# UNDERSTANDING STI AND HIV TESTING RATES AMONG HIGHER RISK UNIVERSITY STUDENTS

by

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# DEDICATION

To my husband, parents and sister, whose constant support, encouragement and faith in my abilities inspires me to persevere through life's obstacles.

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## *ABSTRACT*

Individuals of university age have the highest rates of diagnosed sexually transmitted infection (STI) and are at high risk of human immunodeficiency virus (HIV) acquisition. STI and HIV testing services are free and readily available to most university students in Canada, however, only some individuals choose to access them. Using data from a cross-sectional survey of eight Maritime Canadian universities, we determined that 62% of vaginally sexually active undergraduate students have never had an STI test and 85% have never been tested for HIV. Across groups stratified by biological sex and risk of STI acquisition, younger students with less sexual health knowledge were significantly less likely to be tested for STI and younger, heterosexual students were significantly less likely to be tested for HIV. Health promotion may be most effective at increasing overall lifetime STI and HIV testing when targeting younger students with campaigns designed to improve sexual health knowledge.

## *LIST OF ABBREVIATIONS USED*

**General Abbreviations:**
PAP test = Papanicolaou test
SRB = sexual risk behaviour
STI = sexually transmitted infection
MSM = men who have sex with men
CES-D = Centers for Epidemiological Studies of Depression

**Health Agencies:**
CDC= Centers for Disease Control and Prevention
PHAC = Public Health Agency of Canada
WHO= World Health Organization

**Bacterial STIs:**
chlamydia = *Chlamydia trachomatis* infection
gonorrhea = *Neisseria gonorrhoeae* infection
syphilis = *Treponema pallidum* infection

**Viral STIs:**
HIV = human immunodeficiency virus
HPV = human papillomavirus
HSV = herpes simplex virus

**Canadian Provinces:**
BC = British Columbia
NB = New Brunswick
NS = Nova Scotia
PEI = Prince Edward Island

**Participating Universities:**
Dalhousie = Dalhousie University, Halifax, NS
SMU = St. Mary's University, Halifax, NS
MSVU = Mount St. Vincent University, Halifax, NS
Acadia = Acadia University, Wolfville, NS
StFX = St. Francis Xavier University, Antigonish, NS
CBU = Cape Breton University, Sydney, NS
UPEI = University of Prince Edward Island, Charlottetown, PEI
UNB = University of New Brunswick, Fredericton, NB

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# CHAPTER 1. INTRODUCTION

In Canada, individuals aged 15 to 29 are at highest risk for STI infection (1-3). Undergraduate students in this age range are thought to be at an increased risk of infection since they often engage in behaviours such as alcohol consumption, drug use, unprotected sex, casual sex, and routine travel; all of which are known risk factors for STI, including HIV infection (4-11). Health promotion efforts attempting to increase STI knowledge in university populations are largely unsuccessful in changing the prevalence of these risk behaviours, likely due to the effects of denial (5,12-19). Routine STI and HIV testing is recommended across North America for sexually active individuals as a strategy for reducing the spread of STIs in undergraduate-aged populations (20-22). Regular STI and HIV testing allows for the identification and eradication of disease in those with curable STIs (e.g., chlamydia, gonorrhea and syphilis) and for counselling and treatment for those with incurable STIs (ex. HIV, herpes, and HPV). Routine STI and HIV testing would also serve as a point of contact with the health care system for sexual health education. Through the combined efforts of health care workers and health promoters, targeted routine STI and HIV testing could lead to a decrease in the spread of STI in the population and a reduction in the overall burden of disease within the community.

In Canada, the results of the recommended STI and HIV tests are accurate, reliable, confidential, and typically available in the week following sample collection (23-25). Testing services are generally free and readily available to university students in Canada, yet, only some individuals choose to access them. For those at high risk for sexually transmitted infection (STI), including human immunodeficiency virus (HIV), this decision may directly impact their future sexual health and overall well-being. In addition, sexual partners of individuals with untreated STIs engaging in unprotected intercourse are at high risk of STI transmission. Women with untreated STIs are at higher risk for pelvic inflammatory disease, ectopic pregnancy, and infertility (26,27) and both men and women with untreated STIs have an increased chance for the transmission of HIV (28).

Past studies have identified several demographic, behavioural, and psychosocial correlates of STI or HIV testing in the United States and Europe including age, biological sex, ethnicity, sexual orientation, year of post-secondary study, alcohol and drug dependence, forced sex, social norms, attitude, and at-risk perception (29-36). However, little is known about the level of STI

and HIV testing in Canadian undergraduate university student populations, especially those at higher risk for STI. A literature review found no quantitative studies on predictors and barriers for STI and HIV testing within a Canadian population and no study worldwide that looks particularly at a student population at higher risk for these infections. This study addresses the following research questions:

(1) What is the prevalence of STI and HIV testing in a Maritime Canadian undergraduate student population overall and when stratified based on STI risk-level (higher versus lower)?
(2) What are the demographic, behavioural and psychosocial characteristics of Maritime Canadian undergraduate students at higher and lower risk of STI?
(3) What are the possible predictors and barriers to STI and HIV testing in Maritime Canadian undergraduate students at higher and lower risk for STI?

To answer these questions, we used cross-sectional data from the Maritime University Health Survey. This internet-based survey of undergraduate students at eight universities in Maritime Canada measures several different demographic, behavioural, and psychosocial variables identified as potential barriers and facilitators of student use of health services for STI and HIV testing. We reported the prevalence of STI testing in the general population and in groups stratified on STI risk level (i.e., higher and lower), and describe the characteristics of those undergraduate individuals most likely to be at risk for STI and least likely to be tested. We explored the associations between these factors and self-reported STI and HIV testing both in a higher and lower risk subset of the population, using univariable and multivariable regression analysis. By identifying factors associated with never being tested for STI and HIV in populations at both higher risk and lower risk for STI and HIV infection, this study provides student health services and health care providers with a target population most likely to benefit from routine STI and HIV testing and thereby may help to reduce STI related morbidity in student populations.

# CHAPTER 2. BACKGROUND

## 2.1 SEXUALLY TRANSMITTED INFECTION (STI)

### *2.1.1 Impact of Untreated STI*

Sexual health services are free and generally available to most Canadians, yet, only some individuals choose to access them. For those at high risk for sexually transmitted infection (STI), including HIV, their future sexual health and well-being may be directly impacted by this decision. Many individuals with STIs are asymptomatic and thus likely to go untreated unless they undergo regular routine testing (27,37). When offering STI testing to a convenience sample of young adults (18-29 years old), Farley et al. found that of the study subjects that were diagnosed with gonorrhea, 34% of males and 55% of females had an asymptomatic STI and of these individuals 83% of the men and 86% of the women had not been treated (37) Of those diagnosed with chlamydia, 89% of males and 71% of females were asymptomatic and 98% an 92% of these individuals had not received care respectively (37). The Centers for Disease Control and Prevention found that almost 60% of American youth with HIV were unaware of their infection (38).

Women with untreated bacterial STIs (e.g. chlamydia) are at higher risk for pelvic inflammatory disease, ectopic pregnancy, and subsequent infertility (26,27,39). Individuals with untreated bacterial STIs also have an increased chance for the transmission of HIV (28). Leaving viral STIs (e.g. HIV, HSV, HPV) untreated is associated with high morbidity and mortality (27,40).

Untreated STIs do not only affect the health of the infected individual. Sexual partners of individuals with untreated STIs, especially those engaging in unprotected intercourse, are at high risk of subsequent infection. This is especially true in communities where individuals are likely to have multiple partners (41). If many infected individuals in these same communities have not been tested and remain untreated, these populations could experience high burden of disease (42).

### *2.1.2 Undergraduate Students: An At-Risk Population for STI*

Undergraduate-aged students are a higher risk population for STI, including HIV. Worldwide, STIs are most prevalent in those aged 20-24, followed closely by those aged 15-19,

followed in turn by those aged 25-29 (Figure 2.1) (2). In Canada, rates of chlamydia diagnosis have increased consistently in these same higher risk age groups over the last 10 years (Figure 2.2) and gonorrhea diagnosis rates in young adults have more than doubled since 1999 (1). As of 2009, Canadian youth who are of undergraduate university age have the highest STI rates of any age group in Canada (Figure 2.1) (1). Currently, chlamydia presents the most significant STI threat to undergraduate students with 1373.8 per 100,000 young adults between the ages of 20 and 24 diagnosed in 2009 (Figure 2.2); this is 9.5 times that of gonorrhea, the second most common bacterial STI diagnosis in this age group (1). By the end of 2009, 25% of the 69,844 HIV cases reported to the Public Health Agency of Canada (PHAC) were among individuals 15-29 years of age.(43) It is important to remember that these diagnosis rates underestimate the true prevalence of disease in the population since many of those infected with STIs, including HIV, are asymptomatic and therefore less likely to be tested and have their infection detected (37,43).

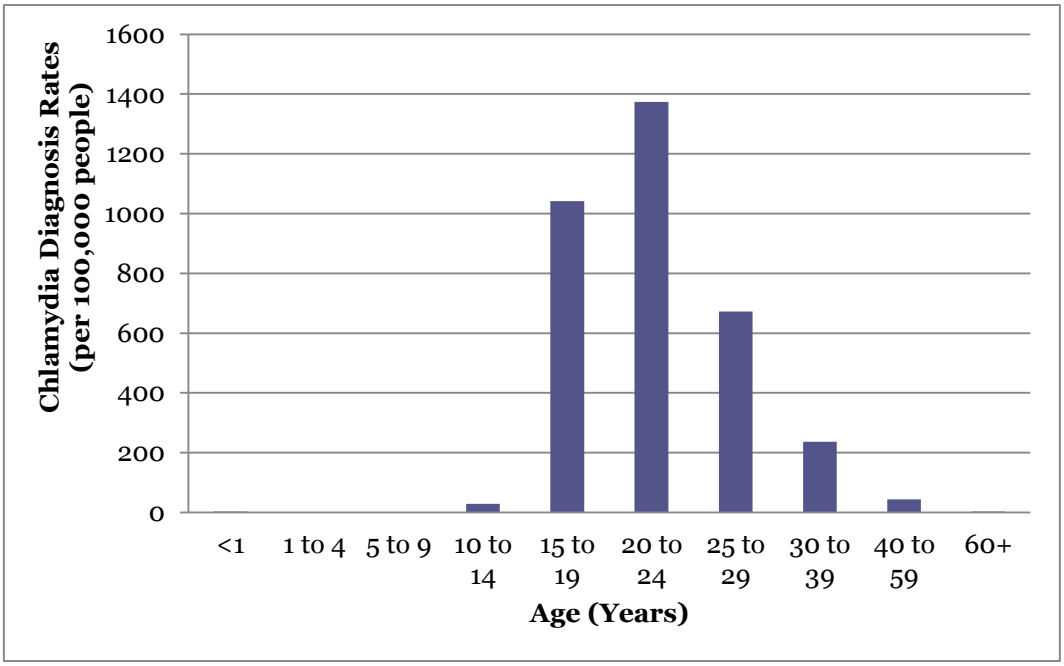


**Figure 2.1**: Chlamydia rates (per 100,000 people) across different Canadian age-groups in 2009 according to PHAC statistics (1).

Undergraduate students are vulnerable to contracting STIs, including HIV. University students exist in a peer and media driven culture promoting behaviours that put students at risk for STI, including: mass alcohol consumption and non-intravenous drug use (4-6). According to

the American College Health Association 2012 survey, 33% of university students surveyed binge drank the last time they "partied" (i.e., ≥5 drinks in a short period of time) and 17% used marijuana in the last month(44). Use of alcohol and other drugs impairs decision-making abilities and can increase the chance that an individual will engage in sexual risk behaviours (SRBs) such as inconsistent condom use, casual sex, and sexual activity with multiple partners (4,6,9,11,45,46). Of sexually active North American university students, 16% had sex while intoxicated in the last year, 45% did not use a condom the last time they had vaginal intercourse, and 39% reported having two or more sexual partners in the last year (44). These SRBs increase the chances of STI and HIV transmission within the student community and in the general population (9,41,47,48). Secondly, undergraduate students often reside at university only during the school term and travel home for holidays and school breaks. Populations containing many transient individuals who routinely travel as part of their lifestyle are at higher risk for the spread of STIs (10). (Figure 2.3)

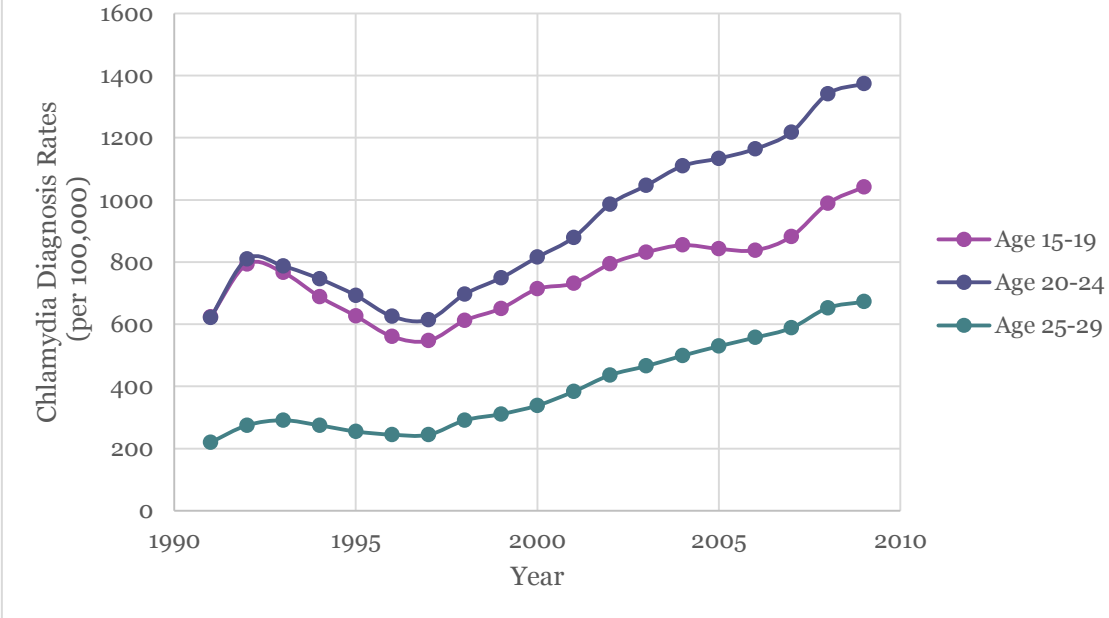


**Figure 2.2:** Chlamydia rates (per 100,000 people) in Canadian youth and young adult populations over time according to PHAC statistics (1).

Past interventions have attempted to decrease STI transmission through health education efforts promoting safer sex, but, few of these interventions were effective in student populations (45). Despite attention and publicity at several universities across Canada, STI diagnosis rates

continue to rise in undergraduate-aged individuals in Canada (Figure 2.2) (1,49). Students at university may not be responsive to such health promotion efforts because they are not reached by them; they may not be involved in campus life or are studying at a distance (49). At the same time, having knowledge about STIs is not associated with improvement in sexual attitudes and behaviours in most college populations, likely due to risk denial or a lack of cooperation between sexual partners on the use of condoms(12-19). Unlike condom use, STI and HIV testing requires the consent of only one individual and, if incorporated into routine check-ups, all individuals visiting their doctors regularly would receive the same information and treatment. Since health promotion efforts are often ineffective in reducing unsafe sexual behaviours in undergraduate students, regularly recommended diagnostic testing among higher risk students may prove a more effective solution in the prevention of widespread STI transmission (50).

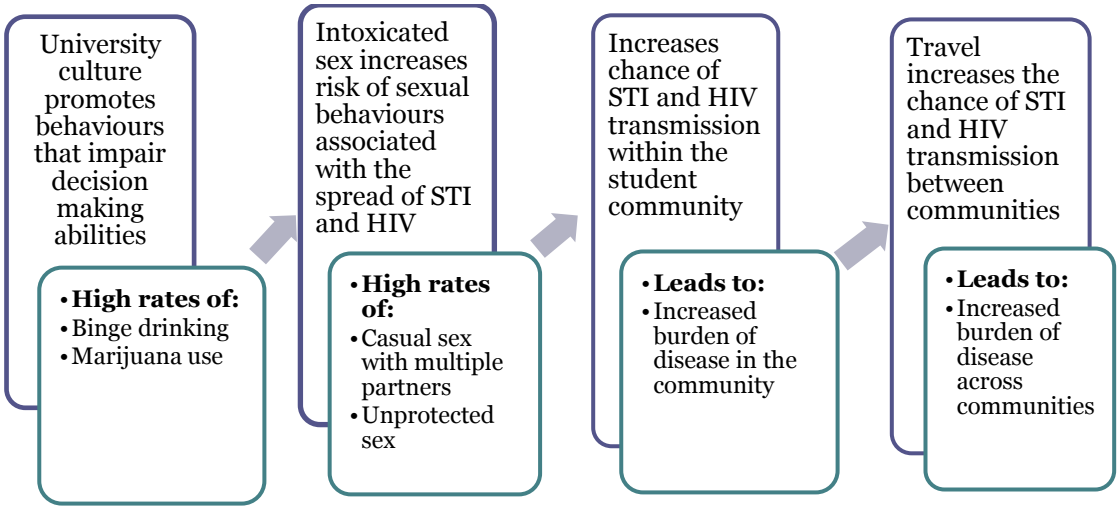


**Figure 2.3**: A summary of the theoretical components contributing to the high burden of disease in university students across Canada

### *2.1.3 Benefits of STI Testing*

In Canada, the results of the recommended STI and HIV tests are accurate, reliable, confidential, and typically available in the week following sample collection (23-25) . Public health experts recommend regular STI testing in higher risk populations as a strategy for early detection and treatment of STIs (51-54). The Public Health Agency of Canada (PHAC) recommends routine STI testing in all sexually active men and women younger than 25 years of age (21) and HIV testing at least once in all sexually active individuals. The primary benefit of

regular STI testing is the ability to diagnose and treat STIs, thereby reducing the burden of disease in the population (39). Many STIs (e.g. chlamydia, gonorrhea, syphilis) are curable with antibiotics. As long as the cured individual takes steps to avoid reinfection, testing could lead to both a direct reduction and indirect of the prevalence of disease in the community. For non-curable STIs (e.g. HIV, herpes) awareness of infection status can reduce the unwitting spread of infection to new sexual partners leading to a reduction in the incidence of non-curable STI in the population (55).

