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The Association between Heavy Episodic Drinking and Alcohol-Related Unsafe Sex among Canadian Undergraduate Student Drinkers

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A thesis submitted in partial fulfillment of the requirements for the Master of Science degree in Epidemiology and Biostatistics

THE ASSOCIATION BETWEEN HEAVY EPISODIC DRINKING AND ALCOHOL-RELATED UNSAFE SEX AMONG CANADIAN UNDERGRADUATE STUDENT DRINKERS

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Abstract

Young adults who engage in risky sexual behaviours are placing themselves at risk for serious health problems. This study assessed the extent of alcohol-related unsafe sex among Canadian undergraduate students and examined the association between unsafe sex and heavy episodic drinking as well as drinking motives, drinking locations, age when they first drank alcohol, and illicit drug use. Data were obtained from the 2004 Canadian Campus Survey (N = 4,437). Logistic regression and modified Poisson regression was used to examine associations with unsafe sex. The proportion of students reporting having had unsafe sex was estimated to be at 7.37%. Heavy episodic drinking (RR = 1.609, 95% CI = 1.240 - 2.088), marijuana (RR: 2.204, 95% CI: 1.683 - 2.887) and illicit drug use (RR: 3.397, 95% CI: 2.519 - 4.580) were found to be significantly associated with unsafe sex. These findings can have important implications for the development of interventions.

Keywords

Unsafe sex, sexual risk talking, risky sexual behaviour, condoms, heavy episodic drinking, binge drinking, alcohol, drug usage, young adults, students

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Chapter 1

1 Introduction

Risky sexual behaviour can be defined as any type of sexual activity that would increase one's risk of sexually transmitted infection (STI) or increase one's risk of becoming pregnant (Cooper, 2002). Current data tend to suggest that students who engage in heavy drinking also report engaging in more risky sexual behaviours. Risky sexual behaviour may be exacerbated by alcohol consumption as alcohol impairs one's judgment and may decrease the likelihood of using condoms (Davis et al., 2014). Unsafe sex is preventable; however, this requires an in-depth understanding of the factors that influence alcohol use and risky sexual behaviours in order to develop effective prevention initiatives. The association between alcohol and unsafe sex has previously been examined; however few studies have examined the heavy pattern of alcohol consumption that is prevalent among young adults. More importantly, a knowledge gap still remains concerning other factors associated with unsafe sex, in particular, drinking motives and drinking locations.

The aim of this present study is to determine the extent of alcohol-related unsafe sex behaviour among Canadian undergraduate university students and examine the associations between unsafe sexual behaviour and heavy episodic drinking (HED) as well as other explanatory factors for unsafe sex, including drinking motives and drinking locations, age when they first drank alcohol and illicit drug use. Data for the present study were obtained from the 2004 Canadian Campus Survey (CCS), a cross-sectional survey of undergraduate students from universities across Canada. Data from 4,437 students were analyzed using statistical techniques including logistic regression with backward elimination and modified Poisson regression. These results can be considered in the development of intervention initiatives and may inform future research on factors related to unsafe sex among university students.

This thesis is presented over the course of 5 chapters: chapter 2 provides a critical examination of the literature and the study objectives; chapter 3 describes the study

methods and analytic techniques; chapter 4 reports the results of the analyses; and chapter 5 concludes with a discussion of the study findings and directions for future research.

Chapter 2

2 Literature Review

2.1 Risky Sexual Behaviour: A Public Health Problem

Risky sexual behaviour includes unprotected sexual activity or inconsistent use of condoms, having sex with high-risk partners (e.g. injection drug users), early sexual debut, and sex with multiple partners or with a partner who has other partners (Cho & Span, 2010). While risky sexual behaviour can be broadly defined, this literature review will focus on unprotected sexual activity as it is the most widely used definition in the literature.

Risky sexual behaviour is associated with numerous health problems. Potential consequences of risky sexual behaviour include immediate and long-term consequences. Immediate consequences can be STIs such as Chlamydia that can be curable; but risky sexual behaviour can also have long term consequences that can affect individual's quality of life or cause mortality, this can include unwanted pregnancies, Human Immunodeficiency Virus (HIV) and Human Papillomavirus Virus (HPV) which can lead to cervical cancer (Calvert, Keenan Bucholz, & Steger-May, 2010; Mamo & Epstein, 2014).

HIV is a global public health issue affecting 34 million people worldwide (World Health Organization, 2013). In Canada, an estimated 71,300 people were infected with HIV/AIDS in 2011, an increase of 11.4% from 2005 (Public Health Agency of Canada, 2013b). The proportion of HIV infections attributed to heterosexual contact in 2011 was 32.6% (Public Health Agency of Canada, 2013a). As well, reported rates of syphilis have increased 456.7% (0.9 to 5.2 per 100,000) from 2001 to 2010 (Public Health Agency of Canada, 2013b). Rates of Chlamydia have also increased significantly in the past ten years; in 2010, the reported rate of Chlamydia in Canada was 277.6 per 100,000 whereas in 2000 the rate was 161.4 per 100,000 (Public Health Agency of Canada, 2013b). In addition, young Canadians have the highest reported rates of STIs (Public Health Agency of Canada, 2013b) and accounted for 24% of new HIV diagnoses in 2012 (CATIE,

2013). These recent statistics highlight the fact that there is a need to reduce levels of sexual risk.

