

**SEXUALLY TRANSMITTED INFECTIONS:
EDUCATIONAL SETTINGS**

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ABSTRACT

Background: Sexually transmitted infections (STIs) are a major public health concern in Canada and worldwide. Nearly two-thirds of STIs are seen among youth. Therefore, it is crucial to provide effective STI interventions to youth. Substance use is an important factor for STI acquisition among youth because of high prevalence and its ability to link proximal sexual risk behaviors and distal contextual factors. STI preventive behavioral interventions remain the gold standard due to the limitations in biomedical interventions. Educational institutions are recognized as ideal settings to target youth. Thus, it is essential to assess whether integrating substance use into STI prevention programs at educational settings is worthwhile as well as whether STI preventive interventions at educational settings are effective and how can they be improved.

Objectives and Methods: The objectives and methodologies of this thesis include 1) determine the prevalence and association between substance use and STIs among Canadian post-secondary students (descriptive analysis and logistic regression of the ACHA-NCHA II Spring 2016 survey data and 2) assess the efficacy and effectiveness of STI preventive intervention programs at educational settings (a systematic review and meta-analysis).

Results: Positive association exists between current cannabis use or other drug use and STIs among Canadian post secondary students. STI preventive interventions at educational institutions in developed countries show effectiveness. Interventions are more effective in promoting knowledge compared to enhancing motivational factors, behavioral skills and behaviors, and for female students. No significant difference in effectiveness is seen based on the type of provider (peer-involved and non-peer-involved) and type of intervention (face-to-face and technology-based).

Recommendations: Based on our findings, it is recommended to integrate substance use preventive interventions into STI preventive interventions at Canadian post-secondary institutions. A potential framework for effective STI preventive interventions at educational settings which can possibly be inferred to the Canadian post-secondary institutions is presented

based on our results. This thesis will help inform, evaluate and guide STI preventive interventions at educational settings to effectively reduce the burden of STIs among Canadian youth. Future research with more rigorous methodology should be undertaken to provide conclusive evidence.

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CHAPTER 1 - INTRODUCTION

1.1. Background

1.1.1. Sexually transmitted infections (STIs) and their consequences

Sexually transmitted infections (STIs) are a significant public health concern in Canada and the world (1,2,3). According to the World Health Organization (WHO), over 360 million people acquire an STI annually (1). More than 30 infectious agents are documented to be sexually transmitted (1). This thesis examines seven of the most commonly reported STIs globally, which includes: chlamydia, gonorrhea, Human Immunodeficiency Virus (HIV), genital herpes or Herpes Simplex Virus (HSV), genital warts or Human Papilloma Virus (HPV), hepatitis B/C virus (HBV/HCV) and Pelvis Inflammatory Disease (PID).

Most STI cases are asymptomatic and thus, difficult to diagnose (1). If left untreated, STIs can cause severe health consequences. For instance, HIV can cause an infection that over time can lead to Acquired Immuno-Deficiency Syndrome (AIDS) (4). AIDS causes progressive failure of the immune system and may allow life-threatening opportunistic infections and certain types of cancers to grow (4). STIs like chlamydia or gonorrhea can result in long-term pelvic pain and increase the risk for an ectopic pregnancy (5). Syphilis can ultimately cause fatal outcomes with damages to the Central Nervous System (CNS) and Cardio-Vascular System (CVS) (2). Some STIs such as chlamydia, syphilis, HSV, HPV and HIV may lead to Mother to Child Transmission (MTCT) and cause adverse effects in newborns (e.g. congenital syphilis, ophthalmia neonatorum) (6,7). Most STIs can occur concurrently and may increase not only the risk of contracting or transmitting HIV (2-3 folds) but also once acquired, may accelerate the severity and deterioration of the HIV infection (2,6).

1.1.2. A brief history of STIs

STIs have been mentioned in hand-written reports since the start of documented history in Europe and Asia (8). Gonorrhea has been described as a urethral discharge in the Old Testament and its natural history and transmission were fully elucidated between the 11th and 15th century (8). HPV has been discussed for more than 2,000 years (8), and it was properly identified in the 16th century (8). Syphilis has been noted since the 15th century (8) and it was classified into primary, secondary, and tertiary phases by the start of the 19th century (8). Chlamydia trachomatis was discovered in 1950 as non-gonococcal urethritis, when men with urethral discharge were not cured by penicillin (8) and the organism was identified in 1959 (8). HIV/AIDS was first documented in 1981 among men having sex with men (MSM) (8). Heterosexual transmission of HIV as well as transmission via blood or birth was discovered a few years later (8).

The history of STIs has been strongly linked and heavily influenced by various environmental factors and socio-cultural events (8). For instance, in the middle of the 20th century, the rates of STIs in the U.S. increased as a consequence of the end of World War II (1945), the soldiers returning to their respective countries (1950's), revitalization of the economy (1960's), the women's liberation and sexual revolution (1960's-1970's), the development of contraceptive methods (and increased premarital sex) (1960's-1970's), and establishment of national STI control program (1970's) (9-12). Present day challenges that have led to increasing trends of STIs may be attributed to increasing travel and urbanization, social stigma, low public awareness, poor diagnosis and treatment conditions, limited resources, lack of access to healthcare services and trained healthcare workers (13).

1.1.3. Current trends and burdens of STIs

Globally, STIs are the most prevalent communicable diseases (14) and are included in the top five disease categories for which adults seek medical healthcare (6). Each day, one million people are infected with an STI (6). Developed countries like the U.S. and Canada are not immune to the scourge of STIs.

In the U.S., it is estimated that approximately 20 million new STIs cases occur every year, leading to more than 20,000 women suffering from infertility and accounting for nearly \$16 billion United States Dollars (USD) in annual healthcare costs (5). It is reported that between 2015 and 2016, three curable STIs; chlamydia, gonorrhea and syphilis (primary, secondary and congenital) were on an upswing reaching 497 cases (4.7% increase), 146 cases (18.5% increase) and 25 cases/100,000 people (17.6% increase), respectively (5). Although the incidence of HIV decreased by 8% between 2010 and 2015 (15), the rates of Persons Living with HIV (PLHIV) has increased from 280.5/100,000 population in 2011 to 303.5/100,000 population in 2015 (16). It is particularly concerning that an estimated 15% of PLHIV have not been diagnosed yet (15).

In Canada, half of the reported infectious diseases are STIs and these represent only the tip of the iceberg (10% of all cases) as most STI cases are asymptomatic and therefore, go unreported (17). With respect to the STI related healthcare costs, recent estimates showed that for the management of chlamydia alone, Canada incurs expenses between \$50-120 million Canadian Dollars (CAD) annually (3). Similar to the U.S., Canada has seen a recent increase among three commonly notifiable STIs: chlamydia (307.4 cases/100,000 equaling a 200% increase), gonorrhea (45.8 cases/100,000 equaling a 61.3% increase) and syphilis (6.63 cases/100,000 equaling a 95% increase), respectively (2). Additionally, the prevalence of HIV infections has increased from 68,800 people in 2011 to 75,500 in 2014 and approximately 21% of PLHIV are unaware of their infection status (18).

1.1.4. Youth and STIs

Globally, youth (defined by the United Nations as 15-24 years old) (19) are recognized as a vulnerable subpopulation for STIs. It is reported that more than 60% of STIs are found among this age group (7) and it is estimated that 5% of adolescents are infected with at least one STI every year (20).

In developed countries, like the U.S., youth accounted for approximately 20% of HIV incidence and 50% of all STI cases in 2015 (21,22). These are disconcerting findings, when one considers the fact that this age group comprises only 25% of the sexually active population (21,22). Equally as concerning, the reported cases of chlamydia, gonorrhea and syphilis among youth depict an

increasing trend from 2012 to 2016 (5). Likewise, in Canada, increasing rates of STIs have been reported among youth. According to the national STI surveillance report (2013-2014), the highest rates of three notifiable STIs (chlamydia, gonorrhoea and syphilis) were seen among the 15-29 age group (2). The reported cases of chlamydia were three-times higher among youth (1,355/100,000 people) compared to adults (aged between 25 and 59 years old) (431/100,000 people) (2). Similarly, the gonorrhoea rates were two-times higher among youth (141/100,000 people) compared to adults (79/100,000 people) (2). For infectious syphilis, the rate of reported cases was lower among youth (7.35/100,000 people) compared to adults (11.9/100,000 people) (2). However, the most prominent increase in rates was seen among 15-19 years old male (2).

1.1.5. Factors associated with current STIs trends

1.1.5.1. General

In high-income countries like the U.S., and Canada, plausible reasons for the elevated trends in STIs may include the increased availability and sensitivity of screening tests (rebound phenomenon) (2,3), more effective case findings (3), higher levels of accessibility to healthcare (18), and increase in the prevalence of HIV cases as a by-product of increased survival among PLHIV with the help of Anti-Retroviral Therapy (ART) (18). Additional factors to consider are risky sexual behaviours (i.e. multiple sexual partners, inconsistent condom use and change in sexual practices) (2,5,34) and the emergence of drug resistance (23).

The immunological rebound phenomenon in particular is an interesting hypothesis to consider. Due to early detection and treatment of chlamydia with the aid of screening, the development of a natural immune response may be impeded (2,3). Thus, there is potential for an increasing number of individuals to become susceptible to acquiring infections repeatedly (2,3). In the case of syphilis, early diagnosis and treatment may trim the latent phase, which is non-infectious (3). Therefore, when a younger generation becomes sexually active, the susceptible population to infectious syphilis increases causing a re-emergence of the disease (3). These hypotheses prove that health promotion interventions focusing on behavioral modification (primary prevention) remain important regardless of the development and advances in screening tests and medical treatments aimed to eradicate STIs (3).

1.1.5.2.Youth

Knowledge, attitudes and behaviours

Youth have an increased susceptibility to STIs compared to adults because of behavioral risk factors (i.e. increased sexual activity, multiple sex partners, inconsistent condom use and use of alcohol and/or other drugs during sex) (24).

The Canadian Youth Sexual Health and HIV/AIDS Study (CYSHHAS) conducted in 2002, found that nearly 50% of 14-16 years old students (grade nine) did not know HIV has no cure (25). Also, the perceived susceptibility to the negative consequences of risky sexual behaviours was very low and had minimal influence on their decision-making to practice safe sex (25). Condom use is still regarded as the gold standard in the primary prevention of STIs and HIV transmission (26). Yet, research uncovered that youth do not prefer the use of condoms and instead favour the use of birth control methods that may prevent unwanted pregnancies but do not provide protection against STIs (7,26,27).

A comparison of key sexual behaviours (i.e. condom use, number of sexual partners, early sexual initiation) between youth in the U.S. and Canada could prove informative and helpful. The U.S. Youth Risk Behaviour Surveillance (YRBS) for high school students in 2015, reported that more than 40% of sexually active students did not use a condom at their last sexual encounter (28). Likewise, the Canadian Community Health Survey (CCHS) data for 2010, reported that nearly 33% of sexually active youth did not use a condom during their last sexual encounter (29). Additionally, it was reported that even among youth who did use condoms, they were likely to use them either inconsistently or incorrectly (30,31).

According to the 2015 YRBS, 11.5% of youth in the U.S. reported having four or more sexual partners in their lifetime (28). In comparison, the 2010 CCHS found that nearly one-third of Canadian youth reported having multiple sexual partners in the last 12 months (32). In 2015, 4% of U.S. high school students reported having an early sexual initiation (before the age of 13 years

old) (28). By comparison, in Canada 9% of the youth reported early age of sexual initiation (before the age of 15 years old) (32).

Today's youth have ready access and are heavily influenced by the internet and social media. Youth use modern technology for socialization purposes and do so at much higher rates than adults, regardless of their gender, ethnicity and/or socio-economic status (34,35). In 2009, nearly three-quarters (73%) of U.S. youth used online social networking platforms (33). In 2013, according to Statistics Canada, nearly all (96%) Canadian youth used social networking sites (36). Ease of access to social media by today's youth creates an online hook-up culture that makes them susceptible to high risk sexual behaviours (i.e. one-night stands, causal partners, early age of sexual initiation) (37-41).

Barriers

There are significant barriers for youth to access the sexual and reproductive healthcare information and services they need. Some of these barriers include confidentiality issues, the concomitant social stigma associated with being diagnosed with STIs, confusion about screening guidelines and unfavourable healthcare service hours (5,24,42). Reluctance in discussing issues related to sexual and reproductive health among youth and their parents also remains an important issue (42).

Substance use among youth

Substance use (i.e. alcohol, cannabis or other drugs) plays a critical role in increasing risky sexual behaviours among youth (25,31,35,38,39,43) due to disinhibition and impaired decision-making (2,26). College aged students are a particularly vulnerable group as they experience a transitional period in their lives that emphasizes independence and increased responsibility (i.e. moving out from their home, lack of parent's supervision and new social environments) (44-47). These new conditions have the potential to encourage youth to engage in risky behaviours including alcohol and/or drug use and unsafe sexual practices while under the influence (44-47). According to a U.S. study, college aged students were more likely to use alcohol and/or drugs including cannabis

when engaging in new sexual partnerships in an effort to break the ice and avoid uncomfortable discussions regarding safe sexual practices (48).

Contextual factors

Distal psycho-social-environmental determinants that affect adolescents' sexual health behaviours should not be neglected when discussing STIs. First, emotional and mental health issues play an important role in engaging in risky sexual behaviours because they often impair good judgement and negatively impact youth's social skills and coping mechanisms (25). Second, social stigma associated with sexual orientation may predispose homosexual/bisexual individuals to suffer from mental health problems, which in turn may trigger risky behaviours such as substance use and unsafe sexual practices (25). Another important factor is social exclusion, which may be rooted in pervasive social-cultural norms and perceptions (49). For instance, research has shown that the social exclusion of certain ethnic minorities, including Aboriginal peoples has significant effects on their health and risk-taking behaviours (49).