STI and HIV testing services are also a point of contact with health care workers which provides the opportunity for targeted sexual health teaching about the sexual risk behaviours that put individuals at risk for STI and HIV transmission. If health care workers both treat and educate those they test for STI and HIV, they may be able to reduce both the prevalence of disease and the incidence of future STIs in these individuals.

Viral STIs (e.g. HIV, HPV, HSV) cannot be cured but HIV and herpes (HSV) can be controlled with treatment. Individuals with viral STIs benefit from testing through an awareness of their disease status, access to treatment to prevent some of the side-effects of these viruses, and exposure to health education and counselling on transmission prevention. Individuals who have been diagnosed are more informed and capable of taking action to prevent the spread of infection to future sexual partners (41,54).

Undergraduate students at risk of STI should be accessing STI and HIV testing services on a regular basis. Most Canadian universities offer easily accessible, complementary health services, like STI and HIV testing, for all registered students; yet evidence from the United States indicates that many students do not access these services (56). Identifying factors associated with never being tested in undergraduate students is an important step towards increasing use of these services and consequently decreasing prevalence of STI within the student population.

## 2.2 FACTORS INFLUENCING STI AND HIV TESTING RATES

Previous studies conducted in Europe and the United States have highlighted some possible barriers to STI testing in university, college, and vocational school settings (29-36). Factors affecting STI and HIV testing can be separated into two groups: personal correlates associated with an individual's choice to be tested (i.e., demographic, behavioural and

psychosocial characteristics) and regional-level correlates affecting utilization of STI and HIV testing services (i.e., environment, society, policy) (33).

### *2.2.1 Demographic Factors Affecting STI and/or HIV Testing*

Demographic factors like age, biological sex, ethnicity, residence, year of post-secondary study, and sexual orientation are associated with STI testing rates in college and university students (17,29,32,34,36,45,56,57). The impact of biological sex is consistent for STI testing but less so for HIV testing in undergraduate students. Several studies find that significantly higher numbers of females are tested for STIs in the United States and for STIs and HIV in the Netherlands (17,29,36,45,57). In America, however, any biological sex-based differences in HIV testing rates are inconsistent and often insignificant (17,29,34,45,56). In general, STI testing occurs more in younger individuals, whereas HIV testing occurs more in older individuals (57). In American college students, HIV testing is most common in those 19-20 years of age (i.e., in their second or third academic year); however, little age-specific information exists for STI testing in college-aged populations (17,32,34). In a study conducted in the Netherlands, HIV and STI testing prevalence was not affected by ethnicity (29). In America, heterosexual college students are less likely to be tested for HIV and those from racial or ethnic minorities are more likely to be tested; little information was available for the relationship between these predictors and STI testing (32,34,36,56). There is a deficit of information on STI testing in North American college populations; the inconsistent or incomplete results of studies conducted in the past warrant further research in this area.

In a past study of correlates of HIV testing at several American colleges, Thomas et al found that those living off campus were two times as likely to be tested for HIV than those living on campus(32), but did not investigate which off-campus living arrangements were associated with HIV testing. When tested, individuals that live with their parents are less likely to test positive for HIV (58); this could indicate that these individuals are engaging in fewer or less frequent sexual risk behaviours than those individuals who do not live with their parents. Individuals living with parents were less likely to return home-based chlamydia tests passed out as part of a sexual behaviour cross-sectional study at a music festival in Australia (59). Since specific living arrangement, like living with parents, could affect individuals' engagement in sexual risk behaviours and their willingness to participate in voluntary sexual health testing, on

campus and multiple categories of off campus living arrangement should be considered when looking into the factors affecting STI and HIV testing rates in young adults.

Previous studies have investigated the potential impact of the use of faith-based medical centres on STI and HIV testing rates but have not yet investigated the effect of individual religious belief on STI and HIV testing rates. Religious belief significantly affects rates of unprotected vaginal intercourse and faith- or religion-based care centres are the only health service centres where service utilization is not associated with STI and HIV testing (32,60). Thomas et al found that individuals visiting a health provider at a faith-based organization were significantly less likely to be tested for HIV than those visiting a student health centre or a local hospital (32). Therefore, analyses on student SRB and STI or HIV testing outcomes should consider the effects of religious-affiliation either at the individual or institutional level.

### *2.2.2 Behavioural Characteristics Affecting STI and/or HIV Testing*

Several studies show that sexually active individuals engaging in risky sexual behaviours are more likely to be tested for HIV, likely due to a higher perception of being at-risk of acquiring HIV (32,34). Behavioural characteristics like age at onset of sexual activity, alcohol and drug dependence, contraceptive use, forced sex, and promiscuity are linked to a student's choice to be tested for STI (32,34,36). Several studies identified 4-6 or more partners in the past year as a correlate of HIV testing in American college students (32,34,36). Thomas et al. also found that American college students engaging in risk behaviours like intoxicated sex, unprotected sex, or sex with someone who is HIV positive were most likely to be tested for HIV (32). Crosby et al. reported a high prevalence of HIV testing after early sexual debut or forced sex (34). Caldeira et al. found evidence of a relationship between alcohol and drug dependence and HIV testing, hypothesizing that this relationship is due to the correlation between risky sexual behaviours and alcohol or drug use (36).

There is a wealth of information on factors affecting HIV testing, however, little evidence on behavioural correlates of STI testing in college populations exists in the literature. Individuals that are forced to have sex against their will are more likely to be tested for HIV and it is logical to assume that they will be tested for STI for the same reasons (32,34). Individuals that abuse alcohol or drugs are also more likely to be tested for HIV, likely due to heightened sense of perceived risk (36). It is logical to assume that similar relationships would exist between alcohol

and drug dependence and STI testing behaviours. Since risk behaviours such as forced sex and alcohol and drug dependence are associated with increased HIV testing and are likely to affect STI testing in a similar manner, these variables should be included as potential independent variables in research on HIV and STI testing in college populations.

### *2.2.3 Psychosocial Characteristics Affecting STI and/or HIV Testing*

Psychosocial characteristics like intention, attitude, at-risk perception, self-efficacy, knowledge, and stigma are related to the likelihood an individual will seek out STI testing(19,29,30,32,33,36,57,61-65). Self-perceived risk is a main component of the Health Belief Model, used to predict individual's health behaviours, and is a strong indicator of STI and HIV testing, as mentioned in 2.2.2 (32-34,61,66). Typically those who perceive themselves as being at risk of STI or HIV infection include those who: (1) engage in higher risk behaviour (i.e., intravenous drug use or unprotected sex with multiple partners), (2) know someone infected, (3) were tested previously, or (4) believe that infection is a problem in their community(33,65). Bond et al. found that several groups of individuals were more likely to be tested – including drug or alcohol abuse rehabilitation patients and incarcerated individuals - likely because of the existence of several of these factors contributing to at-risk perception (33). At the same time, a study carried out on adolescents in the Netherlands indicated that 45% of higher risk participants underestimate their risk, likely due to denial of personal risk stemming from high fear of infection and low self-efficacy (30). Studies have also found high levels of STI- and HIV-related stigma to be a strong barrier to use of STI and HIV testing services, especially in females (57,63). This is often attributed to the lower self-esteem commonly seen in females compared to males (29,57,62,63).

Using a multiple regression analyses, Wolfers et al. constructed a model to identify the psychosocial variables that have the strongest effect on students' intention to be tested for STI. They found that attitude towards testing, perceived social norms, and self-perceived susceptibility to infection (i.e., perception of risk) were the variables that most affected a college student's intention to be tested for STI or HIV. In these models, self-efficacy, perceived stigma, and knowledge were not significant predictors of intention (29). In interviews with Canadian youth, Shoveller et al. found social norms and knowledge gaps relating to testing procedures influenced youths' attitudes towards testing (65). Therefore, three main psychosocial variables –

knowledge of testing procedures, social norms, and at-risk perception- should be considered for use in future studies as measurable representations of STI and HIV testing intention.

Previous studies have not investigated the effect of depression on STI and HIV testing rates. Yet, depression is associated with increased likelihood of risk behaviours that affect HIV testing rates (e.g. alcohol and drug use) and with reduced health service utilization (36,67). Therefore, depression should also be considered as a possible psychosocial variable that could affect STI and HIV testing prevalence.

Never being tested for STI and HIV may also be more likely in individuals who believe that seeking help for their problems is a sign of weakness. This attitude is more often seen in men than women and could possibly explain why women are more likely to be tested than men (36,68). Therefore, a variable measuring subject attitudes towards help seeking may offset potential gender-based differences in testing rates and should also be included when measuring possible predictors of never being tested for STI and HIV.

### *2.2.4 Regional-Level Variables Affecting STI/HIV Testing*

Canada is a multicultural country with distinct geographic differences in both lifestyle and health policy and these distinct influences can affect the overall sexual health and service utilization of the individuals living in these communities at both the regional (e.g. urban versus rural) and provincial level. Canadians residing in urban areas have a different pattern of risk behaviour than those living in rural areas (69). Deering et al. found that individuals in non-metropolitan areas in British Columbia (BC), Canada are less likely to report using a condom at last intercourse and more likely to report a previous STI(70). At the same time, Canadians living in rural communities use health care services less frequently than those living in urban centres (71). Shoveller et al. found that Canadian youth from smaller towns were less likely to be tested for STIs, often due to limited services hours, less permissive community norms, and lack of privacy and confidentiality in small communities (72). Since urbanicity affects both prevalence of SRBs (i.e., unprotected sex) and access to health care services, individuals in urban areas could demonstrate different patterns of risk and use of services than those in rural areas. At the same time, individuals from different regions are exposed to different health promotion campaigns and offered different health services by their regional governments. These societal, political, and environmental differences may manifest as differences in lifestyle behaviours,

health knowledge, and health care utilization patterns between regions. Therefore, Canadian studies of health-related behaviours, sexual risk and health care utilization behaviours collecting data from communities varying significantly in population size and location should control for the potential effects of regional or community culture.

## 2.3 LIMITATIONS IN THE LITERATURE

Several studies exist that outline correlates of STI and HIV testing in college populations, but, few of these give a comprehensive target for Canadian student health promotion purposes. Almost all of the North American studies performed on undergraduate students up to this point looked only at the correlates of HIV testing and these studies were all conducted in the United States(17,32-34,36,45,56). Past studies looking at STI testing correlates in North American students investigated a limited number of factors and did not look for particular behavioural or psychosocial associations (57,61-64,72).

In Canada, chlamydia and gonorrhea are the two most prevalent STIs in the undergraduate-age group, yet there is a deficit of information on the possible factors affecting STI testing rates in Canadian students, especially those at higher risk for STI (1). Thus far only one study conducted in a Canadian youth population in BC touched on possible factors affecting youth experiences with STI testing. However, this study was qualitative in nature and focused more on the social dynamics of the unique communities sampled and characteristics of the participating STI testing facilities than the characteristics of the youth making the choice whether or not to be tested (65). To the best of our knowledge, there are no quantitative studies on predictors of and barriers to STI testing within a Canadian population at high risk for STI. Elsewhere, previous studies on barriers to STI testing in higher risk populations have defined higher risk individuals primarily as men who have sex with men (MSM). (73) By stratifying on risk determined by vaginal sexual behaviour, this study will explore STI testing rates in a previously unstudied population.

The only comprehensive study that looked at the factors associated with STI testing in a university-aged population was done in the Netherlands (29,30). This study focused primarily on the psychosocial variables associated with the intention to be tested for STI; it did not include behavioural variables in the analysis and did not investigate the effects of depression. The Dutch study results are also not consistent with the North American results for the effects of ethnicity

on testing rates; the American studies all found a significant association between ethnicity and HIV testing but the Dutch study found no association between ethnicity and STI testing (29). This could be because the Dutch study was looking at STI testing while the American studies were looking at HIV testing and HIV is typically more of an issue in racial minority populations (74). However, there is a chance that this lack of association between ethnicity and STI testing from the Dutch study is not generalizable to a North American context where communities are highly multicultural and the universities have a high international student population.

Canadian university health care providers and undergraduate health promoters require access to the following information currently missing from the scientific knowledge base: (1) the prevalence of STI and HIV testing in a Canadian undergraduate student population (2) the characteristics of those at higher risk of STI and HIV and those least likely to be tested for STI or HIV in a Canadian context, and (3) possible facilitators and barriers to STI and HIV testing in the general Canadian student population, specifically those at higher risk of STI. The proposed study is a first step towards addressing these knowledge gaps by answering these questions in a Maritime Canadian undergraduate population. Armed with this information, decision-makers can have a significant impact on the sexual and reproductive health of undergraduate populations in Canada.

## 2.4 PURPOSE OF THE STUDY

This study used survey data from eight different Maritime Canadian universities to calculate the prevalence of STI and HIV testing in these undergraduate student populations. It determined the characteristics of Maritime Canadian undergraduate students at higher risk for STI (based on their self-reported sexual risk behaviours). This is the first study to look at sexual risk behaviour and health service utilization in a Canadian university population. Canada has a public health care system that is fundamentally different from both the European and American systems giving Canadians different access public health services, like STI and HIV testing.

This study looked for associations between demographic, behavioural and psychosocial factors and never being tested for STI and HIV. Little is known about the effects of behaviour on STI testing rates, since the only studies that have included these variables were looking specifically at HIV testing rates (34,36). Also, previous researchers of STI and HIV testing correlates neglected to investigate the effects of depression, specific living arrangements, barriers

to help seeking attitudes, and religious belief on testing rates despite the fact that these variables are associated with sexual risk and other kinds of health care utilization (32,36,60,67). These variables have yet to be investigated in other studies involving STI and HIV testing and therefore the relationships discovered in this study are significant contributions to the scientific literature. In addition, since university students experience high levels of stress, anxiety and depression and, in Canada, come from a wide range of religious backgrounds these findings provide a clearer description of those most in need of testing services at the participating Maritime universities (75).

This study looks at the possible barriers to STI testing in a higher risk heterosexual student population by conducting an analysis exclusively on those who have had unprotected vaginal sex in the last month and multiple sexual partners in the last year. To the best of our knowledge, this study will be the first to identify possible predictors of never being tested for STI and HIV in higher risk students. This type of analysis is suggested by previous authors investigating student use of health care services but the topic is not yet explored in the existing literature (30,61,76). This study contributes significantly to the scientific literature in this area by identifying those most in need of STI and HIV testing services and least likely to seek them out.

The findings from this study allow Maritime Canadian health promoters and health care providers to understand predictors of never being tested for STI and HIV among high risk university students. It provides an awareness of the factors associated with never being tested for STI or HIV, and this could help in developing targets for health promotion campaigns and may guide health care workers in identifying those patients most in need of health teaching and other preventative measures. The study has the potential to help reduce the highly publicized STI problem at Canadian universities, including those in the Maritimes (49).

## 2.5 OBJECTIVES

In this study, I intended to:

(1) Determine the overall prevalence of lifetime occurrence of STI and HIV testing in Maritime Canadian undergraduate students overall and in those at higher risk and lower risk of infection

(2) Characterize the sexually active Maritime Canadian undergraduate students at higher and lower risk for STI and HIV infection based on demographic, behavioural and psychosocial factors

(3) Identify the demographic, behavioural and psychosocial factors that may act as barriers or facilitators of lifetime STI and HIV testing in higher and lower risk Maritime Canadian undergraduate students

# **CHAPTER 3.** UNDERSTANDING STI TESTING RATES AMONG HIGHER RISK UNIVERSITY STUDENTS

(Manuscript)

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**ABSTRACT**

*Introduction.* In Canada and worldwide, individuals aged 15 to 29 have the highest rates of diagnosed sexually transmitted infection (STI). STI testing services are free and readily available to most university students in Canada. However, only some individuals choose to access them, and little is known about the correlates of STI testing among Canadian undergraduate students. This study aims to characterize those individuals most at risk of STI and least likely to be tested. This information can be used to refine targets for STI testing among university study populations.

*Methods.* The data for this study comes from the Maritime Undergraduate Student Sexual Health Services Survey, a cross-sectional, anonymous, internet-based survey of undergraduate students at eight universities in Maritime Canada. This dataset contains information on the sexual health of and use of health services by 10,361 university students weighted to be representative of the basic demographics of the participating universities and imputed for missing values. To analyze this data, we stratified by biological sex and STI risk based on reported sexual behaviors, and then performed a descriptive analysis of the characteristics of each subpopulation as well as both simple and multiple logistic regression analyses of the factors associated with being tested for STI in each subpopulation.

*Results.* Results indicate that 62% of sexually active students and 56% of the 1207 students most at-risk of STI, based on their sexual behavior, have never had an STI test. In both males and females at higher risk for STI, younger students with less sexual health knowledge were significantly less likely to be tested for STI; these same students were also significantly less likely to be tested among students less at-risk of STI.

*Conclusions.* Health promotion may be most effective at increasing lifetime STI testing when targeting younger students with campaigns designed to increase general sexual health knowledge related to contraception, STI signs and symptoms, and healthy sexual behavior; these interventions would likely be an effective means to increase STI testing rates in those most at-risk of undiagnosed STI, while still benefiting other sexually active students.

## 3.1 INTRODUCTION

In Canada, undergraduate-aged individuals have the highest reported rates of bacterial STI diagnosis (i.e., gonorrhea, chlamydia, and syphilis) (1-3). In Canada and worldwide, bacterial STI is most prevalent in those aged 20-24, followed closely by those aged 15-19, and aged 25-29. At the same time, rates of reported cases of STI in Canada are likely gross underestimates of the total burden of disease in the population (27,37). After screening a convenience sample of young adults (age 18-29) for STI, Farley et al. found that 89% of males and 71% of females with chlamydia and 34% of males and 55% of females with gonorrhea were asymptomatic and had not been treated (37). Sexual partners of individuals with untreated STI engaging in unprotected intercourse are at higher risk of STI transmission. Women with untreated STI are at higher risk for pelvic inflammatory disease, ectopic pregnancy, and infertility (26,27) and both men and women with untreated STI are at increased risk for the transmission of HIV (28).

Across North America, routine STI testing is recommended for all sexually active individuals under the age of 25 (20,21). Areas with long standing STI control programs have shown significant reductions in PID and ectopic pregnancy rates (39). STI testing services are generally free and readily available to university students in Canada, yet only some individuals choose to access them. Characterizing those individuals most at risk of STI and least likely to be tested would allow clinicians to refine their targets for STI testing health promotion.

