohol use. Although substance use prevention programs, including the ones presented in the provinces included in the study, include education on refusal skills and resisting environmental influences such as peer pressure, it seems that peer use of substances continues to be a major influential factor in an adolescent's decision to use alcohol and drugs.

An important aspect of this study is the attempt to quantify the degree to which substance use prevention education in schools, as well as other factors, may potentially impact the incidence of problems associated with substance use among students. It seems relevant to prevention efforts to investigate whether school-based substance use prevention programs impact not only substance use per se, but the behaviors and problems associated with substance use, as which these behaviors have the potential of negatively affecting students' academic and social lives, as well as their overall well being. These problems include driving and being involved in accidents under the influence of substances. Past studies have alerted us to the presence of such problems among Canadian youth. As many as 15% of senior high school students from Atlantic Canada in 2002/2003 indicated that they had driven a motor vehicle under the influence of cannabis. (96) Driving under the influence of cannabis is a significant predictor of involvement in motor vehicle accidents, and is highly present in fatal collisions. (97)

An important question is, can school-based prevention programs have an influence on decreasing such behaviors, independent of their effect on substance use habits per se? If the results of this study can give us a clue, or a base for exploring this question further, then these programs seem not to produce a significant impact on preventing or decreasing such behaviors. However, an important limitation of the results is that these problem behaviors are measured for the past year, while exposure to classes is measured for the current school year. This may create overlap, or temporality concerns. In terms of past studies, the effect of school-based substance use prevention education on reducing driving under the influence of alcohol and on riding with drinking drivers is not conclusive. Elder et al. have reviewed related research studies and concluded that there is sufficient evidence supporting the effectiveness of school-based instructional programs in decreasing riding with drinking drivers, but the evidence is insufficient on the effectiveness of these programs on decreasing driving after drinking. (98) Similarly, the evidence is insufficient for the effectiveness of social norming programs on reducing both outcomes. (98) Other problem behaviors associated with substance use include

conflict with family or friends as a result of substance use, negative effects on school work or exams, injuring oneself, and getting in trouble with the police as a result of substance use, among other things. Although the findings of this study indicate that substance use prevention education in school does not significantly decrease the incidence of these problems, significant negative associations are seen between both school connectedness and parental connectedness, and the incidence of these behaviors. However, the association between exposure to classes and alcohol or substance use (or problems associated with use) might be underestimated. This is discussed further in the limitations section.

6.2 Strengths of the study

Previous studies and systematic reviews have pointed to some factors that seem to modify the effectiveness of school-based substance use prevention programs. However, to our knowledge, this is the first study assessing the potential role of school connectedness in modifying the association of these programs to levels of substance use. In addition, the levels of substance use per se are usually the only outcome measures assessed in past studies evaluating the impact of substance use prevention programs on substance use. However, in this study *problems* associated with alcohol and drug use, and not just use per se, are also evaluated among the outcomes.

Another strength of this study is the ability to look at the independent association between levels of school connectedness and substance use in the same population where the association between school education and substance use was assessed. The presence of information on a broad range of important co-variables associated with substance use, which have been adjusted for in all analyses, should also be seen as a strength. In addition, the validity of the school connectedness measurement scale, and the survey as a whole, adds confidence to our conclusions. Another important strength is the large sample size and population weights used, which allowed for sufficient power to detect differences, and allowed for generalizing the study findings to the target student population as a whole.

Representativeness of the sample is also ensured by the sampling design of the SDUSAP. However, the limitations of not including private schools and school drop outs in the sampling frame, as pertaining to generalizing to all adolescents in the high school age group, is discussed below. Finally, an important strength of the current study is the high response rate of the survey used. When adding all three provinces, the overall response rate for the SDUSAP is 89.9% of students present on survey day and 77.2% of all students enrolled on survey day. A high response rate ensures minimizing non-response bias, which can affect the validity of a study's results.