Summary

Sexually active youth are at higher risk of acquiring STIs due to a combination of behavioral, operational and contextual factors (5). We can improve health promotion intervention strategies and address operational barriers by furthering our understanding of behavioral and contextual factors. In this regard, substance use is a key intermediary factor between proximal risky sexual behaviours and distal contextual influences in the causal chain of STIs among youth (Figure 1.1).

1.1.6. Interventions for STIs prevention and control

The Joint United Nations Programme on HIV/AIDS (UNAIDS) stated that a combination approach consisting of behavioral, biomedical (i.e. condom use, vaccines, diagnosis and treatment, and screening or opportunistic testing) and structural interventions provide the best outcomes for STIs (50). The subsections that follow provide a brief summary of the various STI interventions.

1.1.6.1. Behavioral interventions

Behavioral interventions are based on the promotion of knowledge, motivational factors and skills to achieve safe sexual practices (14). These approaches include sex education, counseling for testing and risk reduction, behavioral change communication and social marketing (14). Several studies have found behavioral interventions to be an effective strategy in decreasing risky sexual behaviors and STIs (51).

1.1.6.2. Biomedical interventions

Condom use

To date, condom use is the only Multipurpose Prevention Technology (MPT) available for STI prevention (14). Although condom use has been promoted, STI rates continue to rise because a large number of youths do not use it consistently or correctly (7).

Vaccines

Currently, vaccines are available only for two viral STIs: HBV and HPV (1,7). The HBV vaccination is included as part of the childhood immunization program in more than 90% of the countries worldwide and it estimated to help prevent 1.3 million deaths (6). The HPV vaccine is relatively new and not as widely adopted by all countries in the world. However, WHO projects that when HPV vaccine coverage reaches 70%, it would prevent more than 4 million cervical cancer deaths over the next 10 years (6).

Diagnosis and treatment

There have been significant advances in the diagnosis and treatment of STIs, however, challenges still persist. For instance, the rapid test for syphilis is the only one that is simple to use and inexpensive (52). By comparison, diagnostic tests for chlamydia and gonorrhea are expensive and need skillful staff and laboratory facilities (52). Bacterial STIs (i.e. chlamydia, gonorrhea, syphilis) and parasitic STIs (i.e. trichomonas) are curable with antibiotics (6). However, viral

STIs (i.e. HBV, HIV) do not have a known cure and can only be managed with the use of antiviral treatment (6).

Screening or opportunistic testing

The majority of STI laboratory tests are expensive. Therefore, the use of chlamydia and gonorrhea testing is limited to developed countries based on cost considerations (1,53,54,55). On the other hand, most countries are able to provide antenatal syphilis screening because of its low cost and high effectiveness in reducing perinatal death and stillbirths (56).

1.1.6.3. Structural interventions

Structural interventions for STIs are comprised of laws, policies or guidelines that enhance the effectiveness of behavioral and biomedical interventions (57). They can occur at the macro-level (i.e. pap smear guidelines) or micro-level (i.e. integration of STI services in family planning services) (57).

1.2. Statement of the problem

STIs pose a significant disease burden worldwide. To address this issue, STI prevention and control programs should incorporate comprehensive behavioral intervention strategies that take into account relevant risk factors among vulnerable populations. Youth are the most affected population with two-thirds of STIs worldwide occurring among this group (7). Substance use among youth is considered as one of the key factors given its ability to link proximal risky sexual behaviors and distal contextual factors (Figure 1.2).

1.3. Research gaps and objectives

There is a dearth of research conducted among Canadian youth examining the relationship between substance use and STIs. Furthermore, there is a lack of consensus on the effective behavioral interventions within educational settings for this age group. This thesis endeavours to address these gaps by investigating the following objectives:

- 1) Determine the prevalence and association between substance use and STIs among Canadian post-secondary students
- 2) Assess the efficacy and effectiveness of STI preventive intervention programs at educational settings

1.4. Relevance

Substance use and the pending legalization of recreational cannabis make Canadian youth particularly vulnerable for host of negative health outcomes including STIs. These conditions place significant social pressures and financial burdens on individuals and society. This thesis examines the extent of the problem in Canada and presents evidence to support best practices in the implementation of effective STI preventive interventions at educational settings.

1.5. Implications

This thesis will provide new insights examining the association between substance use and STIs among Canadian youth, and the effectiveness of STI preventive interventions within educational settings. Findings will provide evidence suggesting whether integrating substance use into existing STIs programs is worthwhile. In addition, results will provide recommendations for school health services, public health professionals, policy makers and health care providers to implement or modify youth STI preventive interventions. Consequently, this thesis will provide evidence to ameliorate the burden of STIs among youth.

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Figure 1.1: Causal chain of STIs among youth

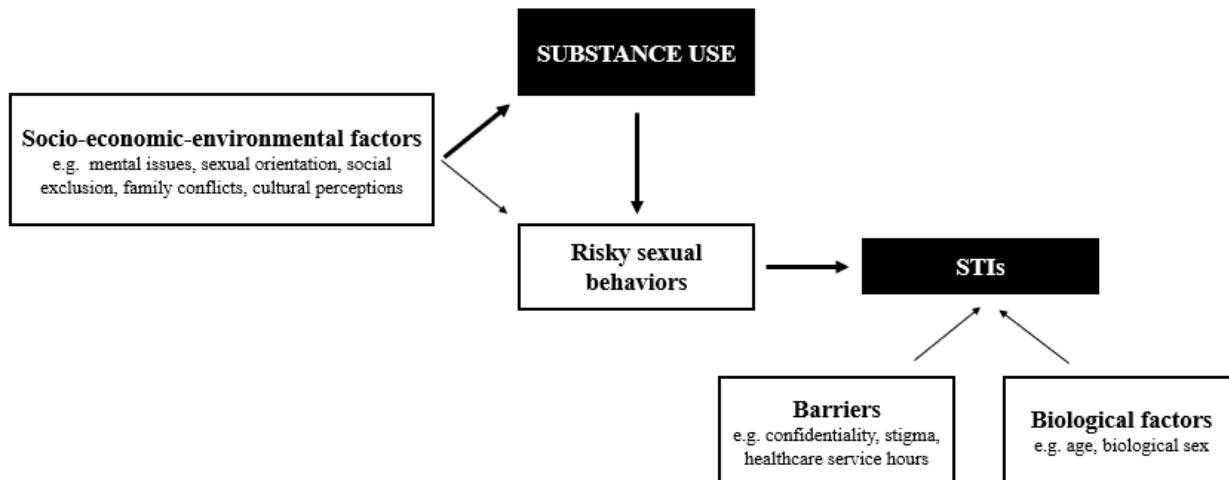
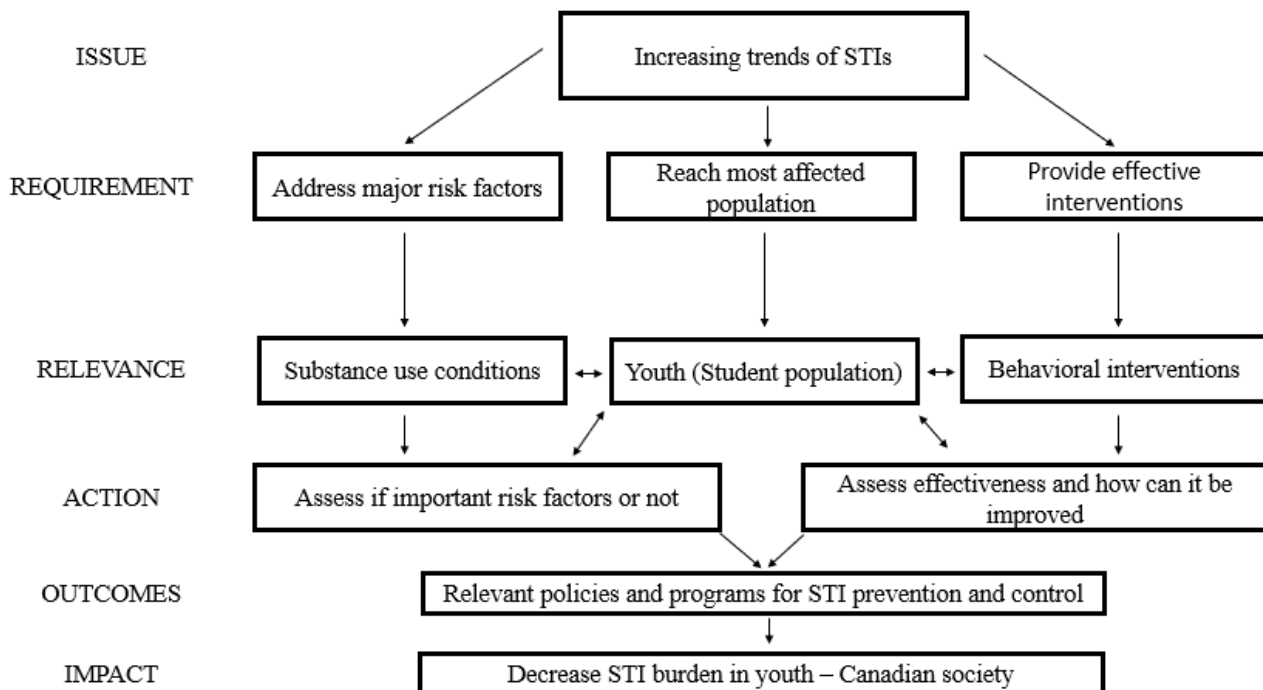


Figure 1.2: Conceptual diagram for the problem statement



CHAPTER 2 - ASSOCIATION BETWEEN SUBSTANCE USE AND SEXUALLY TRANSMITTED INFECTIONS AMONG CANADIAN POST-SECONDARY STUDENTS

2.1. Abstract

Background: In Canada, STI rates are increasing, particularly among the young adult, post-secondary student population. Substance use is one of the key predisposing factors that may lead to risky sexual behaviours. There is considerable economic burden and significant public health concern posed by STIs and substance use. The purpose of this study was to examine the prevalence and association of substance use (alcohol, cannabis and other drugs) and STIs among Canadian post-secondary students.

Methods: This is a cross-sectional study using data from the National College Health Assessment II, Spring 2016 survey conducted by the American College Health Association. There were 31,642 sexually active participants representing 41 post-secondary institutions in Canada. Descriptive analysis and logistic regression were conducted to assess the prevalence and association of substance use and self-reported STIs.

Results: This study found that 3.96% of the participants self-reported being diagnosed or treated for a STI in the last 12-months. Additionally, participants reported being current users of alcohol (80%), cannabis (23%) and other drugs (8%). Multivariate logistic regression analysis revealed current cannabis use to be significantly associated with self-reported STIs (OR, 1.32; 95% CI, 1.1-1.57). There was a significant association between current drug use and STIs among male (OR, 3.07; 95% CI; 2.3-4.11) and female participants (OR, 1.9; 95% CI, 1.55-2.34). Having multiple sexual partners, a history of sexual assault, being homosexual, Black and older than 21 years old were also found to have a significant association with self-reported STIs (p-value<0.001).

Conclusion: In our study, significant associations were found between cannabis and other drug use and STIs among post-secondary students in Canada. The results of this study help inform institutions of higher-learning and public health professionals in the development, implementation and evaluation of STI policies and school-based health programming.

Key words: Sexually transmitted infections (STIs), substance use, alcohol use, cannabis use, drug use, post-secondary students, young adults

2.2. Introduction

Sexually transmitted infections (STIs) and substance use contribute to the global burden of disease and they are responsible for significant expenditure and strain on healthcare systems (1,2). STIs are the most prevalent communicable diseases worldwide (3), infecting approximately 360 million people annually (4). Substance use poses a significant threat to physical and mental health (5) and is reported to affect 275 million people annually (6). Young adults (ages 20-24 years old) including post-secondary students are more likely to engage in risky behaviors such as substance use and unsafe sexual practices which can lead to an increased risk of STIs (7,8,9).

In Canada, 50% of the reported communicable diseases are STIs (10). These cases represent only 10% of all cases, as most STIs are asymptomatic and thus are under-reported (10). STIs are difficult to prevent and control due to their often-asymptomatic nature, the emergence of drug resistance, social stigmatization and personal confidentiality issues (11,12,13). If left untreated, STIs can cause adverse physical health outcomes (i.e. ectopic pregnancy, infertility, unfavourable birth outcomes, certain types of cancers, and increased risk of HIV transmission) (14-17), negative mental health issues (i.e. depression, embarrassment, and guilt) and social problems (i.e. impaired interpersonal relations and isolation) (16).

STI rates are steadily increasing in Canada (18). It is reported that between 1998 and 2015 there was a considerable rise in chlamydia rates from 39,372 to 116,499 and gonorrhoea rates from 5,076 to 19,845 annual cases, among all ages and genders (18). These findings are particularly troubling because they mainly impact young adult, post-secondary aged students. According to

the STI surveillance report (2013-2014), the highest rates of chlamydia and gonorrhoea were seen among young adults aged 20-24 years old (19). Chlamydia cases were nearly four times higher among young adults (1627.6/100,000 population) compared to adults aged 25-59 years old (431.4/100,000 population) (19). Likewise, the gonorrhoea rates were nearly three times higher among young adults (180.41/100,000 population) compared to adults (78.8/100,000 population) (19).