Little is known about the correlates of STI testing in Canadian undergraduate university student populations, especially those at higher risk for STI. A literature review found no quantitative studies on predictors of and barriers to STI testing within a Canadian population and no study that looks at the students at higher risk for these infections. Previous studies on barriers to STI testing in higher risk populations have defined higher risk individuals primarily as men who have sex with men (MSM) (73). By stratifying on risk determined by vaginal sexual behaviour, this study will explore STI testing rates in a previously unstudied population.

Past studies have identified several demographic and psychosocial correlates of STI testing including: age, biological sex, ethnicity, religion, perceived peer norms, stigma, attitude toward testing, perceived risk of STI, previous health services use and community of residence (29,57,72,73). Adam et al. performed multivariable analyses on men who have sex with men (MSM) in Australia and found that age, perceived peer norms, attitudes towards testing and community of residence were all significantly associated with STI testing rates whereas stigma

was not (73). Fortenberry et al. found that sex, age, suspected infection, stigma and previous health care use were all associated with gonorrhea testing during multivariable analyses on an American community- and clinic- based convenience sample (57). Wolfers et al. performed multiple regression analyses to determine correlates of intention to undergo STI testing in vocational school students in the Netherlands; biological sex, age, religion, ethnicity, perceived risk of STI acquisition, perceived peer norms and attitude towards testing were all significantly associated with intention to participate in STI testing whereas stigma was not (29). A Canadian qualitative study indicated that attitude toward testing was most affected by peer norms and knowledge of testing procedures (72). Using the combination of these findings, we hypothesized that biological sex, age, ethnicity, religion, perceived risk of STI acquisition, perceived peer sexual risk taking, sexual health knowledge, and university attended would be associated with STI testing rates in our study population.

Previous studies among university students have not included predictors of procedures closely correlated with STI testing (i.e., HIV testing) or with general access to health services as potential covariates of STI testing. We hypothesize that variables associated with HIV testing (i.e. year of study, sexual orientation, non-consensual sex, living arrangement and alcohol and drug dependence) and other health services use (i.e. depression risk and attitudinal barriers to help seeking) in university populations will also be associated with STI testing rates in our study population (32,34,36,67).

Employing a study population of sexually active university students from eight universities in Maritime Canada, this study will: (1) determine the prevalence of STI testing overall and stratified by STI risk (2) describe the general group characteristics of those at higher and lower risk of STI and (3) identify characteristics associated with never having been tested for STI using a broad range of potential covariates (i.e., demographic, behavioural and psychosocial variables) in higher and lower risk males and females.

## 3.2 METHODS

We used data collected during the online Maritime Undergraduate Sexual Health Services Survey administered by Dalhousie University in the fall of 2012. This is a cross-sectional online survey of a voluntary study population of undergraduate students from eight Maritime universities.

### *3.2.1 Study Population*

The sampling frame is made up of all of the undergraduate students at Dalhousie, St. Mary's (SMU), Mount St. Vincent (MSVU), Acadia, St. Francis Xavier (StFX), Cape Breton University (CBU), the University of Prince Edward Island (UPEI) and the University of New Brunswick (UNB). The university students at these schools are a heterogeneous representation of the Maritime Canadian university student population, including students from various universities differing in size, province, and urbanicity. The survey excludes francophone universities due to language concerns (i.e., survey translation and multiple report writing) and smaller universities which do not offer a broad range of undergraduate programming and are thus less representative of the general undergraduate population. Due to cost and logistical concerns, two smaller universities in New Brunswick were not included. Overall, 10361 students (20.4%) participated. For the purposes of this study, we limited the population to include only those males and females who had ever had heterosexual vaginal intercourse, were between the ages of 17 and 29 and provided complete information on STI risk behaviours used to create the STI risk categories (i.e., condom use at last intercourse and number of sexual partners in the last year). Overall 7,346 individuals were included in the study population; 2499 individuals were excluded for not being vaginally sexually active, 435 were outside the desired age range, 10 had incomplete information about their sexual risk behaviours, 16 were transgender or had missing information regarding biological sex, and 55 were excluded for more than one of these reasons.

### *3.2.2 Survey Administration*

Using the approach suggested by Dillman (77), all undergraduate students at each of the eight participating universities were contacted through the university registrar's email listserver, asked to participate, and provided with a link to the online survey. Responses were collected and stored using OPINIO software, a secure online service hosted at Dalhousie University. To avoid duplication, students were prevented from using the same computer to complete the survey more than once. Incentives (i.e. one iPad draw per university) were used to encourage participation. The survey design and data collection were both approved by the Regional Ethics Board at Dalhousie University.

*3.2.3 Dependent Variable*

- *Never Tested for STI*. The survey asks if the subject has ever accessed STI testing services (1 item). We used this to create a binary outcome variable for STI testing: Never Tested (i.e., those who answer 'No' to ever being tested for STI) and Ever Tested (i.e., those who answer 'Yes' to ever being tested for STI).

*3.2.4 Independent Variables*

These variables were included as key covariates in all multiple variable regression models and defined as follows:

- *Age*. Age (in years) was used as a continuous variable.
- *Ethnicity.* The survey collects ethnicity data as a non-mutually exclusive categorical variable covering the most common ethnic groups found in the Canadian Maritimes (1 item with 5 options: Caucasian, African descent, Aboriginal, Asian, Middle Eastern, and Other). We combined these categories to produce a binary variable: Non-Caucasian Descent and, referent category, Any Caucasian Descent.
- *Personal Importance of Religion.* This was measured using 4 response options (very important, fairly important, not very important and not important at all). A binary variable was created: Religion Not Important (not important at all/not very important) and, the referent category, Religion Important (fairly important/very important).
- *Perceived Risk of STI Acquisition*. Self-reported perception of risk for STI acquisition was measured using 4 response options: greatly at risk, quite a lot at risk, not very much at risk, and not at all at risk. These were dichotomized into: higher perceived risk of STI acquisition (i.e., greatly at risk/quite a lot at risk) and, the referent category, lower perceived risk of STI acquisition (i.e., not very much at risk/not at all at risk).
- *Perceived Peer Sexual Risk Taking*. We measured perceived peer sexual risk taking using 9 items, (score range 9-45) with a higher score meaning perception of more sexual risk taking by friends (Cronbach's $\alpha$=0.78) (78,79).
- *Sexual Health Knowledge*. The survey assesses sexual health knowledge using the score from a true/false/don't know test used in previous studies (80). Correct answers were scored as "1" and incorrect/don't know as "0". The individual item scores were summed to create a

continuous variable (12 items, score range 0-12 with a higher score meaning greater sexual health knowledge) (Cronbach's $\alpha$=0.71) (81).

- *University Attended*. The university attended by each participant.

Individuals being tested for HIV have often been tested for STI previously (36,57,82); this correlation between STI and HIV testing was reflected in the study population ($\rho$=0.5). Therefore, we included additional variables known to be correlates of HIV testing as potential correlates of STI testing, including: year of study (17), sexual orientation (32,36), non-consensual sex (34) alcohol and drug dependence (36), living arrangement (32) and importance of religion (32).

- *Sexual Orientation.* The survey collects information about subjects' sexual orientation as a categorical variable on a non-ordinal scale (1 item with 7 options: 100% heterosexual, mostly heterosexual, bisexual, mostly homosexual, 100% homosexual and unsure). The number of homosexual individuals (both male and female) at higher risk of STI based on their vaginal sexual activity was low (n<5); therefore, we combined the homosexual and bisexual individuals together to produce a binary variable: Non-Heterosexual (bisexual, mostly homosexual/100% homosexual) and, referent category, Heterosexual (100% heterosexual/mostly heterosexual).
- *Forced Sex.* The survey contains a direct measure of whether or not the study subject was forced to have sex of any type against their will while at university (1 item, yes/no). Those that had never had forced sex while at university were used as the referent category.
- *Year of Study*. The survey data provides a direct measure of the year of post-secondary study the subject was currently enrolled in in the fall of 2012. Subjects were categorized into one of five categories based on their year of study: 1$^{st}$ year, 2$^{nd}$ year, 3$^{rd}$ year, 4$^{th}$ year, and other. First year students were used as the referent category.
- *Heavy Alcohol and/or Marijuana Use.* Frequent or heavy use of marijuana has been defined in previous epidemiologic studies as daily or near daily use (83). Episodic heavy alcohol use has been defined previously as the consumption of 5 or more drinks in one sitting (i.e., binge drinking) more than once per month (84). We defined chronic marijuana use as ≥20 times per month and heavy alcohol use as >1 binge drinking episodes per month to create a categorical

variable for heavy alcohol and/or marijuana use with three levels (Both/One/Neither). Neither was used as the referent category in all analyses.

- *Living Arrangements*. This was measured using a categorical variable noting five types of living arrangements: Student Residence (i.e., on campus in student residence/housing), Alone (i.e., living off campus alone), Roommate(s) (i.e., living off campus with only non-sexual or non-romantic partner(s)), Romantic Partner (i.e., living off campus with a romantic or sexual partner), and, the referent category, Parent(s) (i.e., living off campus with one or both parents).

If students are unlikely to access any health services then they will be unlikely to be tested; therefore, we included variables that could affect health service use rates in post-secondary school students as potential covariates for STI testing, including: depression risk (67) and attitudinal barriers to help seeking (68).

- *Risk of Depression*. The survey measures risk of depression using a 12-item version of the Centers for Epidemiological Studies of Depression (CES-D) scale (12 items, score range 0-36, with a higher score indicating a greater risk of depression) (Cronbach's $\alpha$=0.85). The 12-item version has been previously validated and employed in a number of studies to assess risk of depression (85-87). Individuals were categorized, using a commonly accepted cut-off value, into those at risk of depression (score >11) and the referent category, those who are not (score $\leq$11) (86).
- *Attitudinal Barriers to Help Seeking*. The survey uses the Barriers to Help Seeking Scale, a continuous measure, based on 8 items (score range 0-32) with a higher score indicating more attitudinal barriers to help seeking (Cronbach's $\alpha$=0.79) (68).

### *3.2.5 Statistical Analysis*

The data were statistically adjusted using population weights, specific to the age and biological sex distributions at each of the eight universities, to account for non-response. Missing responses were estimated using multiple imputation (i.e., multivariable regression models based on complete data were used to probabilistically determine five different potential responses per respondent for each missing item).

Since males and females use health services at different frequencies and often for different reasons, we stratified the study population based on both biological sex and risk for STI (33,88).

Individuals engaging in sexual activity without a condom outside of a committed relationship are at higher risk for STI (10). To isolate this population, we defined STI risk level using a combination of two risky vaginal sexual behaviours: no condom at last intercourse and multiple sexual partners (>1) in the last year. Only those individuals with both behaviours were classified as higher risk, whereas those with neither or only one were classified as lower risk.

We calculated the weighted prevalence of STI testing in the overall study population and in each of the four subgroups (i.e., higher risk males, higher risk females, lower risk males and lower risk females). We described the characteristics of the undergraduate students in each of the four subgroups using descriptive statistics (i.e., weighted means/proportions with 95% confidence intervals). The mean or prevalence statistics for each of the characteristics were compared between subpopulations using simple regression models; significant differences between males and females or between higher and lower risk individuals were designated based on the regression p-values ($p<0.05$). All descriptive analyses were carried out without adjustment for university attended.

We ran simple logistic regressions to determine the weighted, univariable association between each independent variable and the outcome of interest in each of the four subgroups. We used theoretically important variables (e.g., age) and any measure with a univariable p value less than 0.2 in at least one subgroup, as potential covariates of STI testing in all multivariable logistic analyses; the same group of covariates were used in all four subgroups to allow for ease of comparison between subgroups. We performed two separate multivariable logistic regression models for each of the four subgroups; one (Model 1) with and one (Model 2) without university attended in the model. All regressions that did not include university in the model were corrected for potential intraclass correlation between students attending the same university. All associations were considered to be significant at a p value less than 0.05. All statistical analyses were performed using SAS OnlineDoc® 9.3 software (89).

### 3.3 RESULTS

Overall, 61.6% (95% CI: 60.2-62.9) of the 7346 sexually active students reported never having been tested for STI. Males were significantly more likely to have never been tested for STI than females; 72.5% of males (95% CI: 70.2-74.7) and 53.7% of females (95% CI: 52.2-55.2) reported never having been tested. Higher risk individuals were more likely to report ever

having been tested than those categorized as lower risk; 55.7% (95% CI: 52.3 – 59.0) versus 35.1% (95% CI: 33.7 – 36.5) (data not shown).

Table 3.1 provides a weighted descriptive breakdown of the demographic, behavioural and psychosocial characteristics of each of the four subgroups (i.e., higher risk males, higher risk females, lower risk males, and lower risk females). When comparing characteristics of those at higher versus lower risk of infection within each biological sex using simple regression models, those in the higher risk groups were more likely to be heterosexual (males only), fourth year students, report having had forced sex, heavily use alcohol and/or marijuana, perceive their peers as having more liberal attitudes toward sex, be at-risk of depression (females only), have higher sexual health knowledge scores, have more attitudinal barriers to help seeking (females only), and perceive themselves to be at-risk of infection. Lower risk groups were significantly more likely to consider religion to be important and to live with a romantic partner rather than a roommate. Both males and females categorized as lower risk for STI were significantly more likely to report having never been tested for STI than those categorized as higher risk. Age and ethnicity did not differ significantly between risk groups within each biological sex.

In both the higher and lower risk groups, males were significantly more likely to be older, perceive their peers as having liberal attitudes towards sex, have higher barriers to help seeking attitude scores, and heavily use alcohol and/or marijuana than females. Females in both risk groups were more likely than males to have higher sexual health knowledge scores, consider religion to be important, be at-risk of depression, be Caucasian (low-risk only), and report having had forced sex. In both the higher and lower risk STI subgroups, males were significantly more likely to have never been tested for STI than females. Year of study and self-perceived risk of infection did not differ significantly between males and females at either risk level.

Unadjusted analyses (Appendix A) revealed that, with the exception of ethnicity, all variables were associated with STI testing at $p<0.20$ in at least one of the four subgroups; as such, all variables, except for ethnicity, were included in multivariable models to allow for direct comparisons between subgroups. The exclusion of ethnicity from all multivariable models should not bias results as the majority of the study population was Caucasian (91.1%).

After adjusting for the clustered data collection design, there still was clear evidence of sex-based interactions at both the higher and lower STI risk levels (data not shown). In the lower risk group there was significant interactions between biological sex and age ($p=0.0189$), sexual

orientation ($p<0.0001$), sexual health knowledge score ($p<0.0001$), and living arrangement ($p=0.0015$). At the higher risk level there was significant interaction between sex and year of study ($p=0.0054$). Therefore, all multivariable logistic regressions were performed separately for males and females at each risk level.

Table 3.2 presents the results of both multivariable logistic regression models within the higher risk male subgroup. In Model 1, there were significant associations between younger age, not having been forced to have sex, and lower sexual health knowledge and increased odds of never having been tested for STI. In Model 2, the same variables were significantly associated with odds of never having been tested for STI. Year of study, sexual orientation, importance of religion, living arrangement, heavy alcohol and/or marijuana use, perceived risk of STI acquisition, perceived peer sexual risk taking, attitudinal barriers to help seeking and depression risk were not significantly associated with the likelihood of STI testing among higher risk males in either model.

Table 3.3 presents the results of both multivariable logistic regression models within the higher risk female subgroup. In Model 1, there were significant associations of younger age, lower perceived risk of STI acquisition, more attitudinal barriers to help seeking and lower sexual health knowledge with increased odds of never having been tested for STI. After controlling for the effects of university attended in the higher risk female subgroup (Model 2), younger age, lower sexual health knowledge and more attitudinal barriers to help seeking remained significantly associated with increased odds of never having been tested. Year of study, sexual orientation, importance of religion, living arrangement, forced sex, heavy alcohol and/or drug use, perceived peer sexual risk taking, and depression risk were not significantly associated with the likelihood of STI testing among higher risk females in either model.

Table 3.4 presents the results of both multivariable logistic regression models within the lower risk male subgroup. In Model 1, there were significant associations between younger age, living with parents as opposed to roommates, lower perceived risk of STI acquisition, and lower sexual health knowledge with increased odds of never having been tested for STI. After controlling for the effects of university attended (Model 2), younger age, lower perceived risk, and lower sexual health knowledge remained significantly associated with the odds of never having been tested for STI; in addition, heterosexual students also had significantly increased odds of never having been tested for STI. Importance of religion, forced sex, year of study,

heavy alcohol and/or marijuana use, perceived peer sexual risk taking, attitudinal barriers to help seeking, and depression were not significantly associated with the likelihood of STI testing among lower risk males in either model.

Table 3.5 presents the results of both multivariable logistic regression models within the lower risk female subgroup. In Model 1, a number of characteristics were significantly associated with an increased odds of never having been tested including: younger age, being a first year student rather than a fourth year student, being heterosexual, considering religion important, living with a parent rather than alone, not having been forced to have sex, not heavily using either alcohol and/or marijuana, having lower perceived risk of STI acquisition, perceiving peers as having less risky attitudes towards sex, having more attitudinal barriers to help seeking, having lower sexual health knowledge and not being at-risk of depression. In Model 2, all of these variables remained significantly associated with the odds of never having been tested, with the exception of risk of depression. Living with a parent rather than a roommate was also significantly associated with increased odds of never having been tested for STI in lower risk females in Model 2.

## 3.4 DISCUSSION

We found that more than half of sexually active Maritime undergraduate students (aged 15-29) have never been tested for STI (62%), with males (73%) being more likely to have never been tested than females (54%). This proportion is significantly lower than has been observed previously in an STI testing study performed on Dutch vocational college students, where 89% of males and 80% of females had never been tested for STI (29). It is also promising that a significantly higher proportion of students at higher risk of STI due to their vaginal sexual behaviours are being tested when compared to low-risk students of the same gender. However, 56% of the 1207 students most at-risk of STI acquisition have never had an STI test. Overall, these findings indicate that the Public Health Agency of Canada recommendation for routine STI testing in all sexually active individuals under the age of 25 has likely not yet been achieved in this population (10). Targeting factors common to all of the subgroups, thereby encouraging testing in those most at risk of STI acquisition while still benefiting the remaining sexually active population, would be most effective at improving overall STI testing rates. We identified several different factors within each biological sex and risk subgroup which are potential predictors of or

barriers to STI testing. There were only two factors – age and sexual health knowledge - common in effect size and direction between all four subgroups. Older individuals and those with more accurate sexual health knowledge were more likely to report being tested for STI, regardless of biological sex or risk level.