6.3 Study limitations

This study has a number of limitations. First, the nature of cross-sectional data limits the ability to determine the direction of the associations between the exposure and outcome variables examined. In order for a factor to be determined a risk or protective factor for substance use, evidence of a statistically significant association between an explanatory variable and the initiation, or decision to abstain from, substance use must be present. In addition, the unequivocal evidence that the explanatory variable was present before the student's involvement in substance use is necessary. (92)

The second limitation of the study is introduced by the way that the question on exposure to school-based substance use prevention classes is structured. When assessing an exposure, it is at times desirable to differentiate between those who have *ever* been exposed, and those who have n*ever* been exposed. Asking students about exposure to these classes in the current school year only may have lead to categorizing some students who have been exposed to such classes in the past, but not in their current academic year, as part of the 'no classes' group. This could consequently result in the attenuation of the difference seen between the group of exposed students (to 1-2 classes or 3 or more classes) and the unexposed group (no classes). However, it is reasonable to argue that an interest in the effects of *recent*

exposure to these substance use prevention classes is the focus of this study, especially given the fact that all students in the three provinces involved are exposed to these classes in middle school, which may minimize the variation in baseline exposure. Given its cross-sectional design, this study is intended as an exploratory study that enables generating questions that can be addressed with longitudinal study designs in the future.

The third limitation of the study is that data from self-report surveys, in general, is subject to bias (e.g. inaccurate recall of the frequency of substance use). When sensitive issues are examined, social desirability bias may also influence results in the form of underestimation of associations. (104) The associations could also be overestimated if social desirability bias differentially affected students, specifically by pressuring students who are exposed to prevention classes to hide or underreport their levels of substance use.

Fourth, the survey is restricted to students enrolled in public schools. Students who are excluded by the survey design (e.g. street-youth and school-leavers (i.e. drop-outs)) typically exhibit higher rates of drug use (105) and although prevention efforts may wish to target that population of adolescents too, the associations determined by this study may not be applicable to them. Also, whether or not students attending private schools may respond differently to school-based substance use prevention education cannot be determined by this study. Finally, important indicators such as parental use of drugs and alcohol; students' exposure to parental education on substance use; the tendency of the household to be more strict or permissive towards substance use; and finally, the exposure to social media which normalizes substance use and intoxication, have not been captured by the survey limiting the ability to control for them in the analysis.

6.4 Conclusions

It is known from previous research that school-based substance use prevention programs are mainly ineffective and that even programs which are effective show minimal positive outcomes. The results of this study show that students who receive only 1-2 classes of substance use prevention education, and 3 or more classes do not have a decreased risk of substance use compared to students who are not exposed to these programs in the current academic year. Our assessment of school connectedness as a possible modifier in this association shows that students with high school connectedness were not more likely to show a different association than the overall student population except for alcohol use, in which the risk *increased*. On the other hand, other avenues with potential protective effects are identified. Higher school connectedness, per se, is negatively associated with the use of cannabis, other illicit drugs, as well as problems associated with alcohol and drug use, such as driving under the influence and getting in trouble with the police as a result of substance use. Another important factor with significant negative associations with all forms of substance use is parental connectedness. Stakeholders addressing substance use among adolescents from a preventive lens may need to incorporate goals that go beyond the traditional aims of school-based substance use prevention programs, such as improving school connectedness and parental connectedness as key outcomes of their prevention programs and efforts.

6.5 Future directions

To help gain a deeper understanding of what factors are effective in preventing adolescent substance use, it may be beneficial for provincial wide surveys to determine the type of substance use prevention education that students are exposed to with more detail. A deeper understanding of the type of programs being presented, the content of the curricula, the method of presentation, and the length of these programs can allow for better assessment. In addition, studies determining the effectiveness of school-based substance use prevention programs may benefit from collecting individual level data on levels of school connectedness, as well as the overall culture of the school towards substance use. Also, future research could

measure different components of school connectedness to gain a better understating of what it is that has the strongest associations to lower substance use and lower problems. For example, questions assessing relationships with teachers, with peers, and the extent of a student's involvement in school activities can be measured separately. Evaluating problems associated with substance use as an outcome in future studies could also shed light on an opportunity for positive influence.