By continuing to engage in risky sexual behaviours, young adults are placing themselves at risk for serious health problems. Yet despite public health efforts designed to reduce the rate of STIs (McKay, 2000), it has only increased (Public Health Agency of Canada, 2013b; Public Health Agency of Canada, 2013a; CATIE, 2013). Therefore, it is important to identify behaviours that can decrease the likelihood of engaging in unprotected sex. Evaluating risk factors of risky sexual behaviour in young adults is critical for developing prevention programming to prevent the spread of HIV and STIs as well as unplanned pregnancies. The present study will look at factors associated with risky sexual behaviour among young adults, with a focus on the role of alcohol use.

2.2 Alcohol Use and Risky Sexual Behaviour

Alcohol has been found to have adverse effects on sexual decision-making; research shows that intoxicated individuals are more likely to report intentions of engaging in risky sexual behaviours than their sober counterparts (Davis, Hendershot, George, Norris, & Heiman, 2007; Rehm, Shield, Joharchi, & Shuper, 2012). As well, many people accept as true that alcohol reduces inhibitions and promotes risky sexual behaviour. Ven and Beck (2009) collected "drinking stories" from 466 university students and found that university students viewed alcohol as a disinhibitor that increases the potential for sexual intercourse and is even used as a reason to justify the occurrence or prospective occurrence of sexual events. Alcohol use has also received considerable attention from researchers who often cite the use of alcohol as a contributing factor in risky sexual behaviour (Cooper, 2006). Over 600 studies in the past 20 years have been conducted on this association (Cooper, 2006) and in light of the dramatic increases in STI rates (Public Health Agency of Canada, 2013b; Public Health Agency of Canada, 2013a; CATIE, 2013), the investigation of this relationship has become increasingly important. For example, a study by Patrick (2013) found that binge drinking was associated with a greater likelihood of engaging in penetrative sex in the same day. Similarly, a study by

Wells, Kelly, Golub, Grov, and Parsons (2010) found that individuals who reported binge drinking were six times more likely to report sexual intercourse after consuming alcohol than those who did not binge drink (OR = 6.04, 95% CI = 2.89–12.59).

A primary concern is that individuals are making decisions about sexual behaviours while intoxicated (see Section 2.6 Alcohol Myopia). According to a study conducted by Maisto et al. (2004), men who were intoxicated exhibited poorer condom use negotiation skills than men who were sober. Consuming alcohol can also lead to engaging in sexual activity with a casual partner where discussion of risk information would be limited or completely omitted (Cooper, 2002). This can be especially important, as dishonesty in dating is quite common. According to Cochran and Mays (1990), 34% of male and 10% of female young adults reported lying to their partner in order to have sex, and 68% of males and 59% of females reported having more than one sexual partner that their sexual partner did not know about. When sex is intertwined with alcohol consumption, it may reduce an individual's capacity for assessing sexual health risks (Steele & Josephs, 1990).

2.3 University Student Populations

The focus of this research is on young adults attending university because they report the highest levels of alcohol consumption and frequently engage in sexual activity. The sexual health of young adults warrants attention as many students are living for the first time without any parental supervision and many may view this as an opportunity for increased experimentation, including sexual experimentation. When adolescents enter university and college, they are at risk of developing alcohol related problems because they are entering an environment where their peers consume alcohol and alcohol consumption is viewed as part of the socialization process (Prendergast, 1994). According to Statistics Canada, in 2012, 31.1% of Canadian young adults reported drinking five or more drinks on one occasion, at least once a month, in the past year (Statistics Canada, 2012). This level of consumption (i.e., five or more drinks per occasion) has been defined as “binge drinking” or heavy episodic drinking and has been

found to be related to many negative consequences experienced by young people (Weschler & Nelson, 2001).

Young adulthood also marks a period of increased sexual exploration. According to the Canadian Community Health Survey (CCHS), 66% of young adults, aged 15 to 24, reported having sexual intercourse at least once (Rotermann, 2012). Sexual experience becomes common by age 20, with 91% of males and females reporting being sexually active (Mosher, Chandra, & Jones, 2005). The majority of young adults aged 18 to 24 reported having multiple, serial sexual partners (Seidman & Rieder, 1994) and thus may not see condom use as important because of the misperception that they are not at risk of contracting STIs/HIV from their partner (Rotermann & McKay, 2009). According to data from the Canadian Community Health Survey Cycle 3.1 (CCHS 3.1), condom use was more prevalent among 15-17 year olds than 18-19 year olds (Rotermann, 2008). As well, 4.6% of 15 to 24 year olds who reported having sex at least once in their lives reported being diagnosed with an STI (Jayaraman, Klar, Ivanovic, & Fang, 2012). This figure may be an underrepresentation of the actual rate of infection as some young adults may not experience symptoms or may not be aware of the infections (Rotermann, 2005). And since correct and consistent condom use is needed as an effective method of preventing sexually transmitted disease and unplanned pregnancy, it is disconcerting that 30% of those aged 15 to 24 had not used a condom the last time they had intercourse (Jayaraman, et al., 2012).