It is expected that younger sexually active individuals would be less likely to report having been tested for an STI, as experiences are naturally a function of time. However, it is concerning that 61.6% of a sexually active study population (age 17-29) had never been tested. The Public Health Agency of Canada guidelines suggest that all sexually active individuals under the age of 25 be tested for STI regularly (10); it would be expected that most individuals (regardless of age) should have been tested at least once since becoming sexually active. It is possible that many individuals who have not been tested may have only recently experienced sexual debut. However, considering that the average age at first intercourse in Canada is 16.5 years and the average age of the study population was 21.2 years, it is more likely that routine STI testing guidelines are not being met among Maritime undergraduate students (90). It is promising that a significantly higher proportion of students at higher risk of STI due to their vaginal sexual behaviours are being tested when compared to lower risk students of the same biological sex but special efforts should be made in all students, especially younger students, to increase awareness of the need for testing if sexually active.

Based on the study findings, higher sexual health knowledge may also be a facilitator of STI testing in undergraduate students. Considering the mean age of sexual debut in Canada, it is also possible that effective interventions designed to improve sexual health knowledge in high school students could potentially improve STI testing rates by the time those youth reach university age. McClean et al. found that information-work improved uptake of chlamydia testing services in college students in the United Kingdom (91); such approaches could potentially improve STI testing rates.

Those in the group at higher risk for STI had more sexual health knowledge and were more likely to perceive themselves to be at risk of STI; however, only 18.7% (95% CI: 16.1% - 21.2%) of those categorized as being at higher risk of STI perceived themselves to be so. During multivariable analyses, perceived risk of STI acquisition was associated with increased odds of lifetime STI testing in both the lower risk male and lower risk female groups, but was not significantly associated with STI testing in the two groups at higher risk of STI. The fact that

perceived risk is only significantly associated with lack of testing in two out of four of the subgroups and sexual health knowledge is associated with lack of testing in all four subgroups, indicates that sexual health knowledge may be a factor that is necessary but not sufficient to bring about STI testing. Wolfers et al. found the sexual health knowledge is significantly associated with perceived risk of STI acquisition (30). Recognizing this association, health service providers and health promotion practitioners should ensure that sexual health knowledge be provided consistently and accurately to students and that it includes information on the behaviors that put students at higher risk for STI.

The marked lack of association between forced sex and STI testing in higher risk females and lower risk males is noteworthy. The prevalence of STI testing among lower risk males who had experienced forced sex was slightly lower than all of the other subgroups, but not significantly so; 42% of lower risk males experiencing forced sex were tested for STI whereas 78% of higher risk males, 67% of higher risk females, and 65% of lower risk females that had experienced forced sex were ever tested for STI. The prevalence of STI testing among those reporting having experienced forced sex was similar between higher risk males and higher risk females. However, while there was an association between forced sex and STI testing in higher risk males, there was no association with STI testing in higher risk females. This suggests that the relationship between forced sex and STI testing may be mediated by another factor in the higher risk female subgroup. In a previous study, it was shown that American female college students that have experienced rape or attempted rape often experience higher levels of distress associated with seeking help (92,93). In this study, attitudinal barriers to help seeking were associated with STI testing in females only. It is possible that the association between forced sex and STI testing in the female subgroups is mediated by attitudinal barriers to help seeking; specifically, women experiencing forced sex could be prevented from accessing testing services due to attitudinal barriers to help seeking (i.e., believing that asking for help is a sign of weakness) which could be closely related to other psychosocial barriers to help seeking (i.e., fear, stigma, shame) (57,92,93). These findings indicate that improved effort may need to be made to make post-abuse counseling and testing services more accessible (both physically and psychologically) to those experiencing forced sex while at university. Ideal interventions should aim to improve awareness of the importance for post-abuse STI screening, as perceived need for

help among sexual assault victims has been shown to partially mediate the distress associated with seeking help among sexually abused female college students (92).

### *3.4.1 Strengths*

This study was successful in providing Maritime university health care providers and undergraduate health promoters with information about (1) the prevalence of STI testing, (2) the characteristics of those at higher risk of STI and (3) potential facilitators of and barriers to STI testing all in a Maritime Canadian university student population. This is the first study to look at STI testing correlates in those that have had heterosexual intercourse rather than in men who have sex with men (MSM). It is also the first study to provide estimates of testing among Canadian university students. Prior studies had identified a small number of demographic and psychosocial correlates of STI testing in post-secondary students (29,62,64,72), but neglected to include potential covariates associated with STI testing indirectly; through HIV testing or general use of other sexual health services by undergraduate students. Individuals being tested for HIV are often tested for STI in the same visit and several factors associated with HIV testing in the scientific literature were also found to be associated with STI testing (e.g. forced sex). For similar reasons, factors considered to be barriers to use of health services by undergraduate students were also included in these analyses and one was found to be significantly associated with a lack of STI testing among females (e.g. attitudinal barriers to help seeking).

There was sufficient power in this study, in all but the higher risk groups, to effectively discern a statistical difference of 2.5% for a dichotomous prevalence of 50%.

### *3.4.2 Limitations*

This study is limited by its cross-sectional design and thus potential endogeneity (e.g., being tested might improve sexual health knowledge rather than sexual health knowledge increasing the odds of testing). However, the sexual health knowledge variable used was constructed from questions covering a wide range of sexual health topics; it is, therefore, unlikely that contact with a health care provider during an STI test would have improved sexual health knowledge over the wide range of sexual health topics measured. As such, the more likely conclusion from the study findings is that higher sexual health knowledge leads to STI testing

rather than STI testing leading to higher sexual health knowledge. However, to be truly confident, these findings would need to be confirmed by longitudinal studies.

The response rate for this study (20.4%) is low; however, the response rate is comparable to other internet-based surveys and is similar to other surveys conducted among university populations (94,95). Moreover, it is less clear if non-response was systematic or random, and thus our estimates must be interpreted with caution. As such, the generalizability of study findings may be limited. Typically, individuals who complete voluntary sexual health surveys tend toward novelty-seeking personalities, are more likely to be educated, consume alcohol, and have had a major depressive episode and are typically less conservative that those that refuse to participate (96). Such volunteer bias would likely increase the proportion of participants in the higher risk group and may make the lower risk study population less generalizable to the lower risk individuals in the typical undergraduate population. Males were also underrepresented in the survey dataset compared to females, with response rates of 17.4% and 30.8% respectively. Since all analyses were performed stratified by both sex and risk, it is unlikely that these potential imbalances will bias the findings, though comparisons between the subgroups should be interpreted with caution.

There is also the possibility of differential misclassification of STI testing in women that do not differentiate between PAP testing and STI testing (65); this could have inflated the STI testing prevalence in the female population and differential misclassification of never being tested for STI. In using "never having been tested for STI" as the main outcome of interest the effects reported in this study may be underestimates of any actual associations. Therefore, any associations that are of borderline significance (e.g. the association between peer attitudes towards sex and odds never having been tested for STI in the higher risk groups) could in fact be significant if based on more objective measures of STI testing (i.e., medical records). Future studies using more objective measures should not discount these variables as potential covariates of STI testing in Maritime undergraduate students.

Due to the small number of homosexual students in the higher risk groups it was necessary to combine homosexual and bisexual students together into one category (i.e. non-heterosexual); however, Thomas et al. have shown that bisexual and homosexual individuals behave differently in their access to HIV testing services (32). It is logical to hypothesize, therefore, that bisexual and homosexual students are also likely to be tested for STI at different rates. Future studies that

define STI risk based on all forms of sexual intercourse (i.e., vaginal, oral and anal sex) would likely have higher response rates among the higher risk non-heterosexual population, and would be better able to demonstrate potential differences in STI testing rates between bisexual and homosexual university students.

## 3.5 CONCLUSIONS

Overall, using survey data from eight different Maritime Canadian universities, we were able to determine the prevalence of STI testing, to characterize those at higher risk of STI based on risky sexual behaviour, and identify several factors that could potentially be facilitators of and barriers to STI testing in a higher risk vaginally sexually active Maritime Canadian university students.

This is the first quantitative study to look at sexual risk behaviour and health service utilization in a Canadian university population. As such we are one of the first to determine that, as of yet, STI testing rates among Canadian university students may not be meeting the routine screening targets recommended by the Public Health Agency of Canada (10). In addition, this is the first study to investigate a wide variety of variables that are known to be connected to STI testing, HIV testing, and health care utilization in university students as potential correlates of STI testing, specifically depression-risk, living arrangements, attitudinal barriers to help seeking, and religion. As all four of these variables were found to be significantly associated with STI testing in at least one risk and biological sex stratified subgroup, this study has identified several new potential covariates that should be included in future analyses of STI testing rates in university populations (32,36,60,67).

In performing analyses stratified on both biological sex and risk, we were able to determine that health promotion may be most effective at increasing lifetime STI testing when targeting younger students with campaigns designed to increase general sexual health knowledge; these interventions would likely be effective at increasing STI testing rates in those most at-risk of undiagnosed STI while still benefiting the remaining sexually active student population

In summary, this exploratory study is a first step towards identifying predictors of and barriers to STI testing in higher risk vaginally sexually active university students. This type of analysis has been suggested by previous authors investigating student use of health care services and until now has not been explored in the scientific literature (30,61,76). This study contributes

to the literature by identifying potential associations to be explored in future longitudinal studies and in studies designed to employ higher response rates. The findings from this study also provide an awareness of the factors associated with never being tested for STI, and could help in developing targets for health promotion campaigns and may guide health care workers in identifying those patients most in need of health teaching and other preventative measures.

**Table 3.1** Characteristics of the study population (n=7,346), stratified by student sex and STI risk.

| | Higher Risk | | Lower Risk | |
|---|---|---|---|---|
| | **Male** | **Female** | **Male** | **Female** |
| | Population Mean or Proportion (n=326) | Population Mean or Proportion (n=881) | Population Mean or Proportion (n=1716) | Population Mean or Proportion (n=4423) |
| **Total †** | 6.5 (5.7 – 7.2) | 9.6 (9.0 – 10.3) | 35.0 (33.7 – 36.4) | 48.9 (47.5-50.2) |
| **Age*** | 21.6 (21.3-22.9)[¥] | 20.8 (20.6-21.1) | 21.4 (21.2-21.6)[¥] | 21.1 (21.0-21.2) |
| **Year of Study**** | | | | |
| First | 17.7 (13.3 – 22.0) | 22.0 (19.1 – 25.0) | 23.0 (20.8 – 25.1) | 22.9 (21.6 – 24.2) |
| Second | 23.1 (18.1 – 28.2) | 26.8 (23.7 – 30.0) | 21.5 (19.4 – 23.6) | 21.4 (20.0 – 22.7) |
| Third | 20.5 (15.7 – 25.3) | 21.7 (18.5– 24.9) | 21.8 (19.6 – 24.0) | 22.2 (20.8 – 23.5) |
| Fourth | 30.4 (24.8 – 35.9)[£] | 20.6 (17.6 – 23.6) | 23.0 (20.7 – 25.2) | 24.4 (23.0 – 25.8)[£] |
| Other (>Fourth) | 8.3 (4.9 – 11.8) | 8.8 (6.7 – 11.0) | 10.8 (8.9 – 12.6) | 9.1 (8.2 – 10.1) |
| **Not Caucasian**** | 8.5 (5.3 – 11.8) | 7.0 (5.1 – 8.8) | 11.8 (10.1 – 13.4) | 7.3 (6.5 – 8.2) |
| **Not Heterosexual **** | 1.5 (0.1 – 2.9)[£] | 8.4 (5.8– 10.9) | 5.5 (4.3 – 6.7) | 6.6 (5.8 – 7.5) |
| **Religion Important**** | 15.5 (11.1 – 19.9) | 21.7 (18.5 – 24.9)[¥] | 22.7 (20.5 – 25.0)[£] | 28.3 (26.8 – 29.8)[£,¥] |
| **Living Arrangements**** | | | | |
| Student Residence | 18.8 (14.5 – 23.2) | 20.2 (17.2 – 23.3) | 21.9 (19.8 – 24.0) | 21.0 (19.7 – 22.2) |
| Alone | 7.7 ( 4.3 – 11.1) | 8.4 (6.3 – 10.6) | 8.0 (6.5 – 9.5) | 6.3 (5.5 – 7.1) |
| Roommate(s) | 50.3 (44.3 – 56.3) | 43.3 (39.7 – 46.9) | 33.4 (30.9 – 35.9) | 31.4 (29.9 – 32.9) |
| Romantic Partner | 6.1 (3.3 – 8.9) | 7.1 (5.2 – 9.1) | 15.1 (13.2 – 17.0)[£] | 19.2 (17.9 – 20.5)[£] |
| Parent(s) | 17.1 (12.3 – 21.9) | 20.9 (18.0 – 23.9) | 21.7 (19.5 – 23.8) | 22.1 (20.8 – 23.4) |
| **Had Non-Consensual Sex**** | 6.0 (2.9 – 9.1)[£] | 12.2 (9.4 – 14.9)[£,¥] | 1.6 (0.9 – 2.2) | 6.9 (6.0 – 7.8)[¥] |
| **Heavy Alcohol and/or Marijuana Use** | | | | |
| Neither | 13.6 (9.4 – 17.8) | 25.5 (22.4 – 28.7) | 37.3 (34.7 – 39.8) | 48.3 (46.7 – 49.9) |
| Either | 73.7 (68.5 – 79.0)[£,¥] | 68.1 (64.7 – 71.5)[£] | 55.4 (52.8 – 58.0)[¥] | 49.1 (47.5 – 50.7) |
| Both | 12.6 (8.8 – 16.5)[£,¥] | 6.4 (4.7 – 8.0)[£] | 7.3 (5.9 – 8.7)[¥] | 2.5 (2.0 – 3.0) |
| **Higher Self-Perceived Risk**** | 18.8 (14.0 – 23.5)[£] | 18.6 (15.8 – 21.4)[£] | 5.4 (4.2 – 6.6) | 4.1 (3.4 – 4.7) |
| **Perceived Peer Sexual Risk Taking *** | 26.1 (25.4-26.8)[£,¥] | 21.8 (21.4-22.2)[£] | 22.2 (21.9 – 22.5)[¥] | 19.5 (19.3 - 19.7) |
| **Sexual Health Knowledge Score*** | 7.4 (7.1-7.7)[£] | 9.0 (8.9 – 9.2)[£,¥] | 6.9 (6.8-7.0) | 8.7 (8.6 – 8.8)[¥] |
| **Barriers to Help Seeking Score*** | 24.7 (24.0-25.4)[¥] | 23.2 (22.8-23.6)[£] | 23.9 (23.6 – 24.3)[¥] | 22.6 (22.4– 22.8) |
| **At-Risk of Depression**** | 27.9 (22.7 – 33.2) | 43.6 (40.0 – 47.3)[£,¥] | 27.7 (25.3 – 30.1) | 35.1 (33.6 – 36.6)[¥] |
| **Never Tested for STI **** | 53.9 (47.7 – 60.1)[¥] | 37.7 (34.0 – 41.3) | 75.9 (73.5 – 78.3)[£,¥] | 56.8 (55.1 – 58.5)[£] |

* Mean of strata (95% CI)

** Proportion of strata (95% CI)

†Proportion of total study population (95% CI)

[£] Significantly higher ($p<0.05$) when comparing higher risk males to lower risk males or higher risk females to lower risk females

[¥] Significantly higher ($p<0.05$) when comparing higher risk males to higher risk females or lower risk males to lower risk females

**Table 3.2** Adjusted logistic regression of never being tested for an STI among higher risk males on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=326).

| Covariates of Interest | Full Model – Unadjusted for University[¥] | Full Model – Adjusted for University[£] |
|---|---|---|
| Age | **0.81 (0.74 , 0.89)*** ** | **0.77 (0.67 , 0.89)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 0.74 (0.15 , 3.64) | 0.79 (0.32 , 1.99) |
| · Third | 0.86 (0.20 , 3.72) | 1.09 (0.37 , 3.22) |
| · Fourth | 0.75 (0.19 , 2.93) | 0.91 (0.34 , 2.45) |
| · Other | 1.63 (0.49 , 5.38) | 1.71 (0.41 , 7.07) |
| Not Heterosexual | 0.09 (0.004, 1.63) | 0.03 (0.000 , 1.85) |
| Religion Important | 1.28 (0.81 , 2.03) | 1.36 (0.57 , 3.22) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 0.62 (0.23, 1.67) | 0.71 (0.21 , 2.42) |
| · Roommate(s) | 0.97 (0.51 , 1.84) | 0.96 (0.39 , 2.38) |
| · Student Residence | 1.18 (0.47 , 2.95) | 1.54 (0.55 , 4.30) |
| · Romantic Partner | 1.69 (0.50 , 5.71) | 1.90 (0.43 , 8.45) |
| Had Non-Consensual Sex | **0.25 (0.08 , 0.77)*** | **0.18 (0.03 , 0.95)*** |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 1.16 (0.51 , 2.63) | 1.19 (0.51 , 2.82) |
| · Both | 0.92 (0.38 , 2.22) | 0.76 (0.24 , 2.45) |
| Higher Self-Perceived Risk | 1.08 (0.76 , 1.54) | 1.09 (0.50 , 2.39) |
| Perceived Peer Sexual Risk Taking | 0.98 (0.94 , 1.03) | 0.99 (0.94 , 1.05) |
| Sexual Health Knowledge Score | **0.86 (0.80 , 0.93)*** ** | **0.83 (0.74 , 0.94)*** |
| Barriers to Help Seeking Score | 0.98 (0.94 , 1.02) | 0.97 (0.93 , 1.03) |
| At- Risk of Depression | 1.59 (0.84 , 3.01) | 1.55 (0.78 , 3.10) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

**Table 3.3** Adjusted logistic regression of never being tested for an STI among higher risk females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=881).