Some important factors that could be measured in future studies to give a more holistic picture include: exposure to other outlets of substance use prevention education such as parents, siblings, or the community; the home environment in regards to the availability and permissiveness towards substance use; family members' substance use habits; the adolescents' tendency towards risk taking and experimentation; ease of access to substances in the adolescents' community; exposure to substance use content on social media and traditional media outlets; and the type of laws and regulations present for teen substance use in the adolescent's community. In terms of strengthening study design, longitudinal study designs may allow for stronger causality inferences and may have stronger implications for the prevention of substance use and abuse among adolescents. Finally, qualitative research methods may shed some light on ideas we are currently unaware of. The opportunity to learn first hand what factors motivate some students to initiate and engage in substance use, and lead others to choose to abstain from use, may provide valuable information that cannot be collected through quantitative methods and pre-determined questions exclusively.

6.6 Implications

To prevent or decrease levels of cannabis and other illicit drug use among adolescents, school boards may want to invest in assessing and improving the school environment to increase levels of school connectedness. However, the possible increase in alcohol intake among adolescents as levels of school connectedness improve must be monitored and addressed. Parental connectedness

is another important avenue with a seemingly strong potential in influencing substance use among adolescents. These results can help stakeholders shift their perspective on what components of prevention programs decrease or prevent substance use among adolescents. Re-evaluating the aims of school-based substance use prevention education to incorporate more methods to increase school connectedness may be a solution. In their article titled "Promoting science-based prevention in communities", Hawkins et al. highlight that prevention programs need to target modifiable risk factors and to strengthen protective factors. (106) As evidence suggests, school connectedness is considered a modifiable factor that can be improved. In addition to improving school connectedness, more parental involvement and empowerment towards their role in substance use prevention may be crucial for the success of these programs. Researchers may design clustered randomized trials for new prevention programs focusing on increasing school connectedness and parental connectedness as major aims, and comparing them to current programs, to evaluate their effectiveness.

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APPENDIX A

Table 1: Types of programs reviewed by Foxcroft et al. based on content of the program

Program types based on content*	Description
"Specific curricula delivered as school lessons (content: educational, psychosocial or a combination)"	"Educational interventions aim to raise awareness of the potential dangers of alcohol misuse (e.g. increased knowledge) so that young people are less likely to misuse alcohol.
"Class behavior management programs (content: educational, psychosocial or a combination)"	"Psychosocial interventions aim to develop psychological and social skills (e.g. peer resistance through modeling, understanding, norm-setting and social skill practice, so that young people are less likely to use alcohol"

*This distinction was not a basis of comparison in the review but was used to identify potential characteristics of effective programs.
Universal school-based prevention program for alcohol misuse in young people" Cochrane review- Foxcroft et al. 2011

Table 2: Review of 53 randomized trials assessing universal school-based prevention program for alcohol misuse in young people by Foxcroft et al. 2011

Program type based on scope (EMCDDA, 2010)	Number of trials included	Effectiveness
Universal school-based programs specifically targeting prevention or reduction of alcohol misuse	11 trials	In 5 trials: program did not have a statistically significant difference from usual curricula in alcohol misuse outcomes, including: alcohol use in previous year, frequency of drinking, number of drinks, proportion of weekly drinkers, drinking and driving in the past month). In 6 trials the alcohol specific programs showed statistically significant lower rates of alcohol outcomes among students receiving the program compared to controls.
Generic programs addressing the prevention of multiple aspects (e.g. alcohol, other drug use/abuse, antisocial behavior)	39 trials	14 of the 39 showed significantly reduced alcohol use in the intervention group either overall or through a subgroup effect (gender, ethnicity or baseline alcohol use).