Young adult, post-secondary students are more susceptible to STIs compared to adults due to several risk factors. These include inadequate knowledge (20), increased independence (21), perceived invulnerability (20), inconsistent or inappropriate condom use (22,23), access and use of social media to arrange for casual and multiple sexual partners (24,25), and sexual encounters under the influence of substance use (8). Substance use in particular plays a critical role by increasing risky sexual behaviors due to its causing disinhibition and impaired decision making (22).

Substance use is a major public health concern and predominately affects young adults including post-secondary students in Canada (26,27). The most commonly used substances include alcohol, cannabis, and other drugs (hallucinogens, ecstasy and cocaine) (28). The highest percentage of drinking in the last year was among young adults aged 18-24 years old (83%) (2015) (26). Similarly, cannabis use in the last year was highest among young adults, who reported rates (30%), that were more than three times higher compared to adults 25 years and older (10%) (2015) (29). Likewise, the prevalence of other illicit drug use (cocaine, ecstasy, methamphetamines, hallucinogens or heroin) in the last year for young adults (9%) was nine times higher compared to adults (1%) (2015) (27).

Young adults, post-secondary students are at an increased risk and thus, a target population for the prevention and control of STIs (30-32). To reduce the burden of STIs among young adults, it is essential to identify and quantify the relevant risk factors and implement effective intervention strategies. Substance use is an important risk factor for contracting STIs among young adults due to its high prevalence and capacity to link distal contextual factors (i.e. emotional and mental health issues) and proximal risky sexual behaviors (i.e. unprotected sex). Previous research into

substance use and STIs among young adults found positive associations, however, the majority of studies focused on high-risk groups (i.e. street youth, minority groups, problematic drug users) (33-41). Moreover, there is scarcity of studies in this area in Canada. Therefore, the purpose of this study was to examine the prevalence and association of substance use (alcohol, cannabis and other drugs) and STIs among Canadian post-secondary students.

2.3. Materials and methods

2.3.1. National College Health Assessment II (NCHA II), Spring 2016

The present study analysed secondary data from the National College Health Assessment II (NCHA II), Spring 2016 survey, conducted by the American College Health Association (ACHA). It is a national, comprehensive, cross-sectional survey, which collected data using self-administered questionnaires from 41 Canadian post-secondary institutions. The overall response rate was 19.2%. The questionnaire consisted of eight domains: 1) health, health education and safety, 2) alcohol, tobacco and drugs, 3) sexual behaviour and contraception, 4) weight, nutrition and exercise, 5) mental health, 6) physical health, 7) impediments to academic performance, and 8) demographic characteristics. The present study specifically focused on the following categories: alcohol, tobacco and drugs; sexual behaviour; physical health; and demographic characteristics. Details about the survey's design and methodology are published elsewhere (42).

2.3.2. Participants

In total, there were 43,780 participants from 41 post-secondary institutions in Canada. The present study examined the responses from 31,642 participants, who reported being sexually active.

2.3.3. Measures

Outcome Variable

The survey asked participants whether they were diagnosed or treated within the last 12-months by a professional for one of the following seven STIs: chlamydia, gonorrhoea, HIV, genital

herpes, genital warts, hepatitis B/C or pelvis inflammatory disease. The response to the questions was dichotomous (yes or no). In our study, these variables were combined to create one variable (being diagnosed or treated with at least one STI in the last 12-months).

Exposure variables

Our study included three exposures of interest: 1) alcohol use, 2) cannabis use, and 3) other drug use. Each exposure was further categorized as: never users, ever users (used, but not in the last 30-days) and current users (used, in the last 30-days).

Other Covariates

The present study included socio-demographic and behavioural factors previously recognized as potential confounders associated with our exposures and outcomes of interest. These included: age (18-21 years and 22 years or older), biological sex (male or female), ethnicity (White, Black, Hispanic, Aboriginal, Asian/Pacific Islander, Biracial/Multiracial), sexual orientation (heterosexual, homosexual, bisexual and others), sexual assault in the last 12-months (yes or no), multiple sexual partners (two or more) in the last 12-months (yes or no), tobacco use in the last 30-days (never users, ever users and current users) (14,20,22,43-47).

2.3.4. Data analysis and model building

Initially, frequency distributions of self-reported STIs in the last 12-months, substance use (alcohol, cannabis, and other drugs) and other covariates were tabulated. A sequence of univariate logistic regression analyses was conducted to measure crude associations between each independent variable and self-reported STIs (p value < 0.25). Multicollinearity among independent variables was checked using the variance inflation factor ($VIF < 2.5$) (48).

Subsequently, a multivariate logistic regression was used to assess adjusted associations between substance use (alcohol, cannabis and other drugs) and STIs, while accounting for other covariates.

The variables with p value > 0.05 were tested for their confounding effect on the associations between substance use (alcohol, cannabis, and other drugs) and STIs before exclusion. If the magnitude of change of the regression coefficients was $\geq 20\%$ before and after adjusting, the variable was considered a confounder and kept in the model (49). Two-way interactions between exposures of interest and appropriate independent variables were analysed and reported (p value ≤ 0.05). Model fit was assessed using Hosmer-Lemeshow goodness-of-fit statistics (50) and the model's predicted probability was tested using ROC curve (53). We did not impute missing values in our analyses. All 11 variables included in this study had <5% missing values. Data analysis was conducted using SAS version 9.4.

2.4. Results

2.4.1. Descriptive analysis

Sexually transmitted infections

There were 31,642 sexually active participants of whom 3.96% self-reported that they had been diagnosed or treated for at least one STI in the last 12-months. Chlamydia was the most common self-reported STI (1.98%). Detailed statistics for STI occurrence among respondents can be seen in Table 2.1.

Alcohol, cannabis and other drug use

Table 2.2 shows the frequencies for alcohol, cannabis and other drug use among participants. Nearly 80% of the respondents described themselves as current alcohol users, 23% current cannabis users and 8% current other drug users.

Other characteristics of the study population

The majority of the participants were female (70.74%), over the age of 21 years old (51.04%), White (74.64%), and heterosexual (79.9%). Of the participants, 20.04% reported tobacco use in

the last 30-days, 14.63% sexual assault in the last 12-months and 31.3% multiple sexual partners in the last 12-months. Detailed statistics are presented in Table 2.3.

2.4.2. Univariate analysis

Univariate analysis was used to measure the crude associations of each independent variable with self-reported STIs. The strongest association was found between having multiple sexual partners and self-reported STIs (OR, 3.57; 95% CI, 3.17-4). Detailed information regarding crude ORs and their respective 95% confidence intervals are described in Table 2.4.

2.4.3. Multivariate analysis

Association between alcohol use and self-reported STIs

No significant association was found when comparing current users or ever users versus never users of alcohol in terms of self-reported STIs (Table 2.4).

Association between cannabis use and self-reported STIs

No significant association was found when comparing ever users versus never users of cannabis with respect to self-reported STIs. However, the comparison between current users versus never users was significant (OR, 1.32; 95% CI, 1.1-1.57) (Table 2.4).

Association between other drug use and self-reported STIs

The two-way interaction between biological sex and other drug use was significant. Therefore, adjusted ORs for the association between other drug use and self-reported STIs were analysed for male and female participants separately. For male students, a significant association was found only when comparing current users versus never users (OR, 3.07; 95% CI, 2.3-4.11). For female students, significant associations were detected for both ever users versus never users (OR, 1.69; 95% CI, 1.41-2.01) and current users versus never users (OR, 1.9; 95% CI, 1.55-2.34) (Table 2.4).

Associations between other covariates and self-reported STIs

Participants who had multiple sexual partners in the last 12-months were nearly three times more likely to be diagnosed or treated for a STI compared to participants who did not (OR, 2.87; 95% CI, 2.52-3.27). Participants who experienced sexual assault in the last 12-months were 54% more likely to report a STI compared to participants who did not (OR, 1.54; 95% CI, 1.34-1.77). Homosexuals were two times more likely to be diagnosed or treated for a STI compared to heterosexuals (OR, 2.05; 95% CI, 1.57-2.69), whereas other sexual orientations did not show significant difference from heterosexuals. STI risk was higher in Black compared to White students (OR, 1.6; 95% CI, 1.15-2.21), however, no significant association was found for other ethnicities compared to White students. Respondents older than 21 years old were 56% more likely to self-report a STI compared to their younger counterparts (OR, 1.56; 95% CI, 1.38-1.76). (Table 2.4)

Model fit and predicted probability

The final model with the interaction terms showed a good fit to the data, when examined using the Hosmer and Lemeshow Goodness-of-Fit test (p value=0.075) (50). Predicted probability of the final model by means of Area Under the ROC Curve was 0.73 and thus, the prediction ability of the model is said to be satisfactory (51).

2.5. Discussion

The purpose of this study was to examine the prevalence and association of substance use (alcohol, cannabis and other drugs) and self-reported STIs among Canadian post-secondary students.

In the present study, the prevalence of self-reported chlamydia (1,980/100,000) and gonorrhea (430/100,000) among sexually active Canadian post-secondary students were higher than the reported cases of chlamydia (668/100,000) and gonorrhea (87/100,000) among the general population aged 15 years old and older (19). This finding is not entirely surprising as our study

population included only sexually active students, who chronologically fall within the high-risk age group. However, it further highlights the growing importance and need of STI preventive interventions at Canadian post-secondary institutions.

Our study found that 93% of the sexually active, post-secondary students were lifetime alcohol users (current users plus ever users). This rate is close to the national averages, which estimate that 91% of Canadians aged 15 years old or older reported alcohol use in their lifetime (52). Although the association between alcohol use and STIs was significant in the univariate analysis, it was not significant in our final model after adjusting for covariates. A review of the literature revealed a lack of consensus, when examining the relationship between alcohol use and STIs (33-41). In support of our findings, two studies found no significant association between alcohol use and STI occurrence among post-secondary students (35,40). It is possible that recently instituted health promotion initiatives and guidelines related to the risks of alcohol use and STIs have helped increase awareness and knowledge among post-secondary students in Canada (53-59). This has potentially led post-secondary students to exercise better judgement and decision-making, when using alcohol and participating in sexual relationships. Other studies found contradictory evidence, which showed alcohol use is associated with STIs (33,34,36-38). However, these studies used different target populations including: 1) street youth (33), 2) youth living with HIV (34) 3) African American youth (36,38), and 4) Aboriginal youth (37). The differences in the study population, may suggest that post-secondary students are a distinct group and the findings from other vulnerable populations are not necessarily generalizable to them.

According to our findings, the prevalence of lifetime cannabis use (53%) was higher among sexually active post-secondary students compared to the national statistics (44.5%) (60). As Canada plans to legalize recreational cannabis in 2018, higher rates of cannabis use may be anticipated due to easier access, social acceptance, lower prices and decreased perceived harm (61-62). Therefore, it is important to continue to research the health consequences of cannabis use and raise awareness, especially among young adults. In our multivariate analysis, current cannabis users were 32% more likely to self-report STIs in the last 12-months compared to never users. Our findings are consistent with those reported in previous studies (34,35,37). There are different possible explanations for our results. One hypothesis suggests that cannabis acts as a

potential immunosuppressant, reducing pro-inflammatory immune markers responsible for fighting infectious agents, making users more susceptible to STIs (63-65). Secondly, it is postulated that cannabis use leads to increased risky sexual behaviors (i.e. unprotected sex) due to disinhibition and impaired decision making, which may result in increased risk to contract STIs (35,66,67).

Among our study population, eight percent reported currently using other drugs. Our analysis found that male current other drug users were three times and females two times more likely to self-report STIs in the last 12-months compared to never users. According to the literature, when males use illicit drugs, they tend to use them with greater frequency, magnitude and are more likely to engage in simultaneous poly-drug use compared to females (68-72). Our results suggest that one in twelve post-secondary students engage in current other drug use regardless of their knowledge and setting. These students are a vulnerable group and prime candidates to benefit from school-based health interventions that address other drug use and STIs.

Our final model revealed a number of interesting findings. Among post-secondary students, having multiple sexual partners had the strongest association with STIs. This result may be attributed to peer influences, absence of parental supervision, a growing hook-up culture and mental stressors (73-76). When examining sexual orientation, homosexuals were more likely to report STIs, which is consistent with the findings reported in previous literature (20,77). This result may be attributed to stigmatization, issues related to sexual identity and psychological distress (20,78). These findings reflect a potential opportunity to design and implement tailored health promotion activities and safe sex practices among post-secondary students in Canada.

2.6. Strengths and limitations

The strengths of our study included: a) a population of interest that is vulnerable and to date not well characterized in Canada; b) a large national sample representing 41 post-secondary institutions across Canada; c) diverse background of the participants (i.e. inclusion of both sexes, different sexual orientations, different ethnic groups); d) the survey instrument used was valid and reliable; and e) inclusion of different substance use variables (alcohol, cannabis and other drugs) in the multivariate logistic regression analysis, which ensured pure estimates (odd ratios).

There were several limitations of this study: a) it used a cross-sectional design and thus, reported on associations but not causation; b) self-reported response on STIs and substance use, which may underestimate the extent of the problem due to stigmatization, social desirability bias and recall bias; c) inability to analyze the magnitude of substance use and the event-specific sequence (i.e. if substance use immediately preceded contracting a STI or not); and d) low participation rate (19.2%).

2.7. Implications for future research and interventions

Future research among post-secondary students in Canada is warranted to examine 1) the association between substance use and STIs by using specific measurements (i.e. magnitude, severity, and event-specific sequence of substance use, clinically diagnosed STIs); 2) the long-term impact of cannabis use on the health-related outcomes including STIs; 3) the association between specific illicit drug use and STIs; and 4) the relationship between socioeconomic and environmental factors and STI occurrence.