| Covariates of Interest | Full Model – Unadjusted for University[¥] | Full Model – Adjusted for University[£] |
|---|---|---|
| Age | **0.82 (0.76 , 0.87)*** ** | **0.79 (0.72 , 0.88)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 1.04 (0.73 , 1.47) | 1.05 (0.64 , 1.70) |
| · Third | 0.70 (0.37 , 1.33) | 0.71 (0.41 , 1.25) |
| · Fourth | 0.80 (0.46 , 1.39) | 0.85 (0.47 , 1.51) |
| · Other | 0.99 (0.47 , 2.07) | 1.06 (0.49 , 2.28) |
| Not Heterosexual | 0.76 (0.28 , 2.03) | 0.75 (0.37 , 1.51) |
| Religion Important | 1.18 (0.77 , 1.80) | 1.20 (0.79 , 1.80) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 0.47 (0.18 , 1.20) | 0.57 (0.27 , 1.20) |
| · Roommate(s) | 0.83 (0.60 , 1.14) | 0.90 (0.56 , 1.45) |
| · Student Residence | 0.81 (0.49 , 1.31) | 0.82 (0.47 , 1.42) |
| · Romantic Partner | 0.67 (0.27 , 1.66) | 0.76 (0.31 , 1.87) |
| Had Non-Consensual Sex | 1.07 (0.47 , 2.40) | 1.15 (0.68 , 1.93) |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 0.87 (0.59 , 1.28) | 0.86 (0.58 , 1.28) |
| · Both | 0.72 (0.46 , 1.11) | 0.60 (0.28 , 1.27) |
| Higher Self-Perceived Risk | **0.71 (0.52 , 0.97)*** | 0.73 (0.48 , 1.13) |
| Perceived Peer Sexual Risk Taking | 0.99 (0.96 , 1.01) | 0.99 (0.96 , 1.02) |
| Sexual Health Knowledge Score | **0.83 (0.77 , 0.90)*** ** | **0.83 (0.76 , 0.91)*** ** |
| Barriers to Help Seeking Score | **1.04 (1.01 , 1.07)*** | **1.05 (1.01 , 1.08)**** |
| At- Risk of Depression | 0.84 (0.58 , 1.21) | 0.80 (0.56 , 1.14) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

**Table 3.4** Adjusted logistic regression of never being tested for an STI among lower risk males on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=1716).

| Covariates of Interest | Full Model – Unadjusted for University[¥] | Full Model – Adjusted for University[£] |
|---|---|---|
| Age | **0.86 (0.81 , 0.92)*** ** | **0.86 (0.81 , 0.91)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 0.66 (0.28 , 1.56) | 0.67 (0.43 , 1.02) |
| · Third | 0.80 (0.42 . 1.51) | 0.83 (0.52 , 1.27) |
| · Fourth | 0.62 (0.33 , 1.15) | 0.65 (0.42 , 1.02) |
| · Other | 0.65 (0.39 - 1.11) | 0.69 (0.39 , 1.21) |
| Not Heterosexual | 0.51 (0.25 , 1.04) | **0.48 (0.28 , 0.82)** ** |
| Religion Important | 0.97 (0.75 , 1.27) | 0.97 (0.69 , 1.36) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 0.75 (0.46 , 1.22) | 0.83 (0.46 , 1.49) |
| · Roommate(s) | **0.67 (0.52 , 0.85)** ** | 0.73 (0.48 , 1.13) |
| · Student Residence | 0.78 (0.55 , 1.11) | 0.85 (0.53 , 1.37) |
| · Romantic Partner | 0.87 (0.51 , 1.47) | 0.95 (0.56 , 1.61) |
| Had Non-Consensual Sex | 0.67 (0.29 , 1.54) | 0.71 (0.23 , 2.22) |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 0.85 (0.63, 1.13) | 0.84 (0.61 , 1.14) |
| · Both | 0.76 (0.36 , 1.59) | 0.77 (0.46 , 1.28) |
| Higher Self-Perceived Risk | **0.38 (0.26 , 0.54)*** ** | **0.37 (0.21 , 0.63)*** ** |
| Perceived Peer Sexual Risk Taking | 0.98 (0.96 , 1.00) | 0.98 (0.95 , 1.01) |
| Sexual Health Knowledge Score | **0.90 (0.84 , 0.96)*** ** | **0.90 (0.85 , 0.95)*** ** |
| Barriers to Help Seeking Score | 1.01 (0.99 , 1.03) | 1.01 (0.98 , 1.03) |
| At- Risk of Depression | 0.87 (0.64 , 1.18) | 0.86 (0.62 , 1.19) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

**Table 3.5** Adjusted logistic regression of never being tested for an STI among lower risk females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=4423).

| Covariates of Interest | Full Model – Unadjusted for University[¥] | Full Model – Adjusted for University[£] |
|---|---|---|
| Age | **0.82 (0.79 , 0.85)*** ** | **0.82 (0.79 , 0.85)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 0.93 (0.73 , 1.18) | 0.91 (0.72 , 1.17) |
| · Third | 0.83 (0.66 , 1.03) | 0.82 (0.64 , 1.06) |
| · Fourth | **0.76 (0.64 , 0.91)**** | **0.76 (0.59 , 0.98)*** |
| · Other | 0.73 (0.47 , 1.13) | 0.73 (0.52 , 1.03) |
| Not Heterosexual | **0.73 (0.58 , 0.92)**** | **0.73 (0.54 , 0.99)*** |
| Religion Important | **1.26 (1.07 , 1.49)**** | **1.24 (1.04 , 1.47)*** |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | **0.67 (0.48 , 0.95)*** | **0.68 (0.47 , 0.98)*** |
| · Roommate(s) | 0.75 (0.55 , 1.03) | **0.76 (0.60 , 0.95)*** |
| · Student Residence | 1.23 (0.93 , 1.64) | 1.23 (0.95 , 1.61) |
| · Romantic Partner | 0.86 (0.68 , 1.09) | 0.87 (0.67 , 1.12) |
| Had Non-Consensual Sex | **0.54 (0.37 , 0.81)**** | **0.54 (0.40 , 0.73)*** ** |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | **0.80 (0.71 , 0.90)*** ** | **0.80 (0.68 , 0.94)**** |
| · Both | **0.56 (0.41 , 0.76)*** ** | **0.55 (0.33 , 0.93)*** |
| Higher Self-Perceived Risk | **0.46 (0.35 , 0.62)*** ** | **0.46 (0.30 , 0.69)*** ** |
| Perceived Peer Sexual Risk Taking | **0.97 (0.95 , 0.99)*** ** | **0.97 (0.96 , 0.98)*** ** |
| Sexual Health Knowledge Score | **0.82 (0.80 , 0.84)*** ** | **0.82 (0.79 , 0.85)*** ** |
| Barriers to Help Seeking Score | **1.03 (1.01 , 1.04)*** ** | **1.03 (1.01 , 1.04)*** ** |
| At- Risk of Depression | **0.88 (0.81 , 0.96)**** | 0.89 (0.75 , 1.05) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

# **CHAPTER 4.** UNDERSTANDING HIV TESTING RATES AMONG HIGHER RISK UNIVERSITY STUDENTS

(Manuscript)

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**ABSTRACT**

*Introduction.* In Canada and the Unites States, individuals between the ages of 15 and 29 are at higher risk of human immunodeficiency virus (HIV) acquisition. HIV testing services are free and readily available to most university students in Canada. However, only some individuals choose to access them, and little is known about the correlates of HIV testing among Canadian undergraduate students. This study aims to characterize those individuals more at risk of acquisition and least likely to be tested. This information can be used to refine targets for HIV testing among university study populations.

*Methods.* The data for this study comes from the Maritime Undergraduate Student Sexual Health Services Survey, a cross-sectional, anonymous, internet-based survey of undergraduate students at eight universities in Maritime Canada. This dataset contains information on the sexual health of and use of health services by 10,361 university students, weighted to be representative of the basic demographics of the participating universities and imputed for missing values. To analyze this data, we stratified by biological sex and risk of acquisition based on reported vaginal sexual behaviors, and then performed a descriptive analysis of the characteristics of each subpopulation as well as both simple and multiple logistic regression analyses of the factors associated with being tested for HIV in each subpopulation.

*Results.* Results indicate that 85% of sexually active students and 78% of the 1207 students more at-risk of STI acquisition (based on their vaginal sexual behaviour) have never been tested for HIV. Higher personal perception of risk was only associated with increased HIV testing in those at lower risk of HIV acquisition, however, 81% of those at higher risk of HIV acquisition perceived themselves as being at lower risk. Across all groups, younger, heterosexual students were significantly less likely to be tested for HIV.

*Conclusions.* Health promotion may be most effective at increasing lifetime HIV testing among vaginally sexually active individuals when targeting younger, heterosexual students with campaigns designed to improve accuracy of HIV risk perception, especially among those engaging in unprotected sex outside of a committed relationship. These interventions could increase HIV testing rates in those most at-risk of undiagnosed HIV, while still benefiting other sexually active students.

## 4.1 INTRODUCTION

In Canada, individuals of undergraduate university age are at higher risk for acquiring HIV. By the end of 2009, 25% of the 69,844 HIV cases reported to the Public Health Agency of Canada (PHAC) were among individuals 15-29 years of age. Females make up 57% of the reported cases of HIV among those aged 15 to 19 and 30% among those aged 20 to 29. In these age groups, new HIV cases are often attributed to heterosexual contact; 28.4% in those aged 15-19 years and 24.0% in those 20-29 years of age (43). At the same time, rates of reported cases of HIV in youth are likely a gross underestimates of the total burden of disease in this population. The Centers for Disease Control and Prevention found that almost 60% of youth with HIV in the United States were unaware that they had been infected (38). Untreated HIV is associated with high morbidity and mortality and sexual partners of individuals with untreated HIV are at higher risk of HIV acquisition (40). Early detection of HIV is associated with improved outcomes for those infected and can help prevent further transmission of HIV (22,55).

Across North America, it is recommended that HIV tests be provided to all individuals who have been sexually active and have never been tested for HIV (22). HIV testing services are generally free and readily available to university students in Canada, yet only some individuals choose to access them. Characterizing those individuals more at risk of HIV and least likely to be tested would allow clinicians and other health services providers to refine their targets for HIV testing and associated health promotion strategies.

Little is known about the correlates of HIV testing in Canadian undergraduate university student populations, especially those at higher risk for HIV. A literature review found no quantitative studies examining the barriers to HIV testing within a Canadian population and no study that has looked at students at higher risk for STI due to vaginal sexual behaviours. Previous studies on barriers to HIV testing in higher risk populations have defined higher risk individuals primarily as either those of African descent or men who have sex with men (MSM), or both (32,97-99). By stratifying on risk of STI determined by vaginal sexual behaviour, this study will explore HIV testing rates in a previously unstudied population.

Past studies have identified several demographic and psychosocial correlates of HIV testing among university students including: age, biological sex, religion, living arrangement, risk perception, ethnicity, sexual orientation, alcohol and drug dependence, perception of risk, testing norms, having had forced sex and year of study. Caldeira et al. performed multiple

regression analysis to determine correlates of HIV testing in unmarried college students in the United States; biological sex, ethnicity, sexual orientation and alcohol and drug dependence (in males) were all significantly associated with HIV testing whereas neighbourhood income was not (36). Thomas et al. indicated that testing norms, year of study, religious affiliation, residence status, and perception of HIV risk may also affect HIV testing rates in American college students (32), while Siegel et al. indicated that HIV testing behaviours vary by year of study (17). Crosby et al. found that ever having been forced to have sex of any kind was associated with HIV testing among undergraduate students attending a large university in the south-eastern United States (34). Using the combination of these findings, we hypothesized that age, ethnicity, sexual orientation, forced sex, year of study, alcohol and drug dependence, living arrangement, perceived risk of STI acquisition and personal importance of religion would be associated with HIV testing rates in our study population.

Several studies have found that past access to health care services, including STI testing, is associated with HIV testing in American college students (32,36,57); however, these previous studies performing multivariable analyses attempting to characterize those tested for HIV in college students have not included predictors of STI testing or general access to health services as potential covariates of HIV testing (32,34,36,57). We hypothesize that variables associated with STI testing (i.e. perceived peer sexual risk taking and sexual health knowledge) and those associated with other health services use (i.e. depression risk, attitudinal barriers to help seeking, and university attended) in university populations will also be associated with HIV testing rates in our study population (29,58,67,68,71,72,100).

Employing a study population of vaginally sexually active university students from eight universities in Maritime Canada, this study sought to: (1) determine the prevalence of HIV testing overall, and stratified by risk of STI, (2) describe the characteristics of those at higher and lower risk of HIV, and (3) identify the correlates associated with never having been tested for HIV including key demographic, behavioural and psychosocial variables in higher and lower risk males and females.

## 4.2 METHODS

We used data collected as part of the Maritime Undergraduate Sexual Health Services Survey administered by Dalhousie University in the fall of 2012. This is a cross-sectional online

survey of a voluntary study population of undergraduate students from eight Maritime universities.

### *4.2.1 Study Population*

The sampling frame is made up of all of the undergraduate students at Dalhousie, St. Mary's (SMU), Mount St. Vincent (MSVU), Acadia, St. Francis Xavier (SFX), Cape Breton University (CBU), the University of Prince Edward Island (UPEI) and the University of New Brunswick (UNB). The university students at these schools are a heterogeneous representation of the Maritime Canadian university student population, including students from various universities differing in size, province, and urbanicity. The survey excludes francophone universities due to language concerns (i.e., survey translation and multiple report writing) and smaller universities which do not offer a broad range of undergraduate programming and are thus less representative of the general undergraduate population. Due to cost and logistical concerns, two smaller universities in New Brunswick were not included. Overall, 10361 of these students (20.4%) participated. For the purposes of this study, we limited the population to include only those individuals who had ever had heterosexual vaginal intercourse that were between the ages of 17 and 29 (n=7,346). For the purposes of this study, we limited the population to include only those males and females who had ever had heterosexual vaginal intercourse, were between the ages of 17 and 29 and provided complete information on STI risk behaviours used to create the STI risk categories (i.e., condom use at last intercourse and number of sexual partners in the last year). Overall 7,346 individuals were included in the study population; 2,499 individuals were excluded for not being vaginally sexually active, 435 were outside the desired age range, 10 had incomplete information about their sexual risk behaviours, 16 were transgender or had missing information for biological sex, and 55 were excluded for more than one of these reasons.

### *4.2.2 Survey Administration*

Using the approach suggested by Dillman (77), all undergraduate students at each of the eight participating universities were contacted through each respective university registrar's email listserver, asked to participate, and provided with a link to the online survey. Responses were collected and stored using OPINIO software, a secure online service hosted at Dalhousie University. To avoid duplication, students were prevented from using the same computer to complete the survey more than once. Incentives (i.e., one iPad draw per university) were used to

encourage participation. The survey design and data collection were both approved by ethics boards at all eight participating universities.

### *4.2.3 Dependent Variable*

The following variable was used as the outcome in all regression analyses:

- *Never Tested for HIV*. The survey asks if the subject has ever accessed HIV testing services (1 item). We used this to create a binary outcome variable for HIV testing: Never Tested (i.e., those who answer 'No' to ever being tested for HIV) and referent category, Ever Tested (i.e., those who answer 'Yes' to ever being tested for HIV).

### *4.2.4 Independent Variables*

To prevent small cell sizes, where possible, variables with similar categories containing fewer respondents were collapsed together. The following key covariates were considered for addition into multiple variable regression models and defined as follows:

- *Age*. Age (in years) was used as a continuous variable.
- *Ethnicity.* The survey collects ethnicity data as a non-mutually exclusive categorical variable covering the most common ethnic groups found in the Canadian Maritimes (1 item with 5 options: Caucasian, African descent, Aboriginal, Asian, Middle Eastern, and Other). We combined these categories to produce a binary variable: Non-Caucasian Descent and, referent category, Any Caucasian Descent.
- *Sexual Orientation.* The survey collects information about subjects' sexual orientation as a categorical variable on a non-ordinal scale (1 item with 6 options: 100% heterosexual, mostly heterosexual, bisexual, mostly homosexual, 100% homosexual and unsure). The number of homosexual individuals (both male and female) at higher risk of STI based on their vaginal sexual activity was low ($n<5$); therefore, we combined the homosexual and bisexual individuals together to produce a binary variable: Non-Heterosexual (bisexual/ mostly homosexual/100% homosexual/unsure) and, referent category, Heterosexual (100% heterosexual/mostly heterosexual).
- *Forced Sex.* The survey contains a direct measure of whether or not the study subject was forced to have sex of any type against their will while at university (1 item, yes/no). Those that had never had forced sex while at university were used as the referent category.

- *Year of Study*. The survey data provides a direct measure of the year of post-secondary study the subject was currently enrolled in in the fall of 2012. Subjects were categorized into one of five categories based on their year of study: 1st year, 2nd year, 3rd year, 4th year, and other. First year students were used as the referent category.
- *Heavy Alcohol and/or Marijuana Use.* Frequent or heavy use of marijuana has been defined in previous epidemiologic studies as daily or near daily use. (83) Episodic heavy alcohol use has been defined previously as the consumption of 5 or more drinks in one sitting (i.e., binge drinking) more than once per month. (84) We defined chronic marijuana use as ≥20 times per month and heavy alcohol use as >1 binge drinking episodes per month to create a categorical variable for heavy alcohol and/or marijuana use with three levels (Both/One/Neither). Neither was used as the referent category in all analyses.
- *Self-Perceived Risk of STI Acquisition (including HIV)*. Self-reported perception of risk for STI acquisition was measured using 4 response options: greatly at risk, quite a lot at risk, not very much at risk, and not at all at risk. These were dichotomized into: higher perceived risk of acquisition (i.e., greatly at risk/quite a lot at risk) and, the referent category, lower perceived risk of acquisition (i.e., not very much at risk/not at all at risk).
- *Personal Importance of Religion.* This was measured using 4 response options (very important, fairly important, not very important and not important at all). A binary variable was created: Religion Important (fairly important/very important) and, the referent category, Religion Not Important (not important at all/not very important).
- *Living Arrangements*. This was measured using a categorical variable noting five types of living arrangements: Student Residence (i.e., on campus in student residence/housing), Alone (i.e., living off campus alone), Roommate(s) (i.e., living off campus with only non-sexual or non-romantic partner(s)), Romantic Partner (i.e., living off campus with a romantic or sexual partner), and, the referent category, Parent(s) (i.e., living off campus with one or both parents).

Individuals being tested for HIV have often been tested for STI previously (36,57,82); this correlation between STI and HIV testing was reflected in the study population ($\rho$=0.5). Therefore, we included additional variables known to be correlates of STI testing as potential correlates of HIV testing, including: perceived peer sexual risk taking (29) and sexual health knowledge (72,100).

- *Perceived Peer Sexual Risk Taking*. We measured perceived peer sexual risk taking using 9 items, (score range 9-45) with a higher score meaning perception of more sexual risk taking by friends (Cronbach's α=0.78) (78,79).
- *Sexual Health Knowledge*. The survey assesses sexual health knowledge using the score from response to 12 knowledge statements with true/false/don't know responses used in previous studies (80). Correct answers were scored as "1" and incorrect/don't know as "0". The individual item scores were summed to create a continuous variable (12 items, score range 0-12 with a higher score meaning greater sexual health knowledge) (Cronbach's α=0.71) (81).