Given the high rate of alcohol consumption and binge drinking and low rates of condom use among university students, it is plausible that an association between alcohol and risky sexual behaviour exists. Encouraging safer sex is a central part of preventative care that should be offered at all health centers in universities. Additionally, it is highly important for researchers to identify the factors associated with engaging in risky sexual behaviour subsequent to alcohol consumption in order to reduce the harmful risks. Current interventions assume that young adults are in a state of rational decision-making in sexual encounters, however, when sexual encounters are coupled with alcohol consumption, the decision-making process is impaired and as such the decisions made are likely not rational.

2.4 Measuring Heavy Episodic Drinking

Heavy episodic drinking (HED) or "binge drinking" is characterized by the consumption of a large quantity of alcohol in a short time frame (Olthuis, Zamboanga, Ham, & Van Tyne, 2011). The Canadian Centre on Substance Abuse (CCSA) has developed a national set of low-risk alcohol drinking guidelines, together with an expert panel advisory including federal, provincial, and territorial health ministers and respected organizations (Canadian Centre on Substance Abuse, 2012). The guidelines were created to help Canadians moderate their alcohol consumption and reduce immediate and long-term alcohol-related harm. According to these guidelines, men should not consume more than four drinks and women should not consume more than three drinks on any single occasion (Canadian Centre on Substance Abuse, 2012). This definition is also applied in population-based research, with the most widely used criteria for binge drinking across research studies is four or more drinks for women and five or more drinks for men (Wechsler, Dowdall, Davenport, & Castillo, 1995). Also of note, the 5/4 definition of binge drinking showed a high degree of sensitivity and specificity as an indicator of at-risk drinking (Fillmore & Jude, 2011).

The 5/4 definition has advantages in ease of calculation; however, there has been some debate on what should actually be the threshold for predicting negative consequences of binge drinking (Lange & Voas, 2001). Some researchers argue that the 5/4 drink standard does not take into account body weight and height or duration of consumption which could mean that some drinkers may not even reach the level of 0.08g/L blood alcohol content threshold (Chavez, Nelson, Naimi, & Brewer, 2011; Lange & Voas, 2001). However, when examining the 5/4 definition against the .08% definition, Fillmore and Jude (2011) found that the .08% definition only detected half of at risk-drinkers according to the Alcohol Use Disorders Identification Test (AUDIT), which is based on the Diagnostic and Statistical Manual of Mental Disorders (DSM), and that the total quantity of drinks per occasion was better at assessing risk in an individual. Other researchers argue that the 5/4 definition is based on a relatively low threshold and may not adequately capture at risk drinkers; therefore, a number of researchers have suggested

taking into account how often people engage in binge drinking (i.e., binge drinking frequency; Wen, Balluz, & Town, 2012; Stickley, Koyanagi, Koposov, Razvodovsky, & Ruchkin, 2013) in addition to simply capturing whether or not a person has engaged in binge drinking.

2.5 Differences: American and Canadian Studies

There are several important factors that need to be taken into consideration when assessing past literature on alcohol consumption and risky sexual behaviour. Little is known about how universally widespread this association is. Though there has been extensive research conducted on this association in the United States, only a handful of studies have examined this effect in Canada. Therefore, most sections of this literature review covering alcohol use and risky sex in university aged students have come almost exclusively from US college populations with an absence of published research from Canadian populations. Because of the similarities between US and Canadian students, these findings are still relevant; however there are significant differences that must be considered between the two nations.

One important consideration is the legal drinking age. In the US the legal drinking age across the country is 21 whereas the legal drinking age in Canada is 18 in Quebec, Manitoba and Alberta, and 19 in the rest of the country. Though underage drinking is rampant in both countries, Canada's lower drinking age could mean that there is a larger proportion of students consuming alcohol in Canadian as compared to American university campuses; that is, differences in drinking age could lead to differences in drinking behaviour when comparing the two countries. Plunk, Cavazaos-Rehg, Bierut, and Grucza (2013) investigated changes in the minimum legal drinking age laws in the 1970s and 1980s in the United States and found that states with permissive drinking laws, where people were able to purchase alcohol before the age of 21, were significantly associated with more frequent binge episodes compared with states where the minimum drinking age was 21 (OR = 1.15, 95% CI = 1.04 -1.28).

Furthermore, what is usually used in research to quantify alcohol consumption is the standard drink size, which differs in US and Canada, thus making comparisons across countries difficult. In the US, the standard drink contains 14g of ethanol, whereas in Canada a standard drink is 13.6g (ICAP, 2013). Furthermore, drinking guidelines differ in the two countries. The US drinking guidelines are as follows: no more than 1 drink per day (14g) for women and 2 drinks a day (28g) for men (Centers for Disease Control and Prevention, 2013). In Canada, the drinking guidelines are: no more than 2 drinks a day (27.2g) for women and 3 drinks a day (40.8g) for men (Centre for Addiction and Mental Health, 2011). This too can lead to differences between US and Canadian populations in terms of drinking behaviour and drinking consequences.