At Canadian post-secondary institutions, the following recommendations are suggested to increase the effectiveness of existing interventions: 1) increased awareness of sexual health and STI prevention programs of substance use as a predisposing factor for STIs (WHO, PHAC, European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) (30,70,79); 2) characteristics of substance use status in detail (i.e. never/ever/current used, frequency, time when use, types, risky sexual encounters under the influence) as part of STI risk assessment (PHAC,79); 3) development and integration of reliable data collection tools to identify the co-occurrence (EMCDDA, 70); 4) training of staff from sexual health and substance use programs to identify and provide basic interventions and referral services for both substance use and STIs (EMCDDA, 70); 5) integrated health promotion events (EMCDDA, 70); and 6) evaluation of integrated services regarding their fidelity, effectiveness and cost-benefit (EMCDDA, 70).

2.8. Conclusion

In our study, a significant association was found between cannabis and other drug use and STIs among post-secondary students in Canada. Our findings provide empirical evidence for public

health professionals, policy makers, and university administrators to use in preparing strategies and programming that help address the scourge of the co-occurrence of substance use and STIs. Future initiatives need to emphasize both collaboration and integration of substance use and STI services to improve the overall health and well-being of post-secondary students.

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Table 2.1:Prevalence of self-reported STIs among sexually active Canadian post-secondary students, Spring 2016			
STI¹	Frequency	%	% of STI (n=1250)
Overall	1250	3.96	-
Chlamydia	623	1.98	50.04
Genital warts	336	1.07	27.01
Genital herpes	270	0.86	21.81
Gonorrhea	136	0.43	10.92
HBV ² /HCV ³	102	0.32	8.21
PID ⁴	100	0.32	8.03
HIV ⁵	86	0.27	6.91

¹Sexually Transmitted Infection, ²Hepatitis B Virus, ³Hepatitis C Virus, ⁴Human Immunodeficiency Virus, ⁵Pelvic Inflammatory Disease.
Overlapping of the frequencies was expected as participants might be co-infected with more than one infection.
Missing values were not included in the calculation.

Table 2.2: Prevalence of substance use among sexually active Canadian post-secondary students, Spring 2016

Substance use	Categories			Missing
	Never used Frequency (%)	Ever used Frequency (%)	Current used Frequency (%)	
Alcohol use	2334 (7.42)	4110 (13.06)	25031 (79.53)	167
Cannabis use	14968 (47.62)	9240 (29.39)	7226 (22.99)	208
Other drug use ^λ	24100 (76.34)	4947 (15.67)	2521 (7.99)	74
^λ Use of at least: cocaine (crack, rock, freebase), methamphetamine (crystal meth, ice, crank), other amphetamines (diet pills, bennies), sedatives (downers, ludes), hallucinogens (LSD, PCP), anabolic steroids (testosterone), opiates (heroin, smack), inhalants (flue, solvents, gas), MDMA (ecstasy), other club drugs (GHB, ketamine, rohypnol) or other illegal drugs.				

Table 2.3: Demographic characteristics of sexually active Canadian post-secondary students, Spring 2016

Variables	Categories	Frequency (%)	Missing
Tobacco use	Never used	17115 (54.31)	131
	Ever used	8081 (25.65)	
	Current used	6315 (20.04)	
History of sexual assault in the last 12-months	No	26994 (85.37)	22
	Yes	4626 (14.63)	
Multiple sexual partners in the last 12-months	No	21578 (68.70)	235
	Yes	9829 (31.30)	
Biological sex	Female	22306 (70.74)	109
	Male	9227 (29.26)	
Sexual orientation	Hetero	25183 (79.90)	122
	homo	849 (2.69)	
	Bi	2081 (6.60)	
	¥Others	3407(10.81)	
Age categories	18-21	15418 (48.96)	149
	22 and older	16075 (51.04)	
Ethnicity	White	23458 (74.64)	213
	Black	823 (2.62)	
	Aboriginal	1463 (4.65)	
	Hispanic	722 (2.30)	
	Asian	3014 (9.59)	
	BI	1094 (3.48)	
	Other	855 (2.72)	

¥ Asexual, pansexual, queer, questioning, same gender loving another or others

Table 2.4: Crude and adjusted Associations of substance use and other covariates with self-reported STIs				
Variables	Categories	Crude OR (95% CI)	Adjusted OR (95% CI)	P (crude/adjusted)
Alcohol use	Never used	1	1	*** / NS
	Ever used	0.92 (0.67-1.25)	NS	
	Current used	1.53 (1.19-1.96)	NS	
Cannabis use	Never used	1	1	*** / **
	Ever used	1.67 (1.44-1.92)	NS	
	Current used	2.67 (2.32-3.06)	1.32 (1.10-1.57)	
Other drug use ^λ	Never used	1	-	*** / ***
	Ever used	2.17 (1.89-2.50)	-	
	Current used	3.87 (3.33-4.50)	-	
Other drug use ^λ (Male)	Never used	-	-	*** / ***
	Ever used	-	NS	
	Current used	-	3.07 (2.30-4.11)	
Other drug use ^λ (Female)	Never used	-	1	*** / ***
	Ever used	-	1.69 (1.41-2.01)	
	Current used	-	1.90 (1.55-2.34)	
Tobacco use	Never used	1	1	*** / NS
	Ever used	1.47 (1.28-1.69)	NS	
	Current used	2.25 (1.97-2.57)	NS	
Multiple sexual partners in the last 12-months	No	1	1	*** / ***
	Yes	3.57 (3.17-4.00)	2.87 (2.52-3.27)	
History of sexual assault in the last 12-months	No	1	1	*** / ***
	Yes	2.46 (2.17-2.79)	1.54 (1.34-1.77)	
Age	18-21	1	1	*** / ***
	>=22	1.28 (1.14-1.43)	1.56 (1.38-1.76)	
Biological sex	Male	1	1	** / ***
	Female	1.19 (1.05-1.36)	-	
Sexual orientation	Heterosexual	1	1	*** / ***
	Homosexual	2.51 (1.95-3.23)	2.05 (1.57-2.69)	
	Bisexual	1.57 (1.28-1.92)	NS	
	[¥] Others	1.35 (1.14-1.61)	NS	
Ethnicity	White	1	1	*** / *
	Black	1.51 (1.12-2.04)	1.60 (1.15-2.21)	
	Hispanic	NS	NS	
	Aboriginal	1.37 (1.08-1.74)	NS	
	Asian/Pacific Islander	0.69 (0.55-0.87)	NS	
	Bi/Multiracial	1.37 (1.04-1.80)	NS	
	Other	1.16 (0.83-1.61)	NS	

*** p<0.001. ** p<0.01. * p<0.05. OR Odds Ratio. CI Confidence Interval. NS Not Significant.
Alcohol use and tobacco use were confounders for the cannabis use and other drug use.
[¥] Asexual, pansexual, queer, questioning, same gender loving another or others
^λ Use of at least: cocaine (crack, rock, freebase), methamphetamine (crystal meth, ice, crank), other amphetamines (diet pills, bennies), sedatives (downers, ludes), hallucinogens (LSD, PCP), anabolic steroids (testosterone), opiates (heroin, smack), inhalants (flue, solvents, gas), MDMA (ecstasy), other club drugs (GHB, ketamine, rohypnol) or other illegal drugs.

CHAPTER 3 - EFFICACY AND EFFECTIVENESS OF PREVENTIVE INTERVENTION PROGRAMS FOR STIs AT EDUCATIONAL SETTINGS: A SYSTEMATIC REVIEW AND META-ANALYSIS

3.1. Abstract

Background: The last decade has seen an increase in sexually transmitted infections (STIs), worldwide. Youth are at a higher risk to contract STIs for various reasons including, risky behaviors and limited access to healthcare services. The majority of youth are students, especially in developed countries. Therefore, educational institutions represent ideal settings to implement effective strategies to help reduce the STI burden. The purpose of this systematic review and meta-analysis was to examine the efficacy and effectiveness of STI preventive interventions at educational settings.

Methods: A systematic review and meta-analysis of relevant databases was conducted including: PubMed, Medline, Embase, Public Health Database and Cochrane Library. Information relating to studies (i.e. type, published year, location), programs (i.e. type, provider, setting), participants (i.e. number, age, sex, ethnicity), and quantitative outcome variables (i.e. behavioral and psychosocial) were extracted. Risk of bias was assessed using criteria presented by the Agency for Healthcare Research and Quality (AHRQ). Finally, meta-analysis was performed using Comprehensive Meta-Analysis (CMA) software version 3 (Biostat Inc., New Jersey, USA).

Results: This systematic review included 16 articles. The outcomes were classified into behavioral and psychosocial categories. The behavioral category included sexual partners, sexual activity, condom practice, STI/HIV testing and alcohol/drug use before sex. The psychosocial category consisted of knowledge, motivational factors and skills. Interventions had a significantly positive impact on both behavioral (OR, 1.28; 95% CI, 1.17-1.39) and psychosocial (OR, 1.92; 95% CI, 1.36-2.72) outcomes. Among the psychosocial outcomes, the interventions

were most effective on promoting knowledge (OR, 3.17; 95% CI, 2.13-4.72), followed by enhancing motivational factors (OR, 1.69; 95% CI, 1.04-2.75) and increasing behavioral skills (OR, 1.43; 95% CI, 1.13-1.81).

Conclusion: The results of this systematic review provide empirical evidence for public health professionals and policy makers regarding planning, implementation, evaluation and modification of STI preventive intervention programs at educational settings.

Key words: STIs, youth, educational settings, STIs preventive interventions, effectiveness

3.2. Introduction

Sexually transmitted infections (STIs) are a significant public health concern worldwide (1). According to the World Health Organization (WHO), more than 360 million people acquire one of four STIs (chlamydia, gonorrhea, syphilis and trichomonas) annually (1). Youth (aged 15-24 years old) are particularly vulnerable to STIs compared to adults due to their higher likelihood to engage in risky behaviors (2,3). The majority of youth are students, especially in developed countries (4-6). Therefore, educational institutions represent ideal settings to implement effective strategies to help reduce the STI burden.

Youth in developed countries are not immune to the scourge of STIs. In the U.S., individuals 25 years old and younger accounted for half of all STI cases despite representing only a quarter of the sexually active population (7). Similarly, in Canada, individuals aged 15-29 years old reported the highest rates among three commonly notifiable STIs (chlamydia, gonorrhea and syphilis) (8). In Australia, 77% of chlamydia incidence cases in 2015 were seen among individuals aged 15-29 years old and highest rates of gonorrhea and syphilis among male aged 20-29 years old (9). In Europe, youth accounted for 62% of chlamydia and 52% of gonorrhea cases (10).

Inadequate knowledge, risky behaviors and lack of effective sexual health education contribute to the high rates of STIs among youth. According to the Canadian Youth, Sexual Health and

HIV/AIDS Study (CYSHHAS), approximately half of grade nine students (14-16 years old) did not know that HIV has no cure, and STI risk perception had little influence on engaging in safe sexual practices (11). Previous studies in the U.S. found that youth are not practicing consistent condom use and instead favour the use of birth control methods that prevent unwanted pregnancies but offer no protection against STIs (12-14). These research findings are supported by statistics suggesting more than 40% of U.S. sexually active high school students (15) and 33% of Canadian youth did not use a condom during their last sexual encounter (16). It is reported that 11.5% of U.S. high school students had four or more sexual partners in their lifetime and nearly 4% had early sexual initiation (before the age of 13 years old) (15). Likewise, approximately one-third of Canadian youth reported having multiple sexual partners in the last 12-months and 9% had early sexual initiation (before the age of 15 years old) (17). Therefore, to address existing deficits in the youth's knowledge, attitudes and practices related to sexual health, effective school-based preventive interventions are needed.

It is widely acknowledged that in order to be successful, preventive efforts require behavioral change (12). Currently, there are numerous biomedical and structural barriers affecting the prevention, diagnosis, and treatment of STIs. Biomedical barriers impacting STI interventions are due to the lack of technological advances in comprehensively addressing STIs (i.e. screening tests, vaccines, and curative treatments) (1,12,18,19). Structural barriers impacting STI interventions are due to policies affecting accessibility and viability of services to youth (i.e. funding cutbacks, lack of infrastructure, and inefficient intervention strategies) (20-22). Furthermore, STIs are difficult to control once an individual is infected because of their asymptomatic nature, drug resistance, social stigmatization and confidentiality issues (23-25).

To implement effective preventive interventions to reduce the risk of STIs among youth, educational institutions are recognized as ideal settings (7,26-28). These settings provide the necessary social framework and educational opportunities for sexual health promotion initiatives that specifically target youth (27,28). However, in the U.S. fewer than half of the high schools and only one-fifth of the middle schools are reported to teach the essential topics related to sexual behavioral health as recommended by the Centers for Disease Control and Prevention (CDC) (7). Australia faces similar challenges with reports of significant gaps in the current

sexual health education programmes and a growing need to improve knowledge, attitudes and behaviors among high school students (29). In Canada, only a few high schools have well established sexual health curricula (27) and the outcomes to date have been unsatisfactory (30).

STI preventive interventions are also needed at post-secondary institutions. In the U.S., post-secondary students showed poor knowledge, low condom use and a high tendency to engage in unsafe sexual practices (6,31-35). Decreases in condom use were also seen among Canadian students especially as they transitioned from high school to post-secondary institutions, where less than half reported using a condom during their last sexual encounter (27). Therefore, to effectively reduce the burden of STIs, preventive interventions that increase knowledge and promote behavioral change including safe sex practices are considered the gold standard. By introducing STI preventive interventions to youth, it is likely they may adopt safe sex practices throughout their lifetime. The purpose of this systematic review and meta-analysis was to examine the efficacy and effectiveness of STI preventive interventions at educational settings.