If students are unlikely to access any health services then they will be unlikely to be tested(32,36,57); therefore, we included variables that could affect health service use rates in post-secondary school students as potential covariates for STI testing, including: depression risk (67), attitudinal barriers to help seeking (68), and university attended (71,72).

- *Risk of Depression*. The survey measures risk of depression using a 12-item version of the Centers for Epidemiological Studies of Depression (CES-D) scale (12 items, score range 0-36, with a higher score indicating a greater risk of depression) (Cronbach's α=0.85). The 12 item version has been previously validated and employed in a number of studies to assess risk of depression (85-87). Individuals were categorized, using a commonly accepted cut-off value, into those at risk of depression (score >11) and the referent category, those who are not (score ≤11) (86).
- *Attitudinal Barriers to Help Seeking*. The survey uses the Barriers to Help Seeking Scale (68), which is based on 8 items, ranging from 0-4. Scale scores range from 0 to 32 with a higher score indicating the presence of more attitudinal barriers to help seeking (Cronbach's α=0.79).
- *University Attended*. The university attended by each participant.

*4.2.5 Statistical Analysis*

The data were statistically adjusted using population weights, specific to the age and biological sex distributions at each of the eight universities, to account for non-response. Missing responses were estimated using multiple imputation (i.e., multivariable regression models based on complete data were used to probabilistically determine five different potential responses per respondent for each missing item).

Since males and females use health services at different frequencies and often for different reasons, we stratified the study population based on both biological sex and risk of STI acquisition (33,88). We verified the correctness of this approach by testing for sex-based effect modification between each potential covariate and HIV testing. Individuals engaging in sexual activity without a condom outside of a committed relationship are at higher risk for STI, including HIV (22). To isolate this population, we defined risk of HIV acquisition using a combination of two risky sexual behaviours: no condom use at last vaginal intercourse and multiple sexual partners (>1) in the last year for vaginal intercourse. Only those individuals with both behaviours were classified as at higher risk of HIV acquisition, whereas those with neither or only one were classified as at lower risk of acquisition.

We calculated the weighted prevalence of HIV testing in the overall study population and in each of the four subgroups (i.e., higher risk males, higher risk females, lower risk males and lower risk females). We described the characteristics of the undergraduate students in each of the four subgroups using descriptive statistics (i.e., weighted means/proportions with 95% confidence intervals). The mean or prevalence statistics for each of the characteristics were compared between subpopulations using simple regression models; significant differences between males and females or between higher and lower risk individuals were designated based on the regression p-values ($p<0.05$). All descriptive analyses were carried out without adjustment for university attended.

We ran simple logistic regressions to determine the weighted, univariable association between each independent variable and the outcome of interest in each of the four subgroups. We included theoretically important variables (e.g., age) and any measure with a univariable p value less than 0.2 in at least one subgroup, as potential covariates of lack of HIV testing in all multivariable logistic analyses; the same group of covariates were used in all four subgroups to allow for ease of comparison between subgroups. We performed two separate multivariable logistic regression models for each of the four subgroups; one (Model 1) with and one (Model 2) without university attended in the model. All regressions that did not include university in the model were corrected for potential intraclass correlation between students attending the same university. All associations were considered to be significant at a p value less than 0.05. All statistical analyses were performed using SAS OnlineDoc® 9.3 software (89).

## 4.3 RESULTS

Overall, 85.3% (95% CI: 84.3-86.4) of the 7346 sexually active students reported never having been tested for HIV. There was not a significant difference in HIV testing rates between males and females; 14.1% of males (95% CI: 12.3-16.0) and 15.1% of females (95% CI: 13.8-16.3) reported ever having been tested. Higher risk individuals were more likely to have reported ever having been tested than those categorized as lower risk; 21.9% (95% CI: 18.7 – 25.0) versus 13.3% (95% CI: 12.2 – 14.4) respectively (data not shown).

Table 4.1 provides a weighted descriptive breakdown of the demographic, behavioural and psychosocial characteristics of each of the four subgroups (i.e., higher risk males, higher risk females, lower risk males, and lower risk females). When comparing characteristics of those at higher versus lower risk of STI within each biological sex using simple regression models, those in the higher risk groups were more likely to be heterosexual (males only), be fourth year students, report having had forced sex, heavily use alcohol and/or marijuana, perceive peers as having more sexual risk behaviours, be at-risk of depression (females only), have higher sexual health knowledge scores, have more attitudinal barriers to help seeking (females only), and perceive themselves to be at-risk of STI. Lower risk groups were significantly more likely to consider religion to be important and to live with a romantic partner rather than a roommate. Both males and females categorized as lower risk were significantly more likely to report having never been tested for HIV than those categorized as higher risk. Age and ethnicity did not differ significantly between risk groups within each biological sex.

In both the higher and lower risk groups, males were significantly more likely to be older, perceive their peers as having liberal attitudes towards sex, have higher barriers to help seeking attitude scores, and to heavily use alcohol and/or marijuana relative to female students. Females in both risk groups were more likely than males to have higher sexual health knowledge scores, to consider religion to be important, to be at-risk of depression, to be Caucasian (low-risk only), and to report having had forced sex. Lower risk females were significantly more likely to have never been tested for HIV than lower risk males, but testing rates were not significantly different between higher risk males and females. Year of study and self-perceived risk of acquisition did not differ significantly between males and females at either risk level.

Unadjusted analyses (Appendix B) revealed that all variables were associated with HIV testing at $p<0.2$ in at least one of the four subgroups; as such, all variables were included in

multivariable models to allow for direct comparisons between subgroups. After adjusting for the clustered data collection design, there still was clear evidence of sex-based interactions at both the higher and lower STI risk levels. In the lower risk group there were significant interactions between biological sex and sexual orientation ($p<0.0001$), sexual health knowledge score ($p=0.0003$), and living arrangement ($p=0.0163$). At the higher risk level there was significant interaction between sex and year of study ($p<0.0001$) and living arrangement ($p<0.0001$) (data not shown). Therefore, all multivariable logistic regressions were performed separately for males and females at each risk level.

Table 4.2 presents the results of both multivariable logistic regression models within the higher risk male subgroup. In Model 1, there were significant associations of younger age, and living with a parent as opposed to alone or with roommates, and heavy use of either alcohol or marijuana with increased odds of never having been tested for HIV. In Model 2, the same variables remained significantly associated with never having been tested for HIV; in addition, heterosexual students, those with lower sexual health knowledge scores and those at-risk of depression also had significantly increased odds of never having been tested for HIV. Non-Caucasian ethnicity, higher year of study, considering religion important, having never had forced sex, higher perceived risk of STI acquisition, increased perception of peer sexual risk taking, and more attitudinal barriers to help seeking were not significantly associated with the likelihood of STI testing among higher risk males in either model.

Table 4.3 presents the results of multivariable logistic regression models for the higher risk female subgroup. In Model 1, there were significant associations of younger age, being of Caucasian descent, heterosexuality, and living with parents as opposed to in student residence with an increase in the odds of never having been tested for HIV. After controlling for the effects of university attended in the higher risk female subgroup (Model 2), younger age, heterosexuality and living with parents versus roommates remained significantly associated with an increased odds of never having been tested. In addition, living with parents as opposed to alone and more attitudinal barriers to help seeking were also associated with increased odds of never having been tested for HIV. Higher year of study, being at risk of depression, considering religion important, having had forced sex, heavy use of alcohol and/or marijuana, higher perceived risk of acquisition, and increased perception of peer sexual risk taking were not significantly associated with HIV testing rates among higher risk females in either model.

Table 4.4 presents the results of multivariable logistic regression models for the lower risk male subgroup. In Model 1, there were significant associations of younger age, being of Caucasian descent, heterosexuality, and having lower perceived risk of STI acquisition with increase in the odds of never having been tested for HIV. After controlling for the effects of university attended (Model 2), these same variables remained significantly associated with never having been tested for HIV. In addition, lower sexual health knowledge was also associated with an increase in the odds of never having been tested for HIV. The remaining variables were not significantly associated with the likelihood of STI testing among lower risk males in either model.

Table 4.5 presents the results of multivariable logistic regression models for the lower risk female subgroup. In Model 1, a number of characteristics were significantly associated with an increase in the odds of never having been tested including: younger age, being of Caucasian descent, heterosexuality, lower perception of risk, less perceived peer sexual risk taking, and lower sexual health knowledge. These variables remained significant in Model 2; additionally, being a fourth year as opposed to a first year student was associated with increased odds of never having been tested for HIV. The remaining variables were not associated with HIV testing in either model.

## 4.4 DISCUSSION

We found that more than 85% of sexually active Maritime undergraduate students (aged 17-29) have never been tested for HIV; this proportion is significantly higher than has been observed previously in HIV testing studies performed on American college students(32,34,36,56). Two American studies indicate that less than half of students in the study population had never been tested for HIV; 42.3% of students in historically black college settings (32) and 47.5% of students from a mid-Atlantic American college had never been tested for HIV (36). Whereas two other American studies found that fewer than 80% of college students had never been tested for HIV; 73.9% of a nationally representative sample of United States college students (56) and 77.5% of a probability sample of American college students had never been tested for HIV (34). Among vocational students in the Netherlands 95% of males and 84% of females had never been tested for HIV (29). Our findings indicate that HIV testing rates among Maritime Canadian university students are similar to those of Dutch vocational college students

but significantly lower compared to American college students; as such, the Public Health Agency of Canada recommendation for HIV testing in all individuals after sexual initiation has likely not yet been achieved in this population (22). It is promising that a significantly higher proportion of students at higher risk of HIV due to their vaginal sexual behaviours are being tested when compared to lower risk students of the same gender, however, 78% of the 1207 students more at-risk of HIV acquisition (based on their vaginal sexual behaviour) have never been tested for HIV. Targeting factors common to all of the subgroups, thereby encouraging testing in those most at risk of HIV acquisition while still benefiting the remaining sexually active population, would be most effective at improving overall HIV testing rates. We identified several different factors within each biological sex and risk subgroup which are potential predictors of or barriers to HIV testing. There were only two factors – age and sexual orientation - common in effect size and direction between all four subgroups. Younger individuals and those identifying as heterosexual were less likely to report being tested for HIV, regardless of biological sex or risk level.

It is expected that younger sexually active individuals would be less likely to report having been tested for HIV, as experiences are naturally a function of time. However, it is concerning that 85.3% of the sexually active study population (age 17-29) had never been tested. The Public Health Agency of Canada guidelines suggest that all sexually active individuals should be tested at least once for HIV (22); therefore, it would be expected that most individuals (regardless of age) should have been tested at least once since becoming sexually active. It is possible that many individuals who have not been tested may have only recently experienced sexual debut. However, considering that the average age at first intercourse in Canada is 16.5 years and the average age of the study population was 21.2 years, it is more likely that the HIV testing guidelines are not being met among Maritime undergraduate students (22). It is promising that a significantly higher proportion of students at higher risk of HIV acquisition due to their vaginal sexual behaviours are being tested when compared to lower risk students of the same biological sex, but special efforts should be made in all students, especially younger students, to increase awareness of the need for testing if sexually active.

Based on the study findings, heterosexual university students are less likely to be tested for HIV than non-heterosexual students; these findings coincide with similar studies on HIV testing performed among college populations in the United States (32,36). Calderia et al found that non-

heterosexual students were 66% more likely to be tested for HIV compared to heterosexual students and Thomas et al indicated that bisexual students were 80% more likely to be tested than heterosexual students; however, Thomas et al found no significant difference in HIV testing rates between completely homosexual and heterosexual students when these individuals were not combined with bisexual students. It is possible that were there sufficient numbers of bisexual and homosexual student in our study that a similar pattern might have been observed. The findings for this study, however, extend across both sexes and cover both those at higher and lower risk of HIV acquisition. This is particularly concerning among higher risk males and females where, despite engaging in sexual behaviours that put them at risk of HIV acquisition, heterosexual individuals remain less likely to be tested for HIV. Previous studies have indicated that individuals that perceive themselves as being at-risk of HIV acquisition will be more likely to be tested for HIV (32,34,36). The lack of testing in heterosexual students could be attributed to a lack of perceived risk among heterosexual individuals. Perceived risk of acquisition was included as a potential covariate but was not found to significantly affect HIV testing in the higher risk males and females, though only 19% of those categorized as being at higher risk of HIV acquisition perceived themselves to be so. The fact that higher perceived risk is only significantly associated with testing in the lower risk subgroups could indicate that an inaccurate perception of risk of acquisition is preventing higher risk heterosexual students from requesting HIV testing services.

There is also a possibility of bias among health care providers that is preventing HIV testing services from being offered to heterosexual individuals. In a review of the literature, Burke et al identified that insufficient time, a burdensome consent process, a lack of knowledge/training, a lack of patient acceptance, pretest counselling requirements, competing priorities and inadequate reimbursement are common barriers of HIV testing cited by US physicians across several studies (101). Due to the nature of the Canadian health care system, reimbursement is likely less of an issue in in Canada; but, all the remaining physician barriers to HIV testing in this list may also be related to the lack of HIV testing seen in heterosexual students in this Canadian study population. Based on these findings and the recommendations of the Public Health Agency of Canada, health service providers and health promotion practitioners should prioritize that (1) students of all sexual orientations are aware of the behaviours that put

them at-risk of HIV acquisition and (2) those students exhibiting these behaviours be offered regular HIV testing services, regardless of sexuality (22).

Students that were not of Caucasian descent were more likely to have had HIV testing than those of Caucasian descent in three out of four subgroups. American studies in college populations have shown that students of African descent are more likely to be tested for HIV than Caucasian students; however, only 1.7% of the study population identified themselves as of African descent (i.e. 19.1% of the non-Caucasian population) so it is unlikely that this effect alone is responsible for the demonstrated association between ethnicity and HIV testing in the study population. It is more likely that many of the students in the study population without any Caucasian ancestry are international students and were screened for HIV as part of the application process for a Canadian student visa (102).

Based on our findings, higher sexual health knowledge may be a facilitator of HIV testing in undergraduate students, albeit indirectly, as sexual health knowledge is associated with STI testing, and previous STI testing is associated with HIV testing (32,36,57,100). In three out of four subgroups, those with more sexual health knowledge were more likely to be tested for HIV. Higher risk females were the only subgroup where sexual health knowledge was not associated with HIV testing; perhaps due to the conflicting effects of inaccurate risk perception or attitudinal barriers to help seeking in this group. If these issues could be addressed, it is possible that improving sexual health knowledge could be one step along a pathway that leads to improved HIV testing rates. McClean et al. found that information-work improved uptake of chlamydia testing services in college students in the United Kingdom (91); such approaches could potentially improve HIV testing rates. Considering the mean age of sexual debut in Canada, it is also possible that effective interventions designed to improve sexual health knowledge in high school students could improve STI testing rates and, in doing so, could improve HIV testing rates by the time those youth reach university age.

Regardless of risk level, female students with attitudes known to be barriers to help seeking were more likely to report never having been tested for HIV; this is despite the fact that attitudinal barriers to help seeking scores were lower in females than males. There was a similar association between barriers to help seeking and STI testing among the females in this study population (100); suggesting that greater attitudinal barriers to help seeking may prevent STI testing which is associated with reduced HIV testing rates. Experiences of HIV-related stigma,

one attitudinal barrier to help seeking, tend to be higher in Canadian women than men (103) and are associated with a lack of STI and HIV testing in college students (57). Lack of knowledge, social norms, and clinic accessibility are also key determinants of youth's attitudes towards STI testing (72,104). The findings of this study indicate a need to counteract these factors contributing to psychological barriers to testing in females, especially those at higher risk of HIV. Educational interventions designed to improve social norms, risk perception, and self-efficacy while ensuring the accessibility of sexual health services have been effective at improving STI testing rates among vocational college students in the Netherlands and are currently being pilot tested as a way to improve STI and HIV testing intervention among Canadian women who have sex with women (31,105). Interventions like these, meant to empower women to take responsibility for their health and access routine sexual health care, may reduce the influence of these attitudes on HIV testing rates.

There was a marked lack of association between forced sex and HIV testing in all but the lower risk female subgroup; despite the fact that the prevalence of HIV testing among those reporting having experienced forced sex was statistically similar between all subgroups (25-35%). This suggests that the relationship between forced sex and STI testing could be mediated by another factor in the lower risk female subgroup. In a previous study, it was shown that American female college students that have experienced rape or attempted rape often experience higher levels of distress associated with seeking help (92,93). In this study, attitudinal barriers to help seeking were found to be associated with HIV testing in high risk females. It is possible that the associations between forced sex and HIV testing in the higher risk female subgroup is mediated by attitudinal barriers to help seeking; specifically, higher risk women experiencing forced sex could be prevented from accessing services due to attitudinal barriers to help seeking (i.e., believing that asking for help is a sign of weakness) which could be closely related to other psychosocial barriers to help seeking (i.e., fear, stigma, shame) (57,92,93). These findings indicate that improved effort may be needed to make post-abuse counseling and testing services more accessible (both physically and psychologically) to those experiencing forced sex while at university. Ideal interventions should aim to improve awareness of the importance for post-abuse STI and HIV screening, as perceived need for help among sexual assault victims has been shown to partially mediate the distress associated with seeking help among sexually abused female college students (92).

*4.4.1 Strengths*

This study was successful in providing Maritime university health care providers and undergraduate health promoters with information about (1) the prevalence of HIV testing, (2) the characteristics of those at higher risk of HIV and (3) potential facilitators of and barriers to HIV testing among vaginally sexually active Maritime Canadian university students. This is the first study to look at HIV testing correlates in those at higher risk of acquisition due to risky vaginal sexual activity rather than in men who have sex with men (MSM). It is also the first study to provide estimates of HIV testing among Canadian university students. Prior studies had identified a small number of demographic and psychosocial correlates of HIV testing in post-secondary students including past STI testing and health care access (32,34,36,57); they did not include potential covariates associated with HIV testing indirectly through STI testing or general use of other sexual health services by undergraduate students. Individuals being tested for STI are often later tested for HIV (32,34,36,57) and several previously identified covariates of STI testing were found to be associated with HIV testing in this study (i.e. sexual health knowledge and perceived peer sexual risk taking). Covariates of health services use by undergraduate students were also included in these analyses and one was found to be significantly associated with a lack of HIV testing (i.e. attitudinal barriers to help seeking).