Universal school-based prevention program for alcohol misuse in young people" Cochrane review- Foxcroft et al. 2011

Table 3: Effectiveness of school-based prevention for drug use based on the Cochrane review "School-based prevention for illicit drug use" by Faggiano et al. 2014

Type	Description	Effectiveness compared to usual curricula or no intervention
Knowledge-focused curricula (courses of study)	Students are only given information about drugs. This approach assumes that changes in behavior related to drug use and misuse will result from information alone.	
Social competence curricula	Social competence curricula teach adolescents generic social and personal skills such as: teaching cognitive skills to enhance assertiveness, to deal with anxiety and stress, and to resist potential influences of the media and interpersonal relationships; and teaching goal setting, decision making, and problem solving. In the social competence curricula teaching takes place through instruction, demonstration, rehearsal, feedback and reinforcement, among other tactics.	Marijuana use at <12 months: Qualitative assessment: results inconclusive (mixed) Quantitative assessment (meta analysis): social competence intervention favored (RR= 0.90 (0.81-1.01)) Marijuana use at 12+ months: Qualitative assessment: results inconclusive (mixed) Quantitative assessment (meta analysis): social competence intervention favored (RR=0.86 (0.74-1.00) Hard drug use at <12 months: Qualitative: results inconclusive (mixed) Quantitative: no difference (RR 0.69 (0.40-1.18) Hard drug use at 12+months: Qualitative: No difference (mean difference -0.01 (-0.06- 0.04) Quantitative: No difference Any drug use < 12 months: Qualitative: No difference Quantitative: Results in favor of social competence interventions (RR 0.27 (0.14-0.51)).
Social norms approaches	Social norms intervention strategies concentrate on two aspects: normative education and resistance skills training. First, educating adolescents about the true rates of drug use among adults and adolescents, to correct perceptions of higher use (overestimates). Second, teaching adolescents to be conscious of high risk-situations; increasing their awareness about the influences of peers, family and the media; and finally teaching adolescents about refusal skills and allowing them to practice those skills.	Marijuana use at <12 months: Quantitative: Marginally statistically significant results in favor of social influence approach (RR 0.88 (0.72-1.07) and (mean difference – 0.26 (- 0.48 - -0.04)). Qualitative: NA Marijuana use at 12+ months: Quantitative: No difference (RR 0.95 (0.81-1.13)) Qualitative: Of four studies, only one found a statistically significant protective effect Hard drug use at 12+months: Quantitative: NA Qualitative: one study showed statistically significant protective effect Any drug use: Not assessed by any studies
Combined methods	Combined methods derive a mixed approach from knowledge-focused curricula, social competence curricula and social norms approached.	Marijuana use at <12 months: Quantitative assessment: trend in favor of intervention (RR 0.79 (0.59 – 1.05)) and one study with no difference (MD 1.90 (-5.83 – 2.03)). Qualitative assessment: NA Marijuana use at 12+ months: Quantitative: Favored combined intervention (RR 0.83 (0.69-0.99)), and one study with no difference (MD 1.90 (-5.83 – 2.03)). Qualitative: NA Hard drug use at <12 months: Quantitative: One study showed significant difference when results were dichotomous, but significant difference when results continuous Qualitative: NA Hard drug use at 12+months: Quantitative: No difference (RR 0.86 (0.39-1.90), and one study with mean difference also showed no difference (MD 0.30 (1.36-1.96)). Qualitative: Significant effect from two studies Any drug use < 12 months: Quantitative: Favored combined intervention (RR 0.76 (0.64-0.89)). Qualitative: NA

"School-based prevention for illicit drug use" Cochrane review Dec 2014- Faggiano et al. 2014