And lastly, more university-age Canadian youth (52%) than university-age US youth (15.1%) live at home with their parents while in university (Kuo et al., 2002). Students who live with a parent are less likely to engage in binge drinking compared to students who live in residence (OR = 1.27, 95% CI = 1.05 – 1.56) and students who live off-campus without parents (OR = 1.36, 95% CI = 1.13-1.65) (Kuo et al., 2002). Students who live with their parents may also be less likely to engage in risky sexual behaviour because they are under the watchful eye of their parents. These differences represent a need for research to be conducted on a Canadian student sample.

2.6 Theoretical Model

Alcohol Myopia Theory and Alcohol Expectancy Theory provide a theoretical backdrop for how alcohol consumption could influence sexual behaviour. The Alcohol Myopia Theory emphasizes the pharmacological effect of alcohol whereas the Expectancy Theory emphasizes alcohol's psychological effects (Cho & Span, 2010).

Alcohol Myopia

It is a popular assumption that alcohol acts as a disinhibitor which causes individuals to become more socially assertive, impulsive, outgoing, aggressive or hypersexual. All of these represent wide-ranging and contradicting behaviours and emotions. The Alcohol

Myopia Theory, developed by Steele and Josephs (1990), explains how alcohol can have varying and irregular effects on an individual. Steele and Josephs (1990) assert that alcohol causes the individual to only focus on certain cues in the environment, usually those cues that are most salient and immediate to them. An environment contains two types of cues; impelling cues emphasize the benefit of the behaviour whereas inhibiting cues emphasize the costs of the behaviour (Steele & Josephs, 1990). Impelling cues are more immediate and apparent than inhibiting cues. When an individual is consuming alcohol, alcohol's pharmacological properties limits cognitive capacity and narrows the range of cues one is able to perceive. The individual then does not process all incoming relevant information which leads them to only attend to the most salient cues rather than distal cues (Steele & Josephs, 1990). This leaves the individual to succumb to momentary pressures. While a sober individual would be able to weigh both types of cues, an intoxicated individual focuses more on impelling cues, such as sexual arousal, and less on relevant inhibiting cues, such as risk of sexually transmitted infection (MacDonald, Fong, Zanna, & Martineau, 2000a). This creates a myopic effect (a cognitive shortsightedness), which influences an individual's behaviour by only processing cues that are "close" or more salient in his or her environment rather than focusing on the consequences of their intended action (Morris & Albery, 2001). Therefore, alcohol may cause people to engage in risky sexual behaviour even when it would contradict their personal values and attitudes while sober (MacDonald et al., 2000a).

Alcohol Expectancy Theory

Alcohol Expectancy Theory highlights the roles of individual beliefs of alcohol effects and comes as a result of a social learning process. Individuals learn from perceived appropriate behaviour while intoxicated (Morris & Albery, 2001). Alcohol intoxication itself does not lead to these behaviours but rather varies as a function of individual beliefs about alcohol's effects. A person's beliefs can have a powerful effect on behaviour. As an example, in a sexual situation, if an individual expects heightened sexual disinhibition and increased sexual relations when drinking then the individual will adapt their behaviour accordingly (Morris & Albery, 2001). The mere belief that one is drinking can lead to sexual inhibition. One of the reasons cited by university students for consuming

alcohol was that there was an expectation that it would increase sexual drive and lessen sexual anxiety (Abbey, McAuslan, Ross, & Zawacki, 1999). The way an individual will behave while drinking will be determined by their beliefs about the effects of alcohol (Morris & Albery, 2001).

2.7 Associations with Risky Sexual Behaviour

The present study will examine the association between alcohol-related unsafe sex and HED as well as secondary variables of interest: reasons for drinking, drinking location, age of first intoxication, drug use, engaging in campus activities, gender and age. Although alcohol use has been examined extensively in previous literature, relatively less is known regarding drinking motives and the influence of drinking environment on unsafe sex.

2.7.1 Primary Explanatory Variable: Alcohol Use

Although, as mentioned above, risky sexual behaviour has been more broadly defined, the main type of unsafe sex that has received considerable attention in literature is unprotected sex, or not using a condom, as it directly affects STI risk. Studies on the association between alcohol consumption and condom use have been mixed. However, these studies have some methodological problems that need to be addressed. One example of such a study is Nikula, Gissler, Jormanainen, Sevon, & Hemminki's (2009) study on 10, 446 male Finnish youth. Condom use was assessed as a dichotomous variable (yes/no) and frequency of alcohol consumption was assessed as: less than once a month, once a month, once a week, and more than once a week. Results showed that alcohol had a strong dose-contingent relationship with non-use of condoms. Drinking once a week (OR = 1.59, 95% CI = 1.10-2.30) and more than once a week (OR = 1.60, 95% CI = 1.07 - 2.40) was associated with non-use of condoms compared to never drinking (Nikula et al., 2009). Though this study assessed frequency of alcohol use, no information was available as to how much alcohol was consumed on each occasion. As well, the results may not be generalizable to young adult females as Nikula et al's (2009) only included male participants.