Despite the fact that the outcome of interest, never having been tested for STI, was measured using self-reports, there is a minimal likelihood that recall bias affected the validity of the measure. The use of an "ever tested" measure for STI testing is a more reliable self-report measure than frequency of use or use over a certain period of time (106). There is also a higher likelihood of the reliability of a self-report measure among younger individuals with some college education where the service use is likely to be somewhat recent (106,107). The recommendation that physicians perform pre- and post-testing counseling increases the overall frequency of contact with a health care provider and may reduce the likelihood of recall bias for this self-reported measure (10). Health care utilization tends to be overestimated by self-reported measures (108); by performing analyses on lack of service use the resulting estimates are likely underestimates rather than overestimates (reducing the likelihood of Type I error). However, any associations that are of borderline significance (e.g. the association between peer attitudes towards sex and odds never having been tested for STI in the higher risk groups) could in fact be significant if based on more objective measures of STI testing (i.e., medical records). Future

studies using more objective measures should not discount these variables as potential covariates of STI testing in Maritime undergraduate students.

Due to the large number of survey participants, there was sufficient power in this study, in all but the higher risk groups, to effectively discern a statistical difference for a dichotomous prevalence of 50%.

### *4.4.2 Limitations*

The response rate for this study is low (20.4%); however, the response rate is comparable to other internet-based surveys and is similar to other surveys conducted among university populations (94,95). It is unclear if non-response was systematic or random, and thus our estimates must be interpreted with caution. As such, the generalizability of study findings may be limited. Typically, individuals who complete voluntary sexual health surveys tend toward novelty-seeking personalities, are more likely to be educated, consume alcohol, and have had a major depressive episode and are typically less conservative that those that refuse to participate (96). Such volunteer bias would likely increase the proportion of individuals in the higher risk group and may make the lower risk study population less generalizable to the lower risk individuals in the typical undergraduate population. Males were also underrepresented in the survey population compared to females, with response rates of 17.4% and 30.8% respectively. Since all analyses were stratified by both biological sex and risk, it is unlikely that these potential imbalances will bias the findings, though comparisons between the subgroups should be interpreted with caution.

This study is limited by its cross-sectional design and thus potential endogeneity (e.g., that being tested improves sexual health knowledge rather than sexual health knowledge increasing the odds of testing). However, in this case, the sexual health knowledge variable used was constructed from questions covering a wide range of sexual health topics; it is, therefore, unlikely that contact with a health care provider during an HIV test would have improved sexual health knowledge over the wide range of sexual health topics measured. As such, the more likely conclusion from the study findings is that higher sexual health knowledge leads to HIV testing rather than HIV testing leading to higher sexual health knowledge. Yet, to be truly confident, these findings would need to be confirmed by longitudinal studies.

Due to the small number of homosexual students in the higher risk groups it was necessary to combine homosexual and bisexual students together into one category (i.e. non-heterosexual). This is also a limitation as Thomas et al. have shown that bisexual and homosexual individuals behave differently in their access to HIV testing services (32). Future studies defining HIV risk based on all forms of sexual intercourse (i.e., vaginal, oral and anal sex) would likely have higher response rates among the higher risk non-heterosexual population, and would be better able to demonstrate potential differences in HIV testing rates between higher risk bisexual and homosexual university students.

## 4.5 CONCLUSIONS

Overall, using survey data from eight different Maritime Canadian universities, we were able to determine the prevalence of HIV testing, to characterize those at higher risk of a HIV based on risky vaginal sexual behaviour, and identify several factors that could potentially be facilitators of and barriers to STI testing in this higher risk sexually active Maritime Canadian university students. This is the first quantitative study to look at sexual risk behaviour in connection with health service utilization in a Canadian university population. As such, we are one of the first to determine that, as of yet, HIV testing rates among Canadian university students are not meeting the guidelines recommended by the Public Health Agency of Canada.(22) In addition, this is the first study to investigate a wide variety of variables that are known to be connected to STI testing, HIV testing, and health care utilization in university students as potential correlates of HIV testing (32,36,60,67). As almost all these variables, with the exception of religion and perceptions of peer sexual risk taking , were found to be significantly associated with HIV testing in at least one risk and biological sex stratified subgroup, this study has identified new potential covariates – specifically sexual health knowledge and attitudinal barriers to help seeking - that should be included in future analyses of STI testing rates in university populations overall and within biological sex- and risk-based subpopulations.

HIV testing rates were poor across all subgroups; however, in performing analyses stratified on both biological sex and risk, we were able to determine that health promotion may be most effective at increasing lifetime HIV testing when targeting younger, heterosexual students with campaigns designed to increase general sexual health knowledge and self-awareness of risk of acquisition; these interventions would likely be effective at increasing STI

testing rates in those most at-risk of undiagnosed STI (due to risky vaginal intercourse) while still benefiting the remaining sexually active student population.

In summary, this exploratory study is a first step towards identifying predictors of and barriers to HIV testing in higher risk vaginally sexually active university students. This type of analysis has been suggested by previous authors investigating student use of health care services and until now, has not been explored in the scientific literature (30,61,76). This study contributes to the literature by identifying potential associations to be explored in future longitudinal studies and in studies designed to generate higher response rates. The findings from this study also provide an awareness of the factors associated with never being tested for HIV, and could help in developing targets for health promotion campaigns and guiding health care workers in identifying those patients most in need of health teaching, testing, and other preventative measures.

**Table 4.1** Characteristics of the study population (n=7,346), stratified by student sex and risk of acquisition.

| | Higher Risk | | Lower Risk | |
|---|---|---|---|---|
| | **Male** | **Female** | **Male** | **Female** |
| | Population Mean or Proportion (n=326) | Population Mean or Proportion (n=881) | Population Mean or Proportion (n=1716) | Population Mean or Proportion (n=4423) |
| **Total †** | 6.5 (5.7 – 7.2) | 9.6 (9.0 – 10.3) | 35.0 (33.7 – 36.4) | 48.9 (47.5-50.2) |
| **Age*** | 21.6 (21.3-22.9)[¥] | 20.8 (20.6-21.1) | 21.4 (21.2-21.6)[¥] | 21.1 (21.0-21.2) |
| **Year of Study**** | | | | |
| First | 17.7 (13.3 – 22.0) | 22.0 (19.1 – 25.0) | 23.0 (20.8 – 25.1) | 22.9 (21.6 – 24.2) |
| Second | 23.1 (18.1 – 28.2) | 26.8 (23.7 – 30.0) | 21.5 (19.4 – 23.6) | 21.4 (20.0 – 22.7) |
| Third | 20.5 (15.7 – 25.3) | 21.7 (18.5– 24.9) | 21.8 (19.6 – 24.0) | 22.2 (20.8 – 23.5) |
| Fourth | 30.4 (24.8 – 35.9)[£] | 20.6 (17.6 – 23.6) | 23.0 (20.7 – 25.2) | 24.4 (23.0 – 25.8)[£] |
| Other (>Fourth) | 8.3 (4.9 – 11.8) | 8.8 (6.7 – 11.0) | 10.8 (8.9 – 12.6) | 9.1 (8.2 – 10.1) |
| **Not Caucasian**** | 8.5 (5.3 – 11.8) | 7.0 (5.1 – 8.8) | 11.8 (10.1 – 13.4) | 7.3 (6.5 – 8.2) |
| **Not Heterosexual **** | 1.5 (0.1 – 2.9)[£] | 8.4 (5.8– 10.9) | 5.5 (4.3 – 6.7) | 6.6 (5.8 – 7.5) |
| **Religion Important**** | 15.5 (11.1 – 19.9) | 21.7 (18.5 – 24.9)[¥] | 22.7 (20.5 – 25.0)[£] | 28.3 (26.8 – 29.8)[£,¥] |
| **Living Arrangements**** | | | | |
| Student Residence | 18.8 (14.5 – 23.2) | 20.2 (17.2 – 23.3) | 21.9 (19.8 – 24.0) | 21.0 (19.7 – 22.2) |
| Alone | 7.7 ( 4.3 – 11.1) | 8.4 (6.3 – 10.6) | 8.0 (6.5 – 9.5) | 6.3 (5.5 – 7.1) |
| Roommate(s) | 50.3 (44.3 – 56.3) | 43.3 (39.7 – 46.9) | 33.4 (30.9 – 35.9) | 31.4 (29.9 – 32.9) |
| Romantic Partner | 6.1 (3.3 – 8.9) | 7.1 (5.2 – 9.1) | 15.1 (13.2 – 17.0)[£] | 19.2 (17.9 – 20.5)[£] |
| Parent(s) | 17.1 (12.3 – 21.9) | 20.9 (18.0 – 23.9) | 21.7 (19.5 – 23.8) | 22.1 (20.8 – 23.4) |
| **Had Non-Consensual Sex**** | 6.0 (2.9 – 9.1)[£] | 12.2 (9.4 – 14.9)[£,¥] | 1.6 (0.9 – 2.2) | 6.9 (6.0 – 7.8)[¥] |
| **Heavy Alcohol and/or Marijuana Use** | | | | |
| Neither | 13.6 (9.4 – 17.8) | 25.5 (22.4 – 28.7) | 37.3 (34.7 – 39.8) | 48.3 (46.7 – 49.9) |
| Either | 73.7 (68.5 – 79.0)[£,¥] | 68.1 (64.7 – 71.5)[£] | 55.4 (52.8 – 58.0)[¥] | 49.1 (47.5 – 50.7) |
| Both | 12.6 (8.8 – 16.5)[£,¥] | 6.4 (4.7 – 8.0)[£] | 7.3 (5.9 – 8.7)[¥] | 2.5 (2.0 – 3.0) |
| **Higher Self-Perceived Risk**** | 18.8 (14.0 – 23.5)[£] | 18.6 (15.8 – 21.4)[£] | 5.4 (4.2 – 6.6) | 4.1 (3.4 – 4.7) |
| **Perceived Peer Sexual Risk Taking *** | 26.1 (25.4-26.8)[£,¥] | 21.8 (21.4-22.2)[£] | 22.2 (21.9 – 22.5)[¥] | 19.5 (19.3 - 19.7) |
| **Sexual Health Knowledge Score*** | 7.4 (7.1-7.7)[£] | 9.0 (8.9 – 9.2)[£,¥] | 6.9 (6.8-7.0) | 8.7 (8.6 – 8.8)[¥] |
| **Barriers to Help Seeking Score*** | 24.7 (24.0-25.4)[¥] | 23.2 (22.8-23.6)[£] | 23.9 (23.6 – 24.3)[¥] | 22.6 (22.4– 22.8) |
| **At-Risk of Depression**** | 27.9 (22.7 – 33.2) | 43.6 (40.0 – 47.3)[£,¥] | 27.7 (25.3 – 30.1) | 35.1 (33.6 – 36.6)[¥] |
| **Never Tested for HIV **** | 77.5 (71.9 – 83.0) | 78.5 (74.9 – 82.2) | 87.4 (85.4 – 87.4)[£] | 93.3 (91.9 – 94.6)[£,¥] |

* Mean of strata (95% CI)

** Proportion of strata (95% CI)

†Proportion of total study population (95% CI)

[£] Significantly higher ($p<0.05$) when comparing higher risk males to lower risk males or higher risk females to lower risk females

[¥] Significantly higher ($p<0.05$) when comparing higher risk males to higher risk females or lower risk males to lower risk females

**Table 4.2 Adjusted logistic regression of never having been tested for HIV among higher risk males on** demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=326).

| Covariates of Interest | Model 1 – Unadjusted for University[¥] | Model 2 – Adjusted for University[£] |
|---|---|---|
| Age | **0.80 (0.73 , 0.88)*** ** | **0.81 (0.69 , 0.96)*** |
| Not Caucasian | 1.44 (0.41 , 5.12) | 1.29 (0.25 , 6.73) |
| Not Heterosexual | 0.04 (0.001 , 1.22) | **0.03 (0.00 , 0.54)*** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 0.68 (0.14 , 3.39) | 0.64 (0.15 , 2.69) |
| · Third | 1.22 (0.22 , 6.68) | 1.04 (0.22 , 4.92) |
| · Fourth | 1.15 (0.23 , 5.80) | 0.99 (0.24 , 4.16) |
| · Other | 0.66 (0.16 , 2.76) | 0.68 (0.09 , 5.37) |
| Religion Important | 0.81 (0.30 , 2.20) | 0.72 (0.25 , 2.09) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | **0.25 (0.08, 0.79)*** | **0.10 (0.02 , 0.59)*** |
| · Roommate(s) | **0.38 (0.17 , 0.84)*** | **0.21 (0.05 , 0.80)*** |
| · Student Residence | 1.03 (0.22 , 4.74) | 0.70 (0.16 , 2.99) |
| · Romantic Partner | 1.37 (0.43 , 4.43) | 1.38 (0.26 , 7.38) |
| Had Non-Consensual Sex | 0.53 (0.13 , 2.20) | 0.50 (0.07 , 3.72) |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 3.39 (0.92 , 12.50) | **3.63 (1.23 , 10.73)*** |
| · Both | 2.66 (0.57 , 12.32) | 2.09 (0.52 , 8.38) |
| Higher Self-Perceived Risk | 1.84 (0.48 , 7.08) | 2.00 (0.60 , 6.69) |
| Perceived Peer Sexual Risk Taking | 1.00 (0.98 , 1.03) | 1.01 (0.94 , 1.08) |
| Sexual Health Knowledge Score | 0.85 (0.68 , 1.07) | **0.84 (0.72 , 0.98)*** |
| Barriers to Help Seeking Score | 0.96 (0.87 , 1.05) | 0.99 (0.93 , 1.06) |
| At- Risk of Depression | 2.19 (0.49 , 9.78) | **2.59 (1.00 , 6.68)*** |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

**Table 4.3 Adjusted logistic regression of never having been tested for HIV among higher risk females on** demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=881).

| Covariates of Interest | Model 1 – Unadjusted for University[¥] | Model 2 – Adjusted for University[£] |
|---|---|---|
| Age | **0.79 (0.73 , 0.87)*** ** | **0.78 (0.69 , 0.87)*** ** |
| Not Caucasian | **0.61 (0.40 , 0.95)*** | 0.65 (0.29 , 1.45) |
| Not Heterosexual | **0.48 (0.29 , 0.78)**** | **0.45 (0.24 , 0.84)*** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 1.40 (0.57 , 3.42) | 1.33 (0.68 , 2.61) |
| · Third | 1.35 (0.65 , 2.84) | 1.31 (0.62 , 2.78) |
| · Fourth | 0.65 (0.31 , 1.35) | 0.71 (0.35 , 1.44) |
| · Other | 1.24 (0.63 , 2.43) | 1.23 (0.47 , 3.21) |
| Religion Important | 1.11 (0.66 , 1.87) | 1.15 (0.67 , 1.97) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 0.28 (0.05 , 1.61) | **0.27 (0.11 , 0.67)**** |
| · Roommate(s) | 0.73 (0.31 , 1.70) | 0.58 (0.27 , 1.22) |
| · Student Residence | **0.34 (0.15 , 0.79)*** | **0.28 (0.12 , 0.65)**** |
| · Romantic Partner | 0.62 (0.15 , 2.66) | 0.58 (0.20 , 1.39) |
| Had Non-Consensual Sex | 0.67 (0.39 , 1.16) | 0.70 (0.39 , 1.26) |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 1.26 (0.86 , 1.84) | 1.20 (0.73 , 1.99) |
| · Both | 1.12 (0.64 , 1.97) | 0.96 (0.36 , 2.60) |
| Higher Self-Perceived Risk of STI | 0.74 (0.48 , 1.13) | 0.75 (0.45 , 1.26) |
| Perceived Peer Sexual Risk Taking | 0.98 (0.95 , 1.01) | 0.98 (0.94 , 1.02) |
| Sexual Health Knowledge Score | 0.93 (0.84 , 1.03) | 0.93 (0.83 , 1.04) |
| Barriers to Help Seeking Score | 1.03 (0.98 , 1.09) | **1.05 (1.00 , 1.09)*** |
| At- Risk of Depression | 0.76 (0.55 , 1.05) | 0.74 (0.47 , 1.17) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

**Table 4.4** Adjusted logistic regression of never having been tested for HIV among lower risk males on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=1716).

| Covariates of Interest | Model 1 – Unadjusted for University[¥] | Model 2 – Adjusted for University[£] |
|---|---|---|
| Age | **0.80 (0.75 , 0.85)*** ** | **0.79 (0.73 , 0.85)*** ** |
| Not Caucasian | **0.49 (0.24 , 0.98)*** | **0.48 (0.29 , 0.80)**** |
| Not Heterosexual | **0.37 (0.18 , 0.74)**** | **0.34 (0.18 , 0.63)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 0.82 (0.29 , 2.26) | 0.83 (0.46 , 1.50) |
| · Third | 1.34 (0.49 . 3.69) | 1.38 (0.73 , 2.60) |
| · Fourth | 0.89 (0.45 , 1.78) | 0.95 (0.52 , 1.72) |
| · Other | 0.71 (0.35 - 1.43) | 0.79 (0.39 , 1.60) |
| Religion Important | 0.77 (0.55 , 1.06) | 0.78 (0.51 , 1.20) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 1.07 (0.52 , 2.18) | 1.21 (0.55 , 2.63) |
| · Roommate(s) | 0.88 (0.49 , 1.59) | 1.00 (0.55 , 1.80) |
| · Student Residence | 0.92 (0.58 , 1.44) | 1.04 (0.55 , 1.97) |
| · Romantic Partner | 2.03 (0.79 , 5.18) | 2.33 (1.09 , 4.99) |
| Had Non-Consensual Sex | 0.77 (0.51 , 1.17) | 0.76 (0.22 , 2.67) |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 1.03 (0.81 , 1.32) | 1.05 (0.69 , 1.61) |
| · Both | 0.86 (0.58 , 1.28) | 0.88 (0.44 , 1.75) |
| Higher Self-Perceived Risk | **0.47 (0.38 , 0.59)*** ** | **0.45 (0.23 , 0.87)*** |
| Perceived Peer Sexual Risk Taking | 0.97 (0.94 , 0.99) | 0.97 (0.93 , 1.00) |
| Sexual Health Knowledge Score | 0.93 (0.84 , 1.03) | **0.92 (0.86 , 0.99)*** |
| Barriers to Help Seeking Score | 1.00 (0.98 , 1.02) | 1.00 (0.97 , 1.03) |
| At- Risk of Depression | 0.76 (0.51 , 1.14) | 0.77 (0.52 , 1.16) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

**Table 4.5** Adjusted logistic regression of never having been tested for HIV among lower risk females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI) (n=4423).