3.3. Materials and methods

3.3.1. Search strategy and study selection

An extensive literature search was conducted using the electronic databases: PubMed, Medline, Cochrane Library, Public Health Database and EMBASE. The following keywords and PubMed MeSH terms were used: HIV, chlamydia, chlamydia infections, gonorrhoea, syphilis, sexually transmitted diseases, mass screening, health promotion, health education, guideline adherence, preventive health services, community health planning, health plan implementation, population characteristics/prevention and control, health education, health knowledge, attitudes, practice, program effectiveness, cost effectiveness, health impact assessment, cost savings, and evaluation studies as topics.

Articles obtained from the systematic search were screened in two steps: 1) title and abstract screening and 2) full text screening. Dual screening was employed, whereby two authors (NMKS and RE) initially screened 20 articles to determine the consistent use of the inclusion and

exclusion criteria. The two authors independently conducted title and abstract screening followed by full-text screening. Discrepancies in decisions between the screeners (NMKS and RE) were initially discussed among themselves, and when consensus was not achieved, a tie-breaking vote was cast by the third author (JM).

3.3.2. Inclusion and exclusion criteria

Articles were included, if they satisfied the following criteria: publicly available; peer-reviewed; published online between 2007 and 2017; English language; human participants; educational settings; examining STIs or chlamydia or gonorrhea or syphilis or HIV; preventive interventions; quantitative outcome measurements; and data from North America, Europe, and Oceania. Articles involving case reports or case series were excluded.

3.3.3. Data extraction

Information extracted from the selected articles included in our study were: authors, published year, location, program types, type of providers, settings, type of study, number of participants, demographics (age, sex, ethnicity), and the quantitative data of the outcome variables (psychosocial, behavioral, and biological), which assessed the effectiveness of the interventions. If there were more than one follow-up measurement, we preferably extracted data from the final follow-up. Data were collected into a common folder and shared between the researchers. Spreadsheets were constructed based on outcomes of interest and data extracted from the final articles.

3.3.4. Risk of bias assessment

Risk of bias was assessed independently by two of the authors (NMKS and RE) by applying the design specific criteria recommended by the Agency for Healthcare Research and Quality (AHRQ) (36). These criteria were used to assess five types of bias: selection, performance, attrition, detection and reporting.

3.3.5. Data analysis

In our study, odds ratio (OR) was used as the principle effect size with values >1 reflecting positive effect of the STI preventive intervention on the outcomes of interest. Crude effect sizes were computed when adjusted ones were not available. Adjusted ORs were preferentially used to provide a conservative effect estimate and included age, gender, ethnicity and parental education.

Pooled estimates were obtained using random effects models to account for heterogeneity. Analysis of heterogeneity was conducted using I^2 tests and Q-statistics to assess the degree of true variation of the effect size among studies (37). Influential analysis was conducted to determine the robustness and effect that each individual study had on the overall pooled estimate. Pooled, comparative, and sub-group meta-analysis was conducted using the Comprehensive Meta-Analysis (CMA) software version 3 (Biostat Inc., New Jersey, USA).

3.4. Results

3.4.1. Study selection

A total of 5,243 articles were identified after an initial search of the electronic databases. Among those, 1,411 articles were removed as duplicates. The remaining 3,832 articles underwent title and abstract screening and upon completion, 181 articles qualified for full-text review. Guided by the inclusion and exclusion criteria determined a priori, 165 articles were further excluded. Finally, 16 articles were deemed appropriate and were selected for further analysis (Figure 3.1).

3.4.2. Risk of bias assessment

Of the selected 16 articles, four studies were determined to have a low risk of bias (38-41), eight a moderate risk of bias (42-49) and four a high risk of bias (50-53). The main methodological concerns were focused on performance bias (15 studies) (39-53) and detection bias (6 studies) (45,46,48,50-52) (Table 3.1).

3.4.3. Study characteristics

There were fifteen STI preventive programs in total. The majority of the programs were in the U.S and conducted in high school (6), post-secondary settings (3) and middle school (2). The rest of the programs were conducted in other countries (Spain, Slovakia, Australia and Bahamas). Most programs were guided by health promotion theories and promoted both knowledge acquisition and improved behavioral skills among participant students. Two-thirds of the programs were conducted face-to-face and one-third were technology-based interventions. There was a peer-to-peer component in seven programs. The duration of the program interventions ranged from one to 18-hours. Program interventions were evaluated at designated time interval(s); immediately after, 3-months, 6-months, and up to one year. Table 3.2 provides a summary description of the included studies.

3.4.4. Synthesis of result

All 16 included studies measured psychosocial outcomes, 10 studies also measured behavioral outcomes, and no studies measured biological outcomes. Synthesis of effect measures was conducted for behavioral outcomes (overall), psychosocial outcomes (overall) and its sub-categories (information/knowledge, motivational factors and behavioral skills).

Effects of interventions on the behavioral and psychosocial outcomes

Overall behavioral (OR, 1.28; 95% CI – 1.17-1.39; I2, 0%; p value, 0.65) and psychosocial (OR, 1.92; 95% CI, 1.36-2.72; I2, 96.95%; p value, 0.00) outcomes were significant compared to controls, suggesting a positive intervention effect (Table 3.3) (Figure 3.2).

Effects of interventions on the psychosocial sub-categorical outcomes

The psychosocial sub-categorical variables, information/knowledge (OR, 3.1; 95% CI, 2.13-4.72; I2, 97.12%), motivational factors (OR, 1.69; 95% CI, 1.04-2.75; I2, 98.67%) and behavioral skills (OR, 1.43; 95% CI, 1.13-1.81; I2, 89.91%) were significant compared to controls, suggesting a positive intervention effect (Table 3.3) (Figure 3.2).

Effects of interventions on the specific psychosocial and behavioral outcomes

When examining pooled estimates of specific behavioral outcomes, sexual partners and condom practice were significantly improved by the interventions, while alcohol or drug use before sex and HIV or STI testing were measured by only one article preventing pooled analysis. When examining pooled estimates of specific psychosocial outcomes, attitudes (condom use and abstinence), norms and beliefs relating to condom, norms and beliefs relating to abstinence, condom efficacy, HIV self-efficacy, partner communication, and parental communication were significantly improved. Information detailing specific outcomes is presented in (Table 3.3).

Comparative Analysis

Comparative analysis found no statistically significant difference in the effectiveness between the psychosocial and behavioral outcomes. Analysis at the sub-categorical level (information versus motivation + behavioral skills and information versus behavioral outcomes) found that interventions were significantly more effective for the dissemination of information compared to improving motivation and behavioral skills ($p < 0.001$) and for improving behavioral outcomes ($p < 0.001$).

Subgroup analysis

There was no significant difference between subgroups based on the type of provider (peer-involved versus non-peer-involved) and type of intervention (face-to-face versus technology-based).

3.5. Discussion and comments

The purpose of this systematic review and meta-analysis was to examine the efficacy and effectiveness of STI preventive intervention programs at educational settings. Our study found that students exposed to STI preventive interventions were 28% more likely to practice safe sexual behaviors and 92% more likely to show improvement in psychosocial factors compared to

those who were not exposed. Therefore, educational settings are potentially ideal venues for the design and implementation of STI preventive intervention programs that help improve the psychosocial factors and behaviors related to sexual health among students.

From our comparative analysis, it was found that the effect of STI preventive interventions was most prominent for promoting knowledge, while some improvements were also seen for enhancing motivational factors, behavioral skills and behavioral outcomes related to sexual practices. In the information-motivation-behavioral skills (IMB) model, behavioral change can be directly predicted by way of information (knowledge) and motivational factors and indirectly by behavioral skills (54). If the desired behavior (i.e. carrying condoms) is not complicated and does not require developing behavioral skills, information dissemination (i.e. on the importance of carrying condoms) might have a direct impact on behavioral change (54). However, if the desired behavior (i.e. use of a condom in every sexual encounter) has a complex nature and requires specific skills (i.e. dealing with new/casual sex partners, negotiations, self-efficacy), information dissemination alone would not be sufficient to achieve successful behavioral change (54). Based on our findings and the concepts of the IMB model, STI preventive interventions targeting students should focus on achieving promising behavioral changes by more effectively emphasizing motivational factors and behavioral skills.

In our meta-analysis, eight of the included studies discussed the difference in the effectiveness of STI preventive interventions based on sex. They suggest that STI preventive interventions were more effective for females compared to males (40,44,45,47,49-51,53) and this finding was consistent with the results reported in other research (55). Female students showed greater improvements in knowledge and motivational factors (i.e. subjective norms, interest and confidence in safe sex behaviors, attitudes towards condom use) and were less likely to engage in risk-taking behaviors (i.e. having multiple sexual partners) after the intervention compared to males (40,44,45,47,49-51,53). These findings may be due to different social norms and expectations (sexual double standard) (56) and an emphasis to date on female-centric programs. Interventions tend to preferentially target females because they suffer more from the adverse effects of risky sexual behaviors, including unwanted pregnancy and STIs (57).

Peer-involved programming is recognized as an effective STI preventive strategy, especially for youth by CDC and Advocates for Youth given the fact that youth are more likely to be influenced by their peers and aim to gain acceptance within their social group (58,59). When examining the effectiveness of peer-involved and non-peer-involved interventions in our subgroup analysis, no significant difference was found. While previous systematic reviews (50,60,61) reported similar results, other studies revealed that peer involvement had a positive impact on STI preventive interventions among youth (62-64). According to Advocates for Youth, to achieve optimal results from peer programming, adequate human and financial resources, careful and continuous recruitment, participation of peers in every step to enhance self-determination and empowerment, repeated training, and systematic supervision and evaluation of peer facilitators are required (59). In the initial planning phase, it is important to consider multiple key factors in order to balance the cost, benefit, feasibility and acceptability of peer-involved STI programming.

When examining the method of delivery for the different STI preventive interventions, we found no significant difference in the effectiveness between face-to-face and technology-based interventions. Previous studies support our finding (65,66). However, face-to-face interventions showed significant effectiveness on both behavioral and psychosocial outcomes. This might be attributed to greater compliance, peer-influence, proper engagement and sufficient dosage of delivery (67,68). However, a recent study found that the most positive and significant outcomes were seen with the use of mixed delivery for interventions (i.e. combination of face-to-face and technology-based) rather than individual approaches (69). Increasingly, youth have become reliant on the use of technology (i.e. internet, mobile phones) as part of their social environment (i.e. daily communication, information gathering and entertainment) (70). Given their popularity among youth, technology-based interventions have several advantages over face-to-face interventions, including: broader coverage, speed, convenience, privacy, confidentiality, opportunities for open discussion, cost-effectiveness, and different delivery methods (i.e. text messaging, social networking sites, webpages, blogs, and applications) (67,68, 69-72). Considering the structural barriers in implementing STI preventive interventions (i.e. inadequate funding, lack of infrastructure, and limited human resources), mixed approach (i.e. face-to-face

and technology-based) may augment the positive impact of the interventions. However, more empirical evidence in this growing area of research is needed.

3.6. Strength and Limitations

This systematic review has several strengths. It used a standardized, previously validated systematic methodology (73). It relied on recently published articles (last 10-years). The majority of the studies included utilized a pretest, post-test, and control group design with group-level randomization, which ensured a more accurate comparison. Our study focused specifically on educational settings in regions with similar overall STI burden, socioeconomic environments, and use of preventive strategies, thus improving comparability. Our findings have a high level of congruence with those reported in the literature.

Despite its strengths, our study has a few limitations. It relies on secondary data that used different statistical analysis and a variety of evaluation scales to measure the outcomes of interest, which may have led to under- or over-estimation of the pooled effect sizes. There were different post-intervention evaluation periods. To best address this issue, we used the last available evaluation period for each included study (i.e. furthest in time from the intervention). None of the included studies evaluated biological outcomes (STIs/HIV incidence and prevalence). Finally, some of the included studies were carried out with populations that could not be entirely generalizable (i.e. small sample sizes or as pilot projects), and therefore, the results should be interpreted with some level of caution.

3.7. Recommendations for future research

Future research evaluating STI preventive interventions at educational settings in developed countries (including Canada, where there is scarcity of research in this area) should: 1) assess the impact of interventions by using clinical outcomes to determine whether these programs contribute to the reduction of STIs; 2) evaluate the short, intermediate and long-term effectiveness of the interventions by using regularly repeated follow-ups over time; and 3) examine the effectiveness of the interventions on the basis of differences in gender (male versus

female), type of delivery (face-to-face versus technology-based), and type of facilitator (peer-involved versus non-peer-involved).

3.8. Conclusion

STIs are a public health concern and pose a major burden on the health and well-being of youth. Our research helps to provide evidence in support of the importance of comprehensive STI preventive interventions at educational settings. Such efforts are shown to have a positive impact on the students' psychosocial factors and behaviors related to sexual practices. To be most effective, future STI preventive interventions need to focus on male students, use a mixed delivery method (i.e. face-to-face and technology-based), and a variety of facilitators (i.e. peer-involved and non-peer-involved). Finally, it is recommended that STI preventive interventions use a formative evaluation process in order to address the dynamic nature of the changes in the sexual behaviors of students and to provide them with timely support and services.