Gilchrist, Smith, Magee, and Jones's (2012) study on 253 female Australian university students found that single-episode heavy drinking (six or more drinks) was related to not using condoms after consuming alcohol within the past 30 days and having negative sexual experiences (e.g. regretted sex, rape). However, researchers used a non-random sample of participants which limits the generalizability of findings.

Certain, Harahan, Saewyc, and Fleming (2009) compared 1,715 heavy drinking undergraduates who always used condoms versus those who used condoms less than always. Binge drinking was defined as consuming four or more drinks for women and five or more drinks for men. A variable for maximum consumption risk was divided into three categories. Low risk was defined as less than 4 drinks for women and less than 5 drinks for men per day, moderate risk was defined as 4-6 drinks for women and 5-7 drinks for men and high risk was defined as 7 or more drinks for women and 8 or more drinks for men. Researchers found that frequency of binge drinking and maximum consumption risk were not significantly associated with reduced condom use (Certain, Harahan, Saewyc, & Fleming, 2009). However, since the study mostly included heavy drinking students (62%) these findings cannot be generalized to other populations. As well, the study did not account for marital status differences.

Individual studies vary considerably in the method used to understand this association, including the experimental manipulation of Blood Alcohol Content (BAC). A Canadian study of 358 university males, by MacDonald, MacDonald, Zanna and Fong (2000b), randomly assigned participants into three conditions: sober, placebo, and intoxicated (BAC .08%mg). The study excluded participants who did not use condoms regularly in order to eliminate bias from participants who would have never used condoms in the first place. The participants then watched a video about a male and female character that meet and express a desire to engage in sexual intercourse only to find out that no condom is available (the female character is on birth control in order to prevent fears of pregnancy). Participants later expressed their intent to engage in unprotected sex as the characters in the video through a questionnaire. Highly aroused participants in the intoxicated condition reported stronger intentions of engaging in unprotected sex than those who

were highly aroused in the placebo condition (MacDonald et al., 2000b). Similar findings were found for studies including women and men (Davis et al., 2009).

As well, Fromme, D'Amico, and Katz (1999) randomly assigned 161 participants to different beverage conditions (alcohol with peak target BAC of .08 mg%, active placebo, and no alcohol) and completed a questionnaire about the negative consequences of unprotected sex. Results showed that intoxicated participants reported lower perceptions of risk during sex and fewer negative consequences than those in the active placebo and no alcohol group (Fromme et al., 1999). As well, Rehm et al. (2012) conducted a meta-analysis on 12 experimentally controlled studies of alcohol consumptions and intentions to engage in unprotected sex. All studies involved a manipulation BAC and incorporated a measure to test intentions of unprotected sex. Rehm at al. (2012) found that a BAC increase of 0.1mg/ml led to a 5.0% (95% CI: 2.8-7.1%) greater likelihood of engaging in unprotected sex. This demonstrates that a higher BAC led to a greater intention of engaging in unprotected sex. However, the main limitation of these studies is that they only assessed intentions to use condoms rather than actual condom use behaviour therefore conclusions cannot be made about the likelihood of engaging in sexual behaviour.

Diary studies have also been used to examine the association between alcohol consumption and condom use. Schroder, Johnson, and Wiebe (2009) used daily self-reports to analyze condom-protected intercourse in 15 women and 17 men. Participants noted the date and time drinking and sexual encounters occurred and whether sexual encounters co-occured with alcohol consumption. The study found no main effect of alcohol use on safer sex. However, the study's greatest limitation is its small sample size. Since sample size is tied to statistical power, undersized studies may not be able to detect a statistically significant difference when there truly is one (Eng, 2003). Furthermore, researchers did not differentiate between "heavy" drinkers and "light" drinkers which could severely affect the relationship between condom use and alcohol use prior to intercourse.

Finally, Leigh et al. (2008) collected information on alcohol use and sexual behaviour for eight weeks from 178 college students at a sexually transmitted disease clinic. Results indicated that condom use was not significantly associated with drinking prior to intercourse (Leigh et al., 2008). However, results should be viewed cautiously as the sample size was modest and as with the previous study, alcohol consumption was analyzed as a dichotomous variable (drinking prior to sex vs. not drinking prior to sex) which does not encompass all levels of alcohol impairment.

2.7.2 Additional Known Risk Factors

Even though previous studies have given considerable attention to binge drinking behaviours and sexual risk behaviours, there is still a need to bring a sharper focus to the understanding of this relationship. The current study will explore individual (e.g. age at first intoxication) and situational (e.g. location of drinking) factors that appear to be related to alcohol use and/or sexual risk taking and therefore may be important to study when examining this relationship. The following variables have rarely been examined in terms of their relative explanatory roles for sexual risk behaviour in the context of a single investigation and may hold clinical significance for reducing HIV and STIs caused by sexual risk behaviours.