APPENDIX B

Table 1: Outcome variables – Alcohol

Variable	SDUSAP Question	SDUSAP variable name	SDUSAP categories	Categorization for analysis
Alcohol use and misuse- past 30 days	In the past 30 days, how many times have you had five or more drinks of alcohol on the same occasion?	afiveda1	I did not drink alcohol at all in the past 30 days=1 I did not *have five or more drinks of alcohol on the same occasion* in the past 30 days=2 Once, I *had five or more drinks of alcohol on the same occasion* in the past 30 days=3 Twice=4 Three times=5 Four times=6 Five or more times=7 Missing=99	Did not drink alcohol=0 Drank alcohol old but did not binge drink=1 Was involved in binge drinking=2
Problems associated with alcohol use – over the past 12 months	1. Has drinking affected your schoolwork or exams so that you did not do as well as you could?	aexamsa1	For each one of the variables Yes=1 No=2 I do not drink alcohol=3 Missing=99	First, questions 1-11 are re-categorized into a dichotomous variables No=0 Yes=1 Then, a single variable reflecting problems associated with alcohol use is created. This variable is a count variable with a possible score ranging between 0 and 11. Question 1-11 are summed up with a score of 1 for every yes/ever and 0 for every no/never answer.
	2. Has your drinking caused tension or disagreement with family or friends;	afamtna1		
	3. Have you been in trouble with the police as a result of your drinking?	atrblaa1		
	4. Has the cost of alcohol caused you to give up buying other things?	acostaa1		
	5. Have you consumed alcohol before or instead of breakfast?	abreaka1		
	6. Have you damaged things after having drunk alcohol?	adamaga1		
	7. Has your drinking caused you to injure yourself	ainjura1		
	8. How often have you been drinking in a bar, tavern, beverage room, or lounge?	adrbara1	For each one of the variables Never=1 Once=2 Twice=3 Three or more times=4 I do not drink alcohol=5 Missing=99	
	9. How often have YOU driven a motor vehicle within an hour of drinking two or more drinks of alcohol?	adrivea1		
	10. Have you been in a motor vehicle accident with YOU as the driver, after drinking in the two previous hours?	aaccida1		
	11. How often were you a PASSENGER in a vehicle with a driver who has too much to drink?	Adkpasa1	Never=1 Once=2 Twice=3 Three or more times=4 Missing=99	

Table 2: Outcome variables – Cannabis and other illicit drugs

Variable	SDUSAP Question	SDUSAP variable name	SDUSAP categories	Categorization for analysis
CANNABIS				
Cannabis use and misuse- past 30 days use	In the past 30 days, how often did you use cannabis (marijuana, grass, weed, pot, hash, hash oil)?	aomj30a1	Not at all during the month=1 Less than every week=2 Every week or almost every week=3 Every day or almost every day=4 Missing=99	Did not use cannabis=0 Used cannabis but not daily=1 Used cannabis daily or almost daily=2
OTHER ILLICIT DRUGS				
Past 12 months use of other illicit drugs 'hard drugs'	In the past 12 months have you used/how often did you use 'substance name'? *Substances are:* LSD; psilocybin or mescaline; cocaine or crack cocaine; ecstasy or MDMA; and methamphetamine	auhalua3, auhalua4, avcocna3, aumdmaa3, auampha3	I do not know what 'substance name' is=1 Not at all=2 One time=3 Two times=4 Three or four times=5 Five to eight times=6 Nine to 12 times (about once a month)=7 Thirteen to 26 times (about twice a month)=8 Twenty-seven or more times (more than twice a month)=9 Missing=99	No use=0 Used any of the drugs at least once=1
PROBLEMS ASSOCIATED WITH DRUG USE				
Problems associated with drug use – over the past 12 months	1. Has your drug use (other than alcohol) affected your schoolwork or exams so that you did not do as well as you could?	aschlwa1	For each one of the variables Yes=1 No=2 I do not use drugs=3 Missing=99	First, questions 1-9 are re-categorized into dichotomous variables No=0 Yes=1 Then, a single variable reflecting problems associated with drug use is created. This variable is a count variable with a possible score ranging between 0 and 9. Question 1-9 are summed up with a score of 1 for every yes/ever and 0 for every no/never answer.
	2. Has your drug use (other than alcohol) caused tension or disagreement with family or friends?	atensna1		
	3. Have you been in trouble with the police as a result of your drug use?	atrblda1		
	4. Has the cost of drugs (other than alcohol) caused you to give up buying other things?	acostda1		
	5. Have you damaged things after having used drugs (other than alcohol)?	admgdga1		
	6. Has your drug use (other than alcohol) caused you to injure yourself?	ainjrda1		
	7. How often have YOU driven a motor vehicle within an hour of using cannabis?	adrvmja1	For each one of the variables Never=1 Once=2 Twice=3 Three or more times=4 I do not use cannabis/drugs or I do not drive =5 Missing=99	
	8. How often were you a PASSENGER in a car or other vehicle driven by someone who had been using cannabis?	apsnmja1		
	9. How often have you driven a vehicle within an hour of using a prescription pain relief pill such as "names of drugs"?	adrgdra1		