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Table 3.1: Summary of risk of bias assessment						
Articles	Bias					Within studies risk of bias
	Selection	Performance	Attrition	Detection	Reporting	
Roberto et al. 2007 (38)	+	+	+	+	+	Low risk of bias
Morales et al. 2015 (39)	+	-	+	+	+	Low risk of bias
Tortolero et al. 2010 (40)	+	-	+	+	+	Low risk of bias
Cornelius et al. 2013 (41)	+	-	+	+	+	Low risk of bias
Aronson et al. 2013 (42)	-	-	+	+	+	Moderate risk of bias
Calloway et al. 2013 (43)	-	-	+	+	+	Moderate risk of bias
Espada et al. 2012 (44)	+	-	+	+	-	Moderate risk of bias
Gaydos et al. 2008 (45)	+	-	+	-	+	Moderate risk of bias
Lemieux et al. 2008 (46)	+	-	+	-	+	Moderate risk of bias
Hlavinkova et al. 2014 (47)	-	-	+	+	+	Moderate risk of bias
Gold et al. 2010 (48)	+	-	+	-	+	Moderate risk of bias
Stanton et al. 2015 (49)	+	-	+	+	-	Moderate risk of bias
Ateka et al. 2007 (50)	+	-	-	-	+	High risk of bias
O' Grady et al. 2009 (51)	+	-	-	-	+	High risk of bias
Peskin et al. 2015 (52)	+	-	+	-	-	High risk of bias
Mahat et al. 2008 (53)	-	-	-	+	+	High risk of bias
<p>For each bias (+) = low risk and (-) = high risk or unclear risk</p> <p>For within studies risk of bias Low risk of bias = (+) for four or all types of bias Moderate risk of bias = (+) for three types of bias High risk of bias = (-) for three or more types of bias</p>						

Author, year of publication and location	Interventions		Settings	Study			
	Type	Providers		Study design	Control	Evaluation	Characteristics of participants
Roberto et al. (38) US 2007	Computer and internet-based intervention addressing pregnancy, HIV, and STIs	No in-person provider	High school	Pretest post-test control group design (randomization at school level)	No intervention	Baseline and 10 weeks after intervention	N=326 Mean age – 15.5 Sex – male and female Ethnicity-European American (majority)
Morales et al. (39) Spain 2015	Culturally adapted HIV prevention and sexual health promotion program for Latino adolescents: “COMPAS (skills for Adolescents with a Healthy Sexuality)”	Trained psychologists	High school	Pretest post-test control group design (randomization at school level)	No intervention	Baseline and 1 year after intervention	N = 1563 Mean age – 14-16 Sex – male and female Ethnicity – Spanish
Tortolero et al. (40) US 2010	Computer-based plus classroom activities for HIV, STIs, and pregnancy prevention: “TYG (Its Your Game ... Keep It Real!)”	Trained facilitators	Middle school	Pretest post-test control group design (randomization at school level)	Regular health classes	Baseline and 1 year after intervention	N = 907 Mean age – 13 Sex – male and female Ethnicity – African American
Cornelius et al. (41) US 2013	Community-based HIV prevention program boosted with mobile cell phone (MCP) technology:	Trained African American college graduate facilitators (peers)	pilot study at university, participated by high school students	Pretest post-test treatment group only design	Baseline	Baseline, immediately and 3 months after intervention	N = 40 Mean age – 15.4 Sex – male and female

	“Becoming A Responsible Team (BART) curriculum”						Ethnicity – African American
Aronson et al. (42) US 2013	HIV preventive intervention for black male college students: “Brothers Leading Healthy Lives”	Trained peer facilitators and educators	College	Pretest post-test treatment group only design	Baseline	Baseline, immediately and 3 months after intervention	N =54 Age range – 18-24 Sex – male Ethnicity – African American
Calloway et al. (43) US 2013	Preventive intervention addressing HIV and STI for African American college students: “Playing it Safe: Protecting yourself from HIV/AIDS and other STIs”	Trained and certified peer educators	College	Pretest post-test control group design (randomization at class level)	No intervention	Baseline, immediately after intervention	N = 97 Mean Age – 18 Sex – male and female (female 79%) Ethnicity – African American (majority)
Espada et al. (44) Spain 2012	Culturally adapted HIV prevention and sexual health promotion program for Latino adolescents: “COMPAS (Skills for Adolescents with a Healthy Sexuality)”	Trained psychologists	High school	Pretest post-test control group design (randomization at school level)	No intervention	Baseline and immediately after intervention	N = 827 Mean age – 15.73 Sex – male and female Ethnicity – Spanish
Gaydos et al. (45) US 2008	Community-university linked research and interventions addressing HIV and STIs: “Focus on Adolescents (FOA): modification of “Focus on Teens (FOT)”	Trained adult interventionists	High school	Pretest post-test treatment only group design (randomization at school level)	Baseline	Baseline, immediately, 6 months and 1 year after intervention	N = 1190 Mean age – 14.9 Sex – male and female (female >70%) Ethnicity – African American

Lemieux et al. (46) US 2008	Music-based HIV preventive intervention	Music Opinion Leaders (MOLs) (peers)	High school	Pretest post-test control group design (randomization at school level)	Regular health classes	Baseline and 3 months after intervention	N = 306 Mean age – 16 Sex – male and female Ethnicity – multiethnicity (predominantly African American and Latinos)
Hlavinkova et al. (47) Slovakia 2014	HIV prevention campaign: “Sunflower project”	Students organised, designed and created contents of the campaign (peers)	High school and college	Pretest Post test treatment group only design	Baseline	Baseline and immediately after campaign	N = 533 Mean age – 15.8 Sex – male and female Ethnicity – multiethnicity
Gold et al. (48) Australia 2010	Sexual health promotion with text messaging focusing on chlamydia screening and condom use	No in-person provider is needed; researchers, professors and students were involved in the study	No physical setting (most participants are high school graduates)	Pretest post-test treatment group only design	Baseline	Baseline and 2 weeks after intervention	N = 587 Median age – 22 Sex – male and female Ethnicity – not mentioned
Stanton et al. (49) Bahamas 2015	National evidence-based HIV prevention program for 6th grade students: “Focus on Youth in the Caribbean (FOYC)”	Trained teachers	Elementary school	Pretest post-test treatment group only design	Baseline	Baseline, immediately and 1 year after intervention	N = 4470 (grade 6 th students) Mean age –10.4 Sex – male and female Ethnicity – African descendants (majority)
Ateka et al. (50) US 2007	Knowledge-based adolescent sexuality program: “City of Houston HIV and STD prevention program”	Trained teachers	High school	Intervention and control comparison at post test only	Regular health classes	Compare the data of intervention and control schools over 1 academic year	N =430 Mean age – 15.3 Sex – male and female Ethnicity – African American and Hispanics (Majority)

O' Grady et al. (51) US 2009	Brief safe sex intervention for college students residing in residence halls: "Skills, Information, Motivation, Peer-led (SIMPL)"	Trained peer educators	College	Intervention and control comparison at post test only	Information only	Immediately after sessions	N = 108 Mean age – 18.85 Sex – Ethnicity – White (majority)
Peskin et al. (52) US 2015	Computer-based sexual health education addressing pregnancy, HIV and STIs: "YIG tech (Its Your Game ... Keep It Real!)"	Trained facilitators	Middle school	Pretest post-test control group design (randomization at school level)	No intervention	Baseline and 1 year after intervention	N = 1374 Mean age – 14.3 Sex – male and female Ethnicity – Hispanic (74%), African American (17%), others (9%)
Mahat et al. (53) US 2008	Peer Education Project (PEP) for HIV prevention: "Teens for AIDS Prevention (TAP)"	Trained peer educators (guided by nurses and teachers)	High school	Pre-test post test control group design (no randomization)	Traditional sexual health education	Baseline and 5 months after intervention	N = 97 Mean age – 14 Sex – male and female Ethnicity – multiethnicity

Table 3.3: Summary table for pooled effect sizes of outcome measures

Outcome measures	# of studies	Pooled OR	Lower limit	Upper limit	Heterogeneity	
					I ²	P value (Q statistics)
Behavioral outcomes	10	1.28	1.17	1.39	0.00	0.648
Sexual partners	7	1.33	1.03	1.72	86.69	0.00
Sexual activity	8	1.06	0.86	1.31	64.72	0.01
Condom practice	5	1.57	0.91	2.73	68.42	0.01
HIV or STI testing	1	1.26	0.93	1.72	-	-
Alcohol or drug use before sex	1	1.00	0.22	4.45	-	-
Psychosocial outcomes	16	1.92	1.36	2.72	96.95	0.00
Information (Knowledge)	14	3.17	2.13	4.72	97.12	0.00
Motivation	13	1.69	1.04	2.75	98.67	0.00
Attitude: condom use, abstinence	6	1.37	1.10	1.69	56.63	0.04
Norms & beliefs: condom	4	1.42	1.00	2.04	70.78	0.02
Norms & beliefs: abstinence	2	1.16	1.03	1.30	0.00	0.96
Norms and beliefs: peers	4	1.07	0.96	1.19	0.00	0.70
Risk perceptions	4	2.06	0.66	6.48	98.98	0.00
Intentions (preventive behaviors)	10	1.68	0.97	2.9	99.00	0.00
Behavioral Skills	9	1.43	1.13	1.81	89.91	0.00
Condom efficacy	6	1.44	1.11	1.87	89.20	0.00
Refusal self-efficacy	3	1.15	0.92	1.45	63.43	0.07
HIV self-efficacy	2	1.62	1.12	2.35	0.00	0.83
Partner communication	3	1.24	1.04	1.26	0.00	0.46
Parental communication	2	1.17	1.08	1.26	0.00	0.33

Figure 3.1: PRISMA flow diagram for included studies

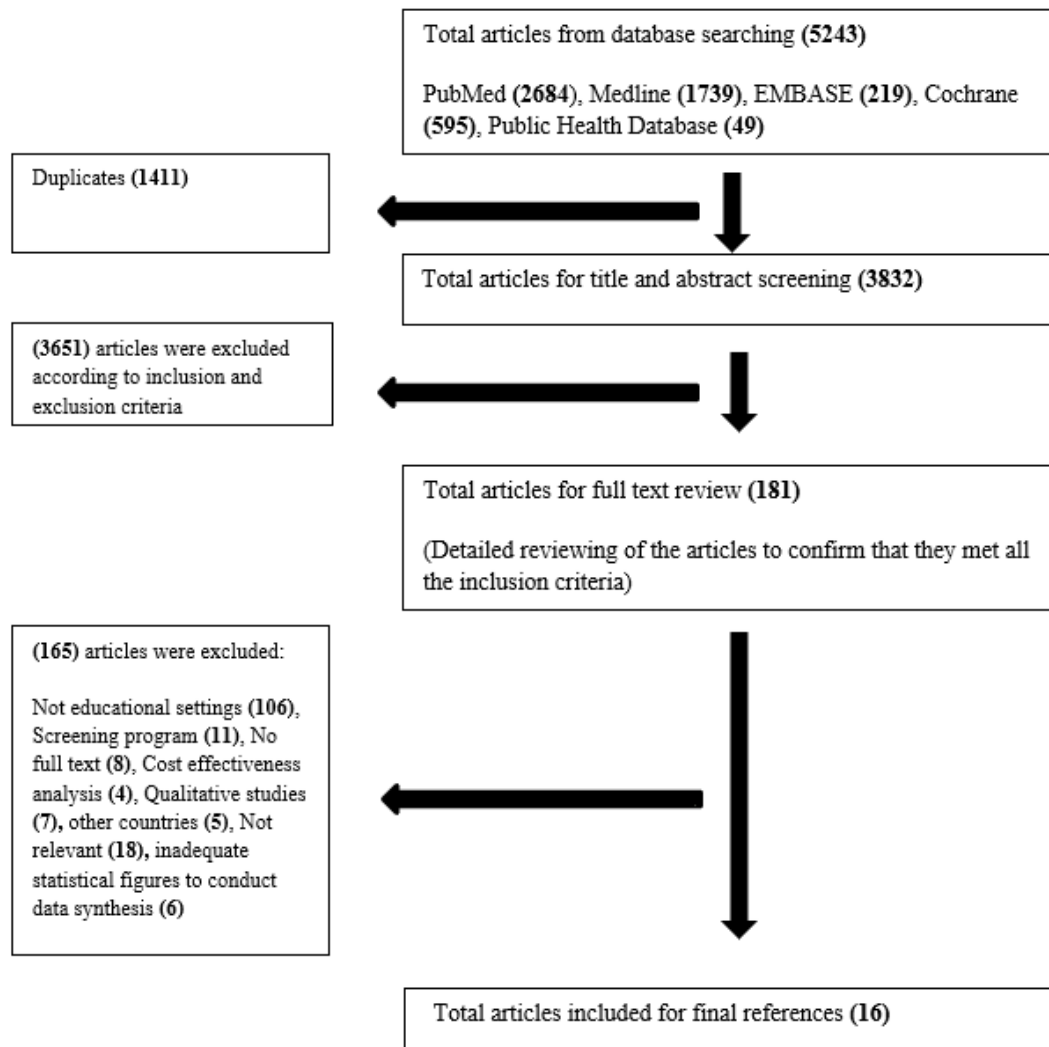
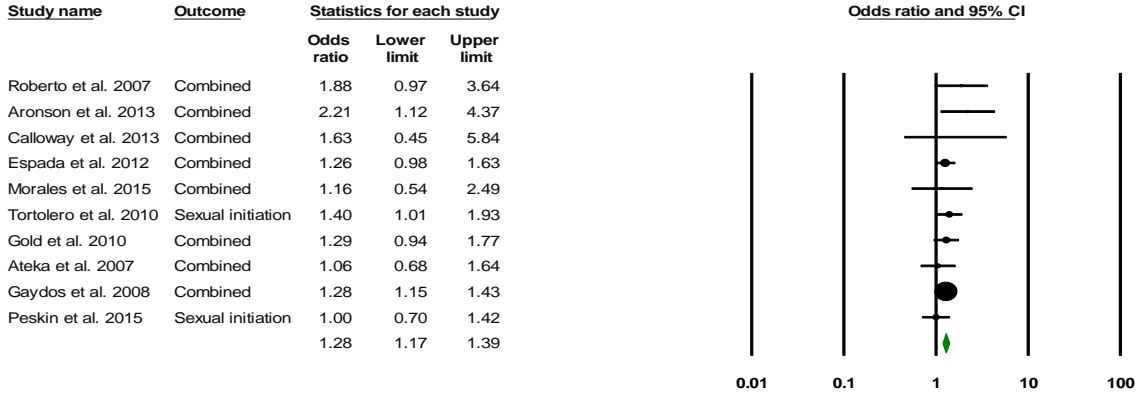
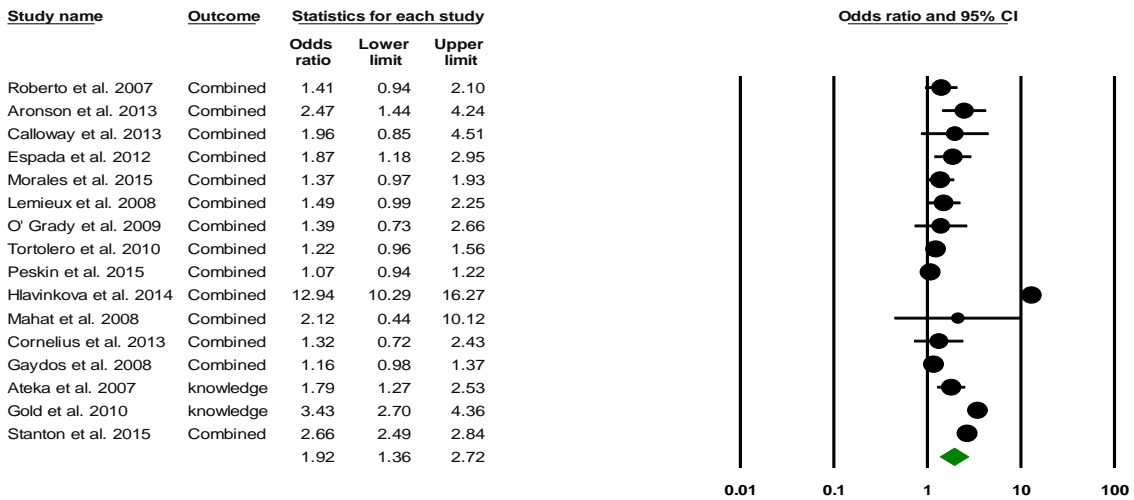