2.7.2.1 Reasons for Drinking

Reasons for drinking have been found to be associated with alcohol use and negative drinking consequences (Gmel, Labhart, Fallu, & Kuntsche, 2012; Kuntsche, & Labhart, 2013; LaBrie, Ehret, Hummer, & Prenovost, 2012) and therefore may be an important variable to consider when examining unsafe sex. For example, a person who drinks to add enjoyment to a meal may not exhibit sexual risk behaviours as someone who drinks to forget his or her worries. However, only one study was found that examined the relationship between drinking motives and unsafe sex. Abdala et al. (2013) investigated drinking motives and their association with unprotected sex in STD clinic patients in Russia. Neither drinking to enhance one's mood (e.g. "it helps me when I feel depressed") nor drinking to facilitate sex (e.g. "to create a romantic mood for my relationship") were associated with unprotected sex. Though this study adds insight into individual drinking

motives and their association with unprotected sex, the study only included adult patients attending an STD clinic and therefore the results may not be generalizable to non-patients or to the young adult population.

2.7.2.2 Location of Drinking

Drinking setting has also been suggested as a significant explanatory factor for risky sexual behaviour. Individuals who are seeking sexual experiences may choose certain venues over others (Bersamin, Paschall, Saltz, & Zamboanga, 2012). These settings may be known to have a "sexual atmosphere" and attract individuals looking to engage in sexual behaviour. If this is the case then it would be expected that venues such as bars and clubs would be associated with risky sexual behaviour whereas drinking in other settings, such restaurants or other public places, may not be associated with such behaviour. Bars and clubs are known for being associated with high levels of alcohol consumption and for having a "sexual atmosphere" where individuals can find sexual partners. According to Wall, McGee, Hinson and Goldstein's (2001) theory of situation-specificity, alcohol consumption varies as a function of the physical setting. Behavioural outcomes that individuals expect to occur as a consequence of drinking are elicited when the individuals encounter environmental cues. This principle works just the same as memory which can be retrieved when individuals reencounter cues that were present at the time of their encoding. Different cues from each unique environment then influence drinking behaviours. In the same way, risky sexual behaviours may differ based the specific drinking location (Bersamin et al., 2012).

Studies that have looked at this association have generally found positive results; however, there are some issues with these studies that prompt the need for further investigation into the association between risky sexual behaviour and drinking setting. A study conducted by Bersamin et al. (2012) of 7,414 undergraduate students in California examined students' drinking behaviour, sexual activity, and their frequency of attending different venues over the course of the semester. Sexual intercourse with a stranger while under the influence of alcohol was most likely to occur at a fraternity party (OR = 10.09, 95% CI = 4.54 - 22.4), residence hall (OR = 4.96, 95% CI = 2.10 - 11.67) and parties off-campus (4.92, 95% CI = 2.23 - 10.86) compared to outdoor setting like parks or beaches

(Bersamin et al., 2012). There was a lack of association between frequenting restaurants and bars and sexual intercourse with a stranger which was unexpected given the high levels of alcohol consumption at bars. The authors theorize that this may be due to the fact that most US undergraduate students are underage and cannot legally enter these establishments (Bersamin et al., 2012). However, this null effect may be explained by the fact that the researchers pooled together into the same category, restaurants, where risky behaviour may be less likely to occur, and bars, where risky behaviour would be expected to occur thus cancelling out any effects bars may have on sexual behaviour in their analysis. It is important to note that this study does not focus on whether the students engaged in unsafe sexual practices but rather only asks whether they had sexual intercourse; thus requiring further investigation on whether drinking location has effects on unsafe sexual practices.

Staras, Maldonado-Molina, Livingston, and Komro (2012) analyzed sexual partner meeting venues and risky sexual behaviour among 1,656 Chicago adolescents. The researchers found that most adolescents met their sexual partner at school but that men and women who reported having unprotected sex, met their partners in public places (such as a bar, nightclub or on the street) versus school (OR=1.7 and 1.9 respectively, 95% CI=1.0 - 2.7 and 1.1-3.4) (Staras et al., 2012). A limitation of this study was that it was only conducted on adolescents and it is expected that results would differ for young adults as they are legally allowed to be admitted into drinking establishments. As well, the study did not establish whether participants were more likely to have unprotected sex as a result of alcohol availability in public venues.

In addition to drinking establishments, alcohol consumption can also take place in fraternity and sorority houses (Campbell, 2013; Hechinger & Glovin, 2013). Some universities have even taken action to ban active participation of fraternities and sororities on campus due to the negative aspects and continued risks of these organizations (Arthurs, 1990). Research has shown that students who belong to fraternities and sororities consume more alcohol than their peers (Gullette & Lyons, 2006). Affiliation with these organizations may also increase a student's sexual risk behaviours due to the role of alcohol in initiation events and its central role in socialization processes. One

reason for this association may be due to young adults, who are already engaging in risk behaviours, self-selecting themselves into these organizations or it may be due to the organization as a whole having an influence on its members (Scott-Sheldon, Carey, & Carey, 2008). A study by Scott-Sheldon et al. (2008) on 1,595 university students reported on their membership with Greek organizations (yes/no) and frequency of engaging in binge drinking and unprotected sex in the past three months. Members of Greek organizations were more likely to consume alcoholic beverages (OR = 1.46) and engage in binge drinking (OR = 2.52) than non-members of Greek organizations (Scott-Sheldon et al., 2008). However, even though members of Greek organizations were more likely to have sex under the influence of alcohol than non-members (OR = 2.07), no differences were found between members of Greek organizations and non-members in using protective measures (always using birth control or condoms) (Scott-Sheldon, et al., 2008). It should be noted that many students may still participate in fraternity and sorority events even without membership and thus it would be important to add to the research by inquiring about participation in fraternity and sorority events rather than membership.