| Covariates of Interest | Model 1 – Unadjusted for University[¥] | Model 2 – Adjusted for University[£] |
|---|---|---|
| Age | **0.77 (0.74 , 0.79)*** ** | **0.77 (0.73 , 0.81)*** ** |
| Not Caucasian | **0.49 (0.34 , 0.71)*** ** | **0.52 (0.35 , 0.76)*** ** |
| Not Heterosexual | **0.62 (0.41 , 0.92)*** | **0.62 (0.44 , 0.88)**** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 1.11 (0.79 , 1.55) | 1.09 (0.77 , 1.56) |
| · Third | 1.35 (0.98 , 1.86) | 1.36 (0.93 , 1.99) |
| · Fourth | 1.42 (0.95 , 2.13) | **1.42 (1.01 , 2.01)*** |
| · Other | 1.38 (0.71 , 2.71) | 1.39 (0.89 , 2.16) |
| Religion Important | 0.93 (0.70 , 1.24) | 0.91 (0.71 , 1.16) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 0.82 (0.54 , 1.24) | 0.76 (0.47 , 1.25) |
| · Roommate(s) | 0.89 (0.60 , 1.31) | 0.81 (0.57 , 1.15) |
| · Student Residence | 1.02 (0.73 , 1.44) | 0.93 (0.61 , 1.43) |
| · Romantic Partner | 0.93 (0.72 , 1.19) | 0.88 (0.61 , 1.28) |
| Had Non-Consensual Sex | 0.67 (0.44 , 1.02) | **0.63 (0.43 , 0.91)*** |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 1.01 (0.65 , 1.56) | 1.03 (0.81 , 1.31) |
| · Both | 0.74 (0.47 , 1.18) | 0.73 (0.40 , 1.33) |
| Higher Self-Perceived Risk | **0.39 (0.27 , 0.56)*** ** | **0.39 (0.25 , 0.60)*** ** |
| Perceived Peer Sexual Risk Taking | **0.96 (0.95 , 0.97)*** ** | **0.96 (0.94 , 0.98)*** ** |
| Sexual Health Knowledge Score | **0.86 (0.82 , 0.89)*** ** | **0.85 (0.80 , 0.91)*** ** |
| Barriers to Help Seeking Score | 1.02 (1.00 , 1.04) | 1.02 (1.00 , 1.04) |
| At- Risk of Depression | 0.84 (0.70 , 1.01) | 0.86 (0.67 , 1.09) |

*p<0.05
** p<0.01
*** p<0.001
[¥] University intraclass correlation corrected for using the 'cluster' command
[£] University included in the model as a control variable

# CHAPTER 5. CONCLUSION

In this study, we examined the prevalence and potential covariates of STI and HIV testing in a large study population of vaginally sexually active Maritime university students (age 17-29). We found that more than half of students have never been tested for STI and over 85% had never been tested for HIV; indicating that the Public Health Agency of Canada recommendation for STI and HIV testing in all sexually active individuals has likely not yet been achieved among Maritime undergraduate students (10,22). Students at higher risk of STI acquisition due to risky vaginal sexual behaviour were more likely to be tested, but testing rates among these individuals was still low. Of the 1207 students more at-risk of STI acquisition, 78% had never been tested for HIV and 56% had never been tested for any other STI. Efforts should be made to normalize testing in higher risk sexually active populations; 'Seek and Treat' initiatives like those being used to improve HIV diagnosis and treatment among at-risk individuals in British Columbia, Canada have been shown to be cost-effective testing strategies to normalize testing among higher risk populations and reduce the overall burden of disease in the population (109,110).

Using a wide variety of variables that are known to be connected to STI testing, HIV testing, and health care utilization in university students as potential correlates of both STI and HIV testing (32,36,60,67), we were able to define targets for health promotion that may be effective at increasing both lifetime STI and HIV testing among Maritime university students. STI testing was closely correlated with HIV testing, reflecting previous findings that indicate that STI testing is a correlate of HIV testing (36,57), and several of the potential facilitators of or barriers to identified in this study were common to both STI and HIV testing procedures. Younger age and lower sexual health knowledge were found to be factors associated with both a lack of STI testing and a lack of HIV testing across a majority of the biological sex- and risk-based subgroups. Higher risk perception of STI (including HIV) was associated with both STI and HIV testing in the lower risk subgroups only; likely due to the inaccuracy of risk perception in the higher risk groups. As such, campaigns targeting younger students designed to increase general sexual health knowledge and self-awareness of risk of STI (including HIV) would likely be effective at increasing both STI testing and HIV testing rates.

Having been forced to have sex of any kind while at university was not significantly associated with ever having accessed STI or HIV testing in higher risk females. It is likely that many high risk females did not report their sexual assaults and, as such, did not access post-assault STI and HIV screening programs. Attitudinal barriers to help seeking (i.e., believing that asking for help is a sign of weakness) could be closely related to psychosocial variables, like fear, shame, and stigma, known to affect post-abuse health services use and as such may be a potential mediator of this relationship in females specifically. However, all analyses of potential interaction effects between attitudinal barriers to help seeking and forced sex were not significant for either the STI or HIV testing outcome variable. In the literature, shame, stigma, and fear have been shown to affect use of post-abuse health services, but these data were not collected as part of the Maritime University Health Survey and therefore these variables were unaccounted for in the analyses for this study (92,93). It is possible, therefore, that these variables could also have explained the lack of association between forced sex and STI and HIV testing among the higher risk females in this study population. These findings indicate that improved effort may also need to be made to make post-abuse counseling and testing services more accessible to all students, especially those experiencing forced sex while at university.

Previous studies have shown that STI and HIV testing services must be accessible to users both physically (i.e., convenient location and hours of operation, affordable, preferred gender of health practitioner available) and psychologically (i.e., no fear of confidentiality breach or judgement) at both the individual- and regional-level (72,93). In this study, we accounted for regional- and individual-level variation in both the physical and psychological accessibility of STI and HIV testing by controlling for university attended, depression risk and attitudinal barriers to help seeking (i.e., believing that asking for help is a sign of weakness). Being at-risk of depression was associated with reduced odds of HIV testing among higher risk males. Attitudinal barriers to help seeking were associated with reduced odds of STI testing among females and reduced odds of HIV testing among high-risk females. Interactions between attitudinal barriers to help seeking and other variables where an association was expected but not observed (e.g. forced sex or sexual health knowledge and STI or HIV testing in high-risk females) were not statistically significant, therefore, the mechanism by which attitudinal barriers to help seeking act as a barrier to STI and HIV testing in the female subpopulations but not the male populations remains unclear.

In this study, the impact of controlling for the regional-effects of university attended are demonstrated in the models, but associations between the specific characteristics of the services offered at each university were not explored. Identifying facilitators of or barriers to health care services access, like STI or HIV testing, requires investigation along multiple dimensions of access, including: availability (i.e. services offered), accessibility (i.e., location), accommodation (i.e., hours of operation), affordability (i.e., costs versus insurance coverage), and acceptability (related to client attitudes about providers and/or provider attitudes about clients) (111). Future studies aiming to improve the health services at the participating universities could look at these differences between universities and their association with STI and HIV testing accessibility to identify community-, university- or clinic-level areas for improvement.

In summary, this exploratory study is a first step towards identifying predictors of and barriers to STI and HIV testing in higher risk vaginally sexually active university students. This type of analysis has been suggested by previous authors investigating student use of health care services and until now, has not been explored in the scientific literature (30,61,76). This study contributes to the literature by identifying potential associations to be explored in future longitudinal studies and in studies designed to generate higher response rates. The findings from this study also provide an awareness of the factors associated with never being tested for STI or HIV, and could help in developing targets for health promotion campaigns and guiding health care workers in identifying those patients most in need of health teaching, testing, and other preventative measures. Future studies looking at testing behaviours in those at higher risk of STI based on sexual risk behaviour should include all forms of intercourse in their definition of risk to identify potential covariates common across all sexual orientations.

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# **APPENDIX A.** UNADJUSTED LOGISTIC REGRESSION OF NEVER BEING TESTED FOR STI

**Table A.1** Unadjusted logistic regression of never being tested for an STI among higher risk males and females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI).

| Covariates of Interest | Males at Higher Risk of STI (n=326) | Females at Higher Risk of STI (n=881) |
|---|---|---|
| Age | **0.81 (0.72 , 0.92)**** | **0.79 (0.74 , 0.84)***** |
| Not Caucasian | 1.14 (0.52 - 2.48) | 0.85 (0.59 - 1.23) |
| Not Heterosexual | **0.17 (0.03 , 1.13)** | **0.65 (0.34 , 1.22)** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | **0.56 (0.19 , 1.62)** | 0.86 (0.64 , 1.17) |
| · Third | **0.49 (0.17 , 1.44)** | **0.48 (0.28 , 0.84)*** |
| · Fourth | 0.41 (0.14 , 1.20) | **0.47 (0.26 , 0.85)*** |
| · Other | 1.63 (0.20 , 1.95) | **0.40 (0.18 , 0.90)*** |
| Religion Important | 1.02 (0.72 , 1.43) | 1.09 (0.69 , 1.74) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | 0.45 (0.12 , 1.75) | **0.35 (0.12 , 1.04)** |
| · Roommate(s) | 0.77 (0.33 , 1.79) | **0.66 (0.44 , 1.00)** |
| · Student Residence | 1.62 (0.49 , 5.36) | 1.01 (0.62 , 1.67) |
| · Romantic Partner | 1.26 (0.39 , 4.06) | **0.53 (0.27 , 1.02)** |
| Had Non-Consensual Sex | **0.23 (0.07 , 0.73)*** | 0.80 (0.36 , 1.77) |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 1.27 (0.75 , 2.14) | 0.91 (0.64 , 1.28) |
| · Both | 1.06 (0.61 , 1.86) | **0.72 (0.50 , 1.04)** |
| Higher Self-Perceived Risk | **0.84 (0.64 , 1.10)** | **0.67 (0.48 , 0.93)*** |
| Perceived Peer Sexual Risk Taking | 0.99 (0.95 , 1.02) | 0.99 (0.96 , 1.02) |
| Sexual Health Knowledge Score | **0.87 (0.80 , 0.95)**** | **0.83 (0.75 , 0.90)***** |
| Barriers to Help Seeking Score | 0.99 (0.94 , 1.05) | **1.03 (1.00 , 1.05)*** |
| At- Risk of Depression | 1.30 (0.71 , 2.30) | 1.03 (0.74 , 1.44) |

*p<0.05
** p<0.01
*** p<0.001
Bolded values = p<0.2

**Table A.2** Unadjusted logistic regression of never being tested for an STI among lower risk males and females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI).

| Covariates of Interest | Males at Lower Risk of STI (n=1716) | Females at Lower Risk of STI (n=4423) |
|---|---|---|
| Age | **0.85 (0.79 , 0.90)*** ** | **0.78 (0.74 , 0.82)*** ** |
| Not Caucasian | 1.25 (0.88 - 1.79) | 0.99 (0.56 - 1.74) |
| Not Heterosexual | **0.49 (0.26 , 0.92)*** | **0.62 (0.49 , 0.78)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | **0.60 (0.31 , 1.18)** | **0.71 (0.60 , 0.84)*** ** |
| · Third | **0.63 (0.39 , 1.02)** | **0.49 (0.41 , 0.58)*** ** |
| · Fourth | **0.42 (0.26 , 0.67)*** ** | **0.34 (0.29 , 0.41)*** ** |
| · Other | **0.40 (0.29 , 0.55)*** ** | **0.26 (0.19 , 0.35)*** ** |
| Religion Important | 1.05 (0.83 , 1.32) | **1.30 (1.18 , 1.44)*** ** |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | **0.47 (0.30 , 0.75)**** | **0.39 (0.28 , 0.53)*** ** |
| · Roommate(s) | **0.51 (0.41 , 0.63)*** ** | **0.58 (0.44 , 0.77)*** ** |
| · Student Residence | 0.89 (0.61 , 1.29) | **1.73 (1.24 , 2.41)**** |
| · Romantic Partner | 0.53 (0.34 , 0.82)** | **0.52 (0.41 , 0.67)*** ** |
| Had Non-Consensual Sex | **0.43 (0.25 , 0.74)**** | **0.39 (0.25 , 0.61)*** ** |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | **0.78 (0.60 , 1.02)** | **0.84 (0.76 , 0.93)*** ** |
| · Both | **0.57 (0.28 , 1.17)** | **0.43 (0.31 , 0.60)*** ** |
| Higher Self-Perceived Risk | **0.27 (0.18 , 0.42)*** ** | **0.37 (0.27 , 0.50)*** ** |
| Perceived Peer Sexual Risk Taking | 0.99 (0.96 , 1.01) | **0.98 (0.96 , 0.99)**** |
| Sexual Health Knowledge Score | **0.88 (0.83 , 0.94)*** ** | **0.78 (0.77 , 0.80)*** ** |
| Barriers to Help Seeking Score | 1.00 (0.98 , 1.02) | **1.02 (1.00 , 1.03)*** |
| At- Risk of Depression | **0.84 (0.66 , 1.07)** | 0.97 (0.91 , 1.03) |

*p<0.05
** p<0.01
*** p<0.001
Bolded values = p<0.2

# **APPENDIX B.** UNADJUSTED LOGISTIC REGRESSION OF NEVER BEING TESTED FOR HIV

**Table B.1.** Unadjusted logistic regression of never being tested for HIV among higher risk males and females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI)

| Covariates of Interest | Males at Higher Risk of STI (n=326) | Females at Higher Risk of STI (n=881) |
|---|---|---|
| Age | **0.80 (0.74 , 0.87)*** ** | **0.78 (0.73 , 0.85)*** ** |
| Not Caucasian | 1.54 (0.43 , 5.49) | **0.50 (0.27 , 0.93)*** |
| Not Heterosexual | 0.15 (0.01 , 1.58) | **0.37 (0.19 , 0.72)**** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | **0.38 (0.21 , 0.70)**** | 1.30 (0.58 , 2.90) |
| · Third | **0.45 (0.23 , 0.90)*** | **0.84 (0.74 , 0.96)*** ** |
| · Fourth | **0.37 (0.16 , 0.86)*** | **0.52 (0.28 , 0.96)*** |
| · Other | **0.21(0.09 , 0.51)*** ** | **0.71 (0.46 , 1.09)** |
| Religion Important | 0.73 (0.35 , 1.54) | 0.87 (0.40 , 1.90) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | **0.20 (0.05 , 0.81)*** | **0.21 (0.04 , 1.14)** |
| · Roommate(s) | **0.41 (0.17 , 0.98)*** | 0.63 (0.26 , 1.53) |
| · Student Residence | 1.15 (0.16 , 8.03) | **0.46 (0.15 , 1.38)** |
| · Romantic Partner | 0.71 (0.10 , 4.82) | **0.39 (0.10 , 1.55)** |
| Had Non-Consensual Sex | 0.52 (0.18 , 1.53) | **0.53 (0.26 , 1.07)** |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | **3.00 (1.72 , 5.23)*** ** | **1.31 (0.91 , 1.89)** |
| · Both | **3.01 (1.72 , 5.24)** | 1.33 (0.59 , 3.00) |
| Higher Self-Perceived Risk | 1.14 (0.50 , 2.60) | **0.71 (0.49 , 1.03)** |
| Perceived Peer Sexual Risk Taking | 1.00 (0.98 , 1.03) | 0.98 (0.94 , 1.03) |
| Sexual Health Knowledge Score | **0.83 (0.69 , 1.00)*** | 0.95 (0.84 , 1.08) |
| Barriers to Help Seeking Score | 1.00 (0.95 , 1.05) | 1.00 (0.98 , 1.03) |
| At- Risk of Depression | 1.58 (0.57 , 4.43) | 0.84 (0.57 , 1.25) |

*p<0.05
** p<0.01
*** p<0.001
- Bolded values = p<0.2

**Table B.2** Unadjusted logistic regression of never being tested for HIV among lower risk males and females on demographic, behavioral, and psychosocial correlates (Odds Ratios and 95% CI).

| Covariates of Interest | Males at Lower Risk of STI (n=1716) | Females at Lower Risk of STI (n=4423) |
|---|---|---|
| Age | **0.82 (0.76 , 0.88)*** ** | **0.77 (0.76 , 0.79)*** ** |
| Not Caucasian | **0.47 (0.31 , 0.72)*** ** | **0.49 (0.33 , 0.74)*** ** |
| Not Heterosexual | **0.33 (0.18 , 0.59)*** ** | **0.47 (0.31 , 0.73)*** ** |
| Year of Study | | |
| · First | 1.0 | 1.0 |
| · Second | 0.78 (0.35 , 1.75) | 0.95 (0.71 , 1.25) |
| · Third | 1.05 (0.44 , 2.47) | 0.86 (0.61 , 1.21) |
| · Fourth | **0.62 (0.40 , 0.95)*** | **0.67 (0.45 , 0.99)*** |
| · Other | **0.49 (0.30 , 0.78)**** | **0.49 (0.32 , 0.76)**** |
| Religion Important | **0.74 (0.50 , 1.11)** | 0.88 (0.64 , 1.20) |
| Living Arrangements | | |
| · Parent(s) | 1.0 | 1.0 |
| · Alone | **0.51 (0.29 , 0.90)*** | **0.41 (0.27 , 0.62)*** ** |
| · Roommate(s) | **0.64 (0.38 , 1.10)** | **0.72 (0.44 , 1.18)** |
| · Student Residence | 0.97 (0.56 , 1.70) | **1.47 (1.04 , 2.10)*** |
| · Romantic Partner | 0.92 (0.37 , 2.33) | **0.51 (0.42 , 0.61)*** ** |
| Had Non-Consensual Sex | **0.43 (0.21 , 0.87)*** | **0.44 (0.28 , 0.69)*** ** |
| Heavy Alcohol and/or Marijuana Use | | |
| · Neither | 1.0 | 1.0 |
| · Either | 1.08 (0.89 , 1.30) | 1.15 (0.85 , 1.56) |
| · Both | **0.69 (0.44 , 1.07)** | **0.60 (0.39 , 0.94)*** |
| Higher Self-Perceived Risk | **0.27 (0.19 , 0.37)*** ** | **0.34 (0.21 , 0.54)*** ** |
| Perceived Peer Sexual Risk Taking | **0.99 (0.96 , 1.00)** | **0.97 (0.96 , 0.98)*** ** |
| Sexual Health Knowledge Score | **0.94 (0.87 , 1.01)** | **0.83 (0.81 , 0.85)*** ** |
| Barriers to Help Seeking Score | **0.98 (0.97 , 1.00)*** | 1.00 (0.99, 1.02) |
| At- Risk of Depression | **0.67 (0.48 , 0.94)*** | **0.79 (0.68 , 0.92)**** |

*p<0.05
** p<0.01
*** p<0.001
- Bolded values = p<0.2