Figure 3.2: Forest plots

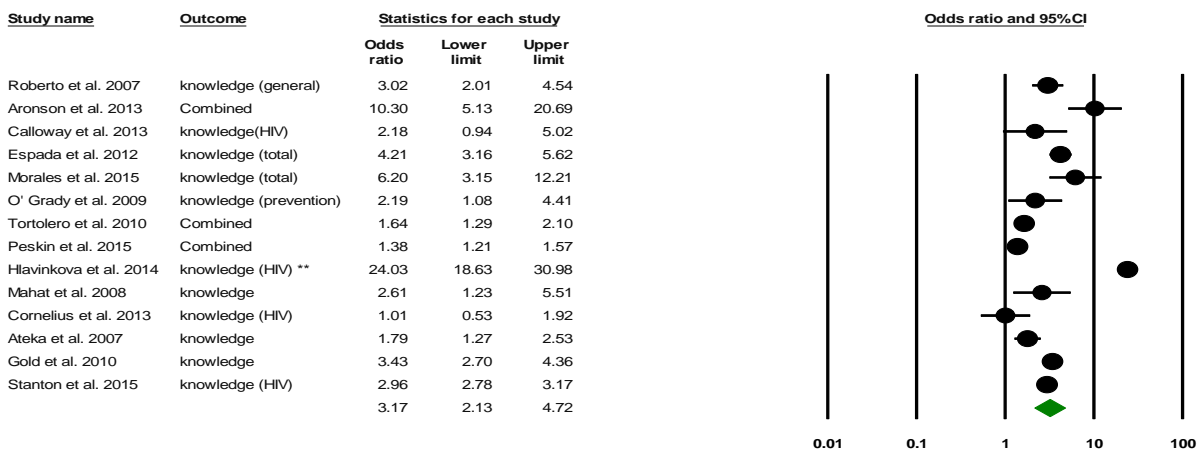
Forest plot for behavioural outcomes



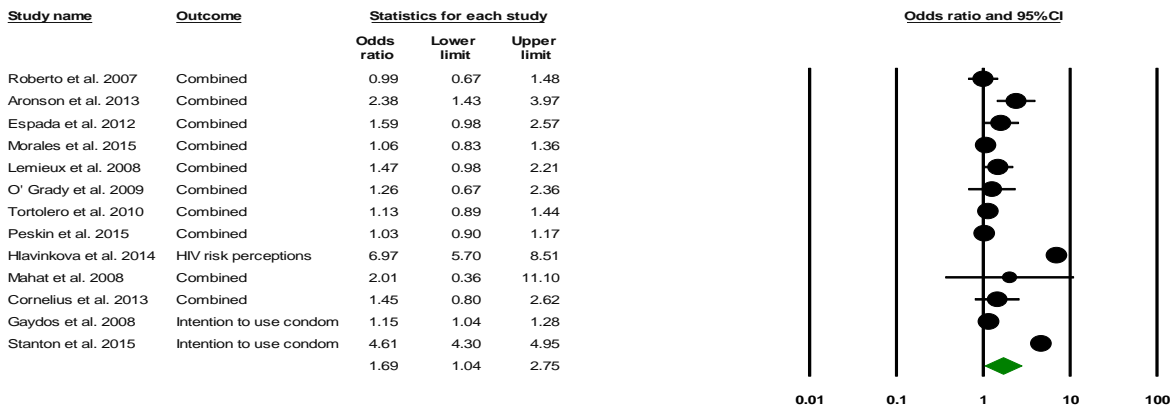
Forest plot for psychosocial outcomes



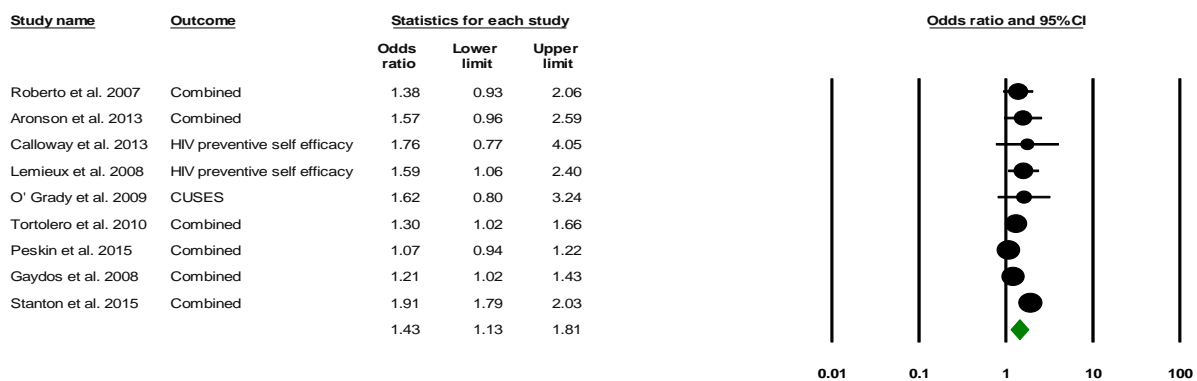
Forest plot for information (knowledge)



Forest plot for motivational factors



Forest plot for behavioural skills



CHAPTER 4 - CONCLUSION

4.1. Statement of the problem

Overview - Importance of STI issue among youth

STIs are a major public health concern and place a significant burden and strain on the healthcare system (1). Youth (15-24 years old) are reported to be more vulnerable to contracting STIs compared to adults, with more than 60% of STI cases found in this age group, worldwide (2). Youth are disproportionately affected due to inadequate knowledge, low perceived vulnerability, and higher likelihood to engage in risky behaviors (3-8). Thus, it is important to design and implement tailor-made and effective STI preventive intervention programs and policies to promote and optimize youth's health.

Chapter 2 - Substance use and STIs among Canadian post-secondary students

Substance use plays a critical role in STI acquisition by increasing risky sexual behaviors (4). In Canada, post-secondary students are a vulnerable group and at increased risk to use alcohol, cannabis and other drugs. In this regard, substance use (alcohol, cannabis, and other drugs) is an important issue among Canadian post-secondary students due to its high prevalence, pending legalization of recreational cannabis, evidence of positive associations with STIs (9-17), and limited research on its co-occurrence with STIs.

Chapter 3 – Effectiveness of STI preventive interventions at educational setting

Over the last few decades, much progress has been made but significant deficits still exist in the knowledge, attitudes and practices related to sexual health among youth (2-8). Due to limitations in current biomedical (i.e. vaccines, testing, treatment) and structural (i.e. policies, programs, strategies) interventions (2,18-22), STI preventive interventions, which promote safe sex

practices are still considered the gold standard. Educational institutions are recognized as ideal settings for the implementation of STI preventive interventions targeting youth (23-25). Therefore, it is essential to assess whether these programs are effectively contributing to the reduction of the STI burden and how they can be improved in order to make more efficient use of limited resources and achieve better outcomes.

4.2. Research focus and methodology

This thesis was undertaken with the goal to provide the empirical evidence necessary for policy and public health professionals to make informed-decision with regard to the effectiveness of STI preventive interventions at educational settings.

Chapter 2 - Substance use and STIs among Canadian post-secondary students

The purpose of this study was to examine the prevalence and association of substance use (alcohol, cannabis and other drugs) and STIs among Canadian post-secondary students. This is a cross-sectional study using data from the ACHA-NCHA II, Spring 2016 survey. There were 31,462 sexually active participants representing 41 post-secondary institutions in Canada. Descriptive analysis and logistic regression were conducted to assess the prevalence and association of substance use and self-reported STIs.

Chapter 3 – Effectiveness of STI preventive interventions at educational settings

The purpose of this study was to examine the efficacy and effectiveness of STI preventive interventions at educational settings. A systematic review and meta-analysis of relevant databases was conducted. Information relating to studies (i.e. type, published year, location), programs (i.e. type, provider, setting), participants (i.e. number, age, sex, ethnicity), and quantitative outcome variables (i.e. behavioral and psychosocial) were extracted. Risk of bias was assessed using criteria presented by the Agency for Healthcare Research and Quality (AHRQ) (26). Finally, meta-analysis was performed using Comprehensive Meta-Analysis (CMA) software version 3 (Biostat Inc., New Jersey, USA).

4.3. Summary of research findings

This thesis provides valuable information related to the prevalence and association of substance use and STIs among Canadian post-secondary students and the efficacy and effectiveness of STI preventive interventions at educational settings.

Chapter 2 - Substance use and STIs among Canadian post-secondary students

This study found that 3.96% of the participants self-reported being diagnosed or treated for a STI in the last 12-months. Additionally, participants reported being current users of alcohol (80%), cannabis (23%) and other drugs (8%). Multivariate logistic analysis revealed current cannabis use to be significantly associated with self-reported STIs (OR, 1.32; 95% CI, 1.1-1.57). There was a significant association between current drug use and STIs among male (OR, 3.07; 95% CI; 2.3-4.11) and female participants (OR, 1.9; 95% CI, 1.55-2.34).

Chapter 3 – Effectiveness of STI preventive interventions at educational settings

This study found that STI preventive interventions at educational settings had a significantly positive impact on both behavioral (OR, 1.28; 95% CI, 1.17-1.39) and psychosocial (OR, 1.92; 95% CI, 1.36-2.72) outcomes. Among the psychosocial outcomes, the intervention were most effective on promoting knowledge (OR, 3.17; 95% CI, 2.13-4.72), followed by enhancing motivational factors (OR, 1.69; 95% CI, 1.04-2.75) and increasing behavioral skills (OR, 1.43; 95% CI, 1.13-1.81). Current STI preventive interventions are more effective for female students compared to male counterparts. No significant difference was seen based on the type of provider (peer-involved and non-peer-involved) and type of intervention (face-to-face and technology-based).

4.4. Contextualizing the findings for public health practice

Findings from this thesis will be beneficial for the development and modification of existing public health preventive interventions for STIs at educational settings. Below, an effort is made to contextualize our findings for public health practice.

Chapter 2 - Substance use and STIs among Canadian post-secondary students

The prevalence of self-reported chlamydia and gonorrhea among sexually active Canadian post-secondary students was higher compared to the overall Canadian population (27), emphasizing the need for STI preventive interventions. The prevalence of life-time cannabis use among the study population was higher than national statistics (28) and a positive association was found between current cannabis use and STIs. This highlights the importance to promote awareness of the many damaging effects of cannabis use (i.e. including the higher risk to contract STIs) especially due to its pending legalization. Moreover, one in twelve students was a current other drug user, and at greater risk for STIs. The WHO recommends integrating substance use and STI interventions as part of comprehensive programming (29). Therefore, in Canada, implementing an integrated health promotion approach addressing substance use and STIs may be beneficial as they are highly prevalent and positively associated among post-secondary students.