Additional research is needed to test these hypotheses and explore how drinking settings influence sexual behaviour. These findings complement studies focusing on individual risk for unsafe sexual behaviour and will be useful in establishing targeted interventions by identifying which drinking locations need to be targeted to reach students who are most at risk for risky sexual behaviour.

2.7.2.3 Age at First Intoxication

Early initiation into drinking has been associated with heavier drinking later in life, becoming dependent, and having alcohol-related health and social problems due to intoxication (Connor, Gray, & Kypri, 2010; Hingson, Heeren, Winter, & Wechsler, 2003). Grant and Dawson's (1997) study using 27,616 respondents from the National Longitudinal Alcohol Epidemiology Survey found that those with the earliest onset of alcohol were most at risk of alcohol abuse. Researchers found that the odds of dependence decreased by 14% and the odds of abuse decreased by 8% with each yearly delay in the onset of alcohol consumption (Grant & Dawson, 1997). These adolescents

then reach university with already established harmful drinking patterns and experience greater drinking problems because of the unrestrained environment on campus (Connor, et al., 2010). As well, adolescents' who are involved in one risk behaviour are likely to engage in other risk behaviours as well (Calvert et al., 2010).

A study by Hingson et al. (2003) surveyed 11,730 university students about their drinking habits as adolescents and their use of condoms since the beginning of the school year. The researchers found that of those first intoxicated before the age of thirteen were twice as likely to have unplanned sex and 2.2 times more likely to have unprotected sex compared to those who had not been drunk until the age of nineteen (Hingson et al., 2003). This association persisted even after for controlling for first cigarette and first marijuana use (Hingson et al., 2003). In addition, Calvert et al.'s (2010) cross-sectional analysis examined the relationship between early alcohol use and risky sexual behaviours in 809 adolescents. They found that early onset drinkers (first full drink at or before age 12) were 5.8 times more likely to have sex without using a condom than non-drinkers, and 1.6 times more likely to have sex without a condom than late-onset drinkers (first full alcoholic drink over the age of 12) (Calvert et al., 2010). As an explanation for this association, the authors posit that individuals who are first drunk at an earlier age may be greater risk-takers in general or have an impulsive personality (Calvert et al., 2010; Hingson et al., 2003).

2.7.2.4 Drug Use

Heavy drug use has also been associated with risky sexual behaviour. Recreational drugs such as cannabis, ecstasy, and cocaine have become part of socializing and have even been used to enhance sexual experience (Lee & Levounis, 2008). However, due to its positive association with cognitive dysfunction (Enevoldson, 2004) and mental confusion, it has lead individuals to make poor decisions in sexual situations and unable to negotiate for safe sex (Lee & Levounis, 2008). A cross-sectional analysis on 20,858 young adults aged 18-22 by Wu, Ringwalt, Patkar, Hubbard and Blazer (2009) found that students who used both alcohol and drugs were more likely to report an STD in the past year (AOR = 11.6) than individuals who did not use either of those substances. As well, a study on university students by Simons, Maisto and Wray (2010) found that students

using marijuana weekly were more likely to report having unprotected sex and engage in intercourse that they later regretted. Similarly, Lowry et al. (1994) found that high school students who used of marijuana, cocaine or other illicit drugs were more likely than those who had not used these substances to report having had more than four sexual partners and not having used a condom at their last intercourse.

2.7.2.5 Engaging in Campus Activities

Limited research has been conducted on participation in campus activities. In a study of 1,210 university students on the differences in risk behaviours between athletes and non-athletes, male athletes were significantly more likely to consume alcohol and less likely to use a condom at last intercourse than male non-athletes, whereas female athletes were significantly less likely to consume alcohol and more likely to use a condom at last intercourse than female non-athletes (Kokotailo, Henry, Koscik, Fleming, & Landry, 1996). Even though the study had quite a large sample size, a convenience sample was used which could bias the results of the study. Additionally, other than athletics, very little attention has been paid to other campus activities including: campus parties, political associations, and religious groups which are variables that are included in the present study. Documenting campus activities associated with unsafe sex may be useful for developing early intervention programs designed for university campuses to reduce these high risk behaviours.

2.7.2.6 Gender

Past research on alcohol use and risky sexual behaviour has mainly focused on women with many studies only including female participants in their sample. There are important implications for only focusing on females; women are more vulnerable to STI transmission than men due to physiological differences and therefore they have a higher risk of contracting STIs (CATIE, 2009). Women between the ages of 20 and 24 have the highest reported rates of Chlamydia, more than seven times the overall national rate (Public Health Agency of Canada, 2013b).Women in Canada are also twice as likely than men to contract Chlamydia (Public Health Agency of Canada, 2010) and 1.5 times more likely to contract genital herpes than men (Rotermann, Langlois, Severini, & Totten,

2013). Furthermore, research shows that women are less likely than men to purchase condoms, often citing reasons of embarrassment (Lewis, Logan, & Neighbors, 2009). Since women do not "use" male condoms they must either insist or convince their male partner to use a condom or refrain from sex in order to avoid potential health risks (Norris et al., 2009). In addition, women may have the added pressure from their significant other to not use condoms if they fear that their partner will become angered or reject them (Testa & Collins, 1997). Contributing to the complexity of the situation is the fact that men and women are making decisions about unsafe sex when they are sexually aroused (Norris et al., 2009). In this respect, women are at a disadvantage when it comes to choosing to have safer sex.