Table 3: Independent variables

Variable	SDUSAP Question	SDUSAP variable name	SDUSAP categories	Categorization for analysis
School-based substance use education	How many classes did you have in this school year that talked about decision-making, peer pressure, assertiveness or refusal skills?	opskila1	None=1 One or two classes=2 Three or more classes=3 Missing=99	None=0 One or two classes=1 Three or more classes=2
School connectedness	I feel safe in my school	oconcte1	Categorical Strongly agree=1 Somewhat agree=2 Somewhat disagree=3 Strongly disagree= 4 Missing= 99	Categorical Low=0 High=1 A theoretical cutoff point was determined. Any student who indicates that he or she 'somewhat agrees' or 'strongly agrees' to all three statements of the school-connectedness scale would be considered a student with a high level of school connectedness. Any student with a lower score would be considered a student with a low level of school connectedness.
	I feel close to people in my school	oconcta1	Categorical Strongly agree=1 Somewhat agree=2 Somewhat disagree=3 Strongly disagree= 4 Missing= 99	
	I feel happy at my school	oconctc1	Categorical Strongly agree=1 Somewhat agree=2 Somewhat disagree=3 Strongly disagree= 4 Missing= 99	

Table 4: Co-variables

Variable	SDUSAP Question	SDUSAP variable name	SDUSAP categories	Categorization for analysis
Sex	Are you male or female?	Sex	Categorical Male =1 Female =2 Missing=99	Categorical Female=0 Male=1
Grade	What grade are you in?	grade	Categorical Grade7 =7 Grade9 =9 Grade10 =10 Grade12 =12	Categorical Grade7 =0 Grade9 =1 Grade10 =2 Grade12 =3
Age	How old are you?	age	Continuous 11-19 years	Continuous 11-19
Mother's education	What is the highest level of education that your mother has attained?	gmoedua1	Continuous Graduated university=1 Attended but did not graduate university=2 Graduated college or trade school=3 Attended but did not graduate college or trade school=4 Graduated high school=5 Attended but did not graduate high school=6 Did not attend high school=7 Don't know=8 No mother=9 Missing=99	Categorical Did not graduate high school=0 (6,7) Graduated high school=1 (5,4,2) Graduated college/trade school/ university=2 (3,1)
Family's socioeconomic class	Imagine this ladder to the right shows how Canadian society is set up. At the top of the ladder are people who are the "best off" – they have the most money, the most education, and the jobs that bring the most respect. At the bottom are the people who are "worst off" – they have the least money, little education, no job or jobs that no one wants. Now think about your family. Please fill in the bubble next to the box that best shows where you think your family would be on the ladder.	gcecona1	Continuous Worst off=1 2=2 3=3 4=4 5=5 6=6 7=7 8=8 9=9 Best off=10 Missing=99	Categorical Low=0 (1,2,3,4) Middle=1 (5,6,7) High=2 (8,9,10)
Peer use of cannabis	How many of your friends use cannabis (marijuana, grass, weed, pot, hash, hash oil)?	acannaa1	Categorical None= 1 A few= 2 About half= 3 More than half= 4 All= 5 Missing= 99	Categorical None= 0 Half or less =1 (2,3) More than half=2 (4) All= 3 (5)
Religiosity	1. How important would you say religion is to you?	orelima1	Not important at all=1 Not very important=2 Fairly important=3 Very important=4 Missing=99	I create a dichotomous variable reflecting level of religiosity Low religiosity=0 (1,2) High religiosity=1 (3,4)
Parental connectedness	1. My parent(s) or guardian(s) usually know where I am and when I am not home	ofamila1	For each question: Strongly agree= 1 Agree= 2 I do not know=3 Disagree= 4 Strongly disagree=5 Missing=99	I create a new single variable reflecting parental/guardian connectedness. First, I reverse code the answers, then I sum them up to create the new variable. The range of possible scores is between 3-15 with a higher score indicating higher connectedness.
	2. My parents(s) or guardian(s) usually know who I am with when I am not at home	ofamilb1		
	3. It is important that I do not let down or disappoint my parent(s) or guardian(s)	ofamilc1		