Based on our research findings, there are a number of recommendations that may prove of benefit to Canadian post-secondary institutions: 1) integrate substance use and STI preventive interventions (29-31); 2) partner and coordinate substance use and STI health promotion events on campus (29-31); 3) collect detailed information about possible substance use (i.e. frequency, time when use, risky sexual encounter under the influence) during STI risk assessment (29-31); 4) provide comprehensive services that address both substance use and STIs (i.e. counseling, referral services) (29-31); and 5) monitor and evaluate the newly established substance use and STI integrated programs for effectiveness, cost-benefit, acceptability and feasibility (29-31).

Chapter 3 – Effectiveness of STI preventive interventions at educational settings

According to our findings, educational institutions represent ideal settings to implement STI preventive interventions for youth in developed countries. Moreover, our comparative analysis and application of the IMB model provide additional insights. STI preventive interventions should emphasize the improvement of motivational factors (i.e. attitudes, perceptions, norms) and skills (i.e. condom efficacy, partner communication) in order to achieve optimal outcomes in sexual behaviors and reducing the burden of STIs among students.

The results of our study suggest that STI preventive interventions were more effective for female rather than male students. This finding may be due to social norms and expectations (sexual double standard) (32) and an emphasis to date on female-centric programs. Interventions tend to preferentially target females because they suffer more from the adverse effects of risky sexual behaviors, including unwanted pregnancy and STIs (33). To be most effective, future STI preventive interventions should be developed and implemented by using a gender-specific approach (i.e. males, females and sexual minorities) to help address deficits in existing programming.

When examining the type of provider (peer-involved versus non-peer-involved) that is most effective in delivering STI preventive interventions, our study did not find a statistically significant difference. Previous literature (34-39) has reported similar results suggesting that factors other than provider delivery may play an important role when implementing STI preventive interventions at educational settings. On one hand, peer-involved programs are considered as appropriate strategies for youth (40,41) and showed increased benefits (39,42,43). On the other hand, it is more costly and complex to implement compared to non-peer involved programs (34). Peer programming has an important role to play in STI preventive interventions, but care should be taken to ensure its best use in educational settings given the real limitations imposed by logistics and resources.

Practical considerations should be taken into account when choosing the type of delivery (i.e. face-to-face versus technology-based) for STI preventive interventions. Our study as well as other research (44,45) found no significant difference in the effectiveness between these two modes of delivery. However, face-to-face STI preventive interventions showed significant effectiveness on behavioral and psychosocial outcomes. This may be attributed to greater compliance, peer-influence, proper engagement and sufficient dosage of delivery (46,47). Other studies suggest that adopting a mixed approach produces better outcomes (48). The blending of technology and face-to-face interventions may help enhance the effectiveness of the STI prevention messaging at educational settings for several reasons, including: youth dependency on technology, low cost, wider reach, speed, convenience, privacy, and overcoming certain structural barriers (i.e. physical and human resources) (46,47,49-51). However, more rigorous

research (comparative study) is needed to help assess the optimal blend for these two approaches.

4.5. Canadian context

This thesis encompasses both the association between substance use and STIs and the evaluation of STI preventive interventions at educational settings. Although no Canadian studies were eligible for inclusion in our systematic review, our results could prove beneficial to post-secondary institutions in Canada because the majority of the included studies were conducted in regions with similar STI preventive strategies and socioeconomic conditions (i.e. North America, Europe, Oceania). A potential framework for implementing effective STI preventive interventions at Canadian post-secondary institutions (Figure 4.1) was designed by using our research findings (i.e. chapter 2 and 3) and the Canadian guidelines for sexual health education by PHAC (52). The IMB model (Figure 4.2) can be used to provide a better understanding of both the implementation and evaluation of STI preventive interventions.

To date, only two national level studies have examined the factors related to sexual health among Canadian youth: 1) Canada Youth AIDS Study in 1989 (53) and 2) Canadian Youth Sexual Health and HIV/AIDS Study in 2002 (3). Current national surveys such as CCHS (54) and ACHA-NCHA (55) only include a limited number of questions related to students' sexual health and therefore, their findings, even though useful, have limited applications. Since STIs are highly prevalent among students, we recommend the robust and regular collection of national data on the sexual health of Canadian post-secondary students. For this purpose, we strongly support the efforts by PHAC to more widely use the Canadian Sexual Health Indicators Survey, which is proven to be highly reliable and valid in collecting data among Canadian youth ages 16-24 years old (56,57).

4.6. Recommendations for future research

Based on our research findings and limitations, the following list represents our key recommendations for future research as it relates to STI preventive interventions at educational

settings: 1) examine the association between substance use and STIs by using specific measurements (i.e. magnitude, severity, and event-specific sequence of substance use, clinically diagnosed STIs); 2) monitor the long-term impact of cannabis use, post-legalization on STIs and risky sexual behaviors; 3) explore the relationship between socioeconomic and environmental factors and STI occurrence; 4) evaluate the short, intermediate and long-term effectiveness of the ST interventions by using regular follow-ups over time; 5) measure the impact of the interventions on clinical outcomes (overall and specific STI incidence and prevalence); and 6) assess the effectiveness of the STI preventive interventions on the basis of differences in gender (male versus female), type of delivery (face-to-face versus technology-based), and type of facilitator (peer-involved versus non-peer-involved).

4.7. Conclusion

This thesis provides empirical evidence examining the association between substance use and STIs as well as the efficacy and effectiveness of STI preventive interventions at educational settings. Society is continuously changing, be it laws, regulations, technologies, norms, beliefs, disease patterns, and susceptibility. Public health preventive efforts require continued updates, modifications, adaptations and development to effectively address new or existing challenges. This thesis provides a framework to help inform, evaluate and guide STI preventive interventions to effectively reduce the burden of STIs among youth.

4.8. References

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Figure 4.1: A potential framework for effective STI preventive interventions at Canadian post-secondary institutions

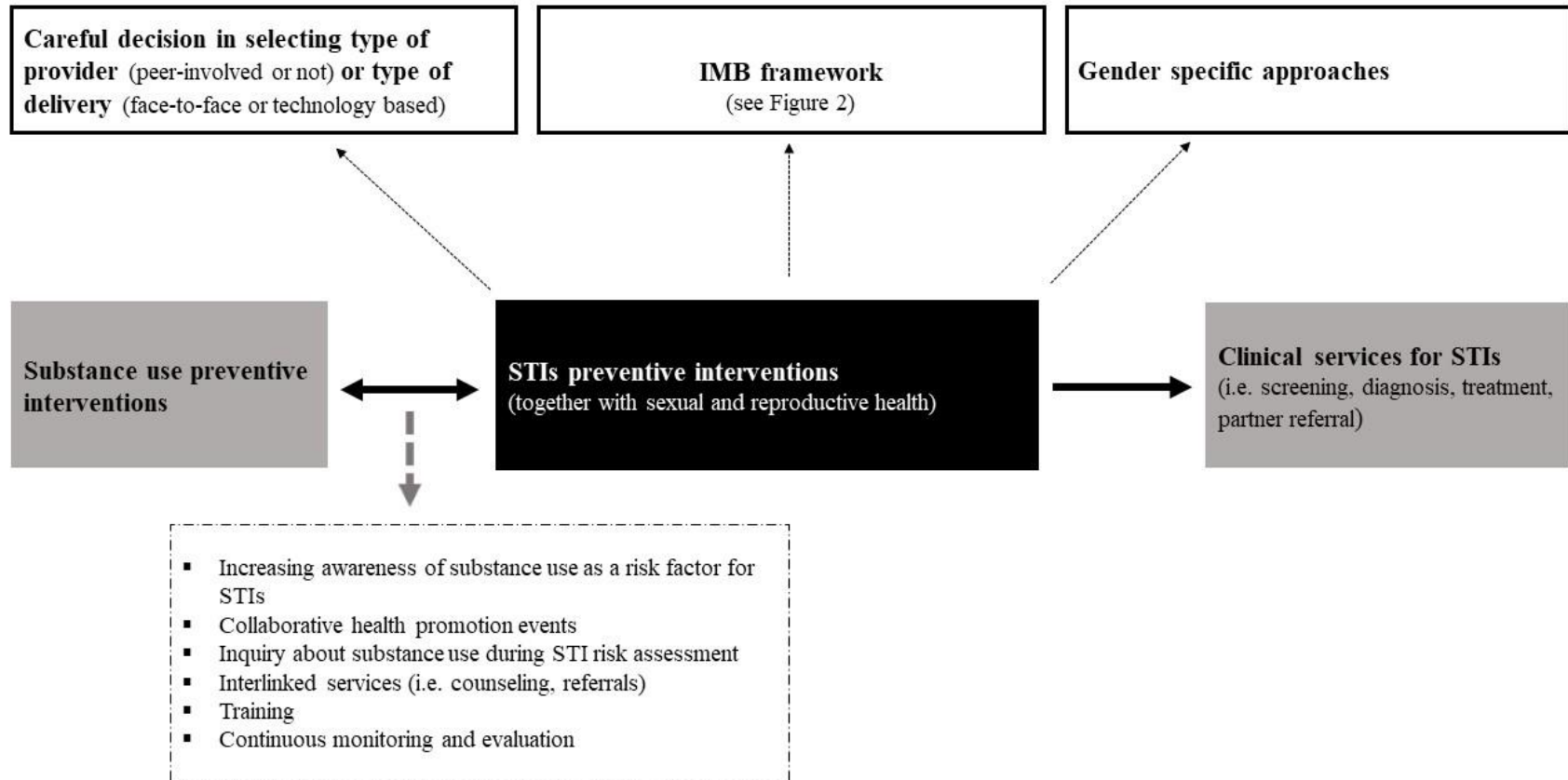
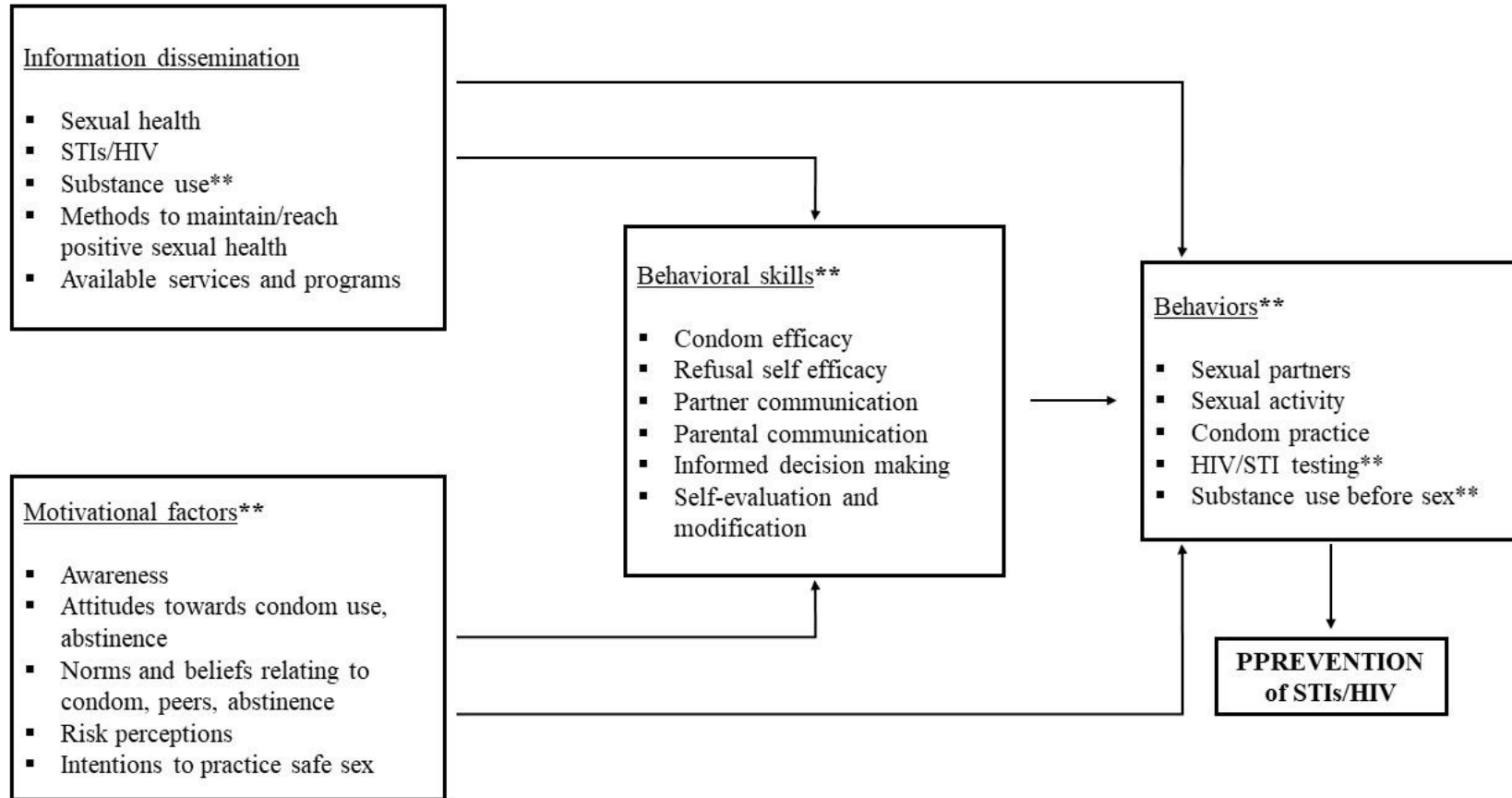


Figure 4.2: IMB model for sexual health and STI preventive interventions



** Elements to emphasize