Most studies have cited these reasons for their exclusive focus on female participants, however, research on women cannot be generalized to men and there are important reasons to expand the focus of this research to men. Though both genders might benefit from the sexual pleasures and intimacy of sex, studies show that men perceive more benefits than costs of having sex whereas women perceive more negative consequences than benefits (Cooper, 2006). Men are more likely than women to report having more lifetime sexual partners, more casual sex, and have greater permissive attitudes towards sex in general (Randolph, Torres, Gore-Felton, Lloyd, & McGarvey, 2009).

In terms of alcohol use, studies often cite women's lowered metabolic absorption of alcohol for their exclusive focus on women. Women have less body water than men of similar body weight so that when men and women of similar body weight drink equal amounts of alcohol, women will absorb 30% more alcohol in their bloodstream (National Institutes of Health, 2000). Thus, women will feel the effects of intoxication more rapidly than men. However, studies have shown that women do eliminate significantly more alcohol per unit of lean body mass by the hour than men (Mumenthaler, Taylor, O'Hara, & Yesavage, 1999) which could mean that women recover quicker from cognitive impairment. Additionally, men consume greater amounts of alcohol and experience more negative consequences when drinking than do women (Lewis, Litt, Cronce, Blayney, & Gilmore, 2012). Men are also more likely to binge drink than women (Kuo et al., 2002). These aforementioned differences could lead to differences in results for men and women

in the prevalence of risky sexual behaviour and the association of alcohol with risky sexual behaviour.

Hittner and Kennington (2008) examined gender differences in their study on 410 undergraduate university students. Students completed a questionnaire on 30-day substance use and frequency of engaging in sexual intercourse without a condom. The researchers found that undergraduate males reported significantly more episodes of unprotected sex when drinking or getting high compared to females (Hittner & Kennington, 2008).

In addition, of the studies that have sampled both men and women, very few analyses have examined gender differences in the link between alcohol use and risky sexual behaviour. Labrie, Schiffman and Earleywine (2002) examined the role of alcohol expectancies on condom use in 563 university students in the US. Participants reported on the frequency of alcohol use in the past 6 months as well as their intentions of using condoms in the future while under the influence of alcohol (using a Likert Scale: 1 = Never to 5 = Always). Researchers found that there were differing gender pathways in the relationship between alcohol and condom use intentions. For men but not for women, drinking was associated with lower intentions to use a condom (LaBrie et al., 2002). One issue with this study however is that, as was previously mentioned, intentions may not predict actual behaviour.

2.7.2.7 Age

Few studies have focused on the relationship between age and unsafe sex. Young adults enter university, most unfamiliar with the negative outcomes of alcohol. Many new relationships form while in university and many students may be untrained in negotiating condom use. Decreasing condom use with age has been attributed to easier access to birth control (Sayegh, Fortenberry, Shew, & Orr, 2006). A study of 483 American college women by Walsh Fielder, Carey, and Carey (2013) examined the changes in condom use across first year college students. Participants completed monthly online assessments for one year and reported on the frequency of which they practiced safe sex after consuming alcohol. Participants decreased their condom use across the first year of college. Even

though initial levels of condom use did not differ for binge and non-binge drinkers, women were more likely to decrease their condom use over time if they had reported binge drinking prior to the school year (Walsh et al., 2013). Similar results were found by Bailey, Fleming, Catalano, Haggerty, and Manhart (2012) study in which increased age was associated with a decline in contraception use regardless of relationship status.

2.7.3 Control Variables

2.7.3.1 Marital/Cohabitation Status

Marriage marks a time of key role transitions and involves changes in attitudes and behaviours. Marriage has been found to have a protective influence on risk behaviours (Stein, Nyamathi, Ullman, & Bentler, 2007). Married individuals have been observed to be less at risk for sexually transmitted diseases than their single counterparts (Stuart & Hinde, 2010). Many studies looking at the association between alcohol consumption and unsafe sex have controlled for marital status in their analysis (Graves & Leigh 1995; Hingson et al., 2003; Bailey et al., 2012). A study conducted by Carroll et al. (2007) found that in young adults, being close to marital horizons compared to looking to get married later in life was negatively associated with sexual permissiveness and frequency of substance use. The institution of marriage possesses implicit and explicit obligations and individuals who are not married may desire to obtain a wide range of experiences before settling down into their adult life responsibilities (Arnett, 2000). Research has also shown that eschewing risky behaviour is also associated with cohabitation status. Cohabitating individuals, similar to married individuals, exhibited fewer risk behaviours (e.g. have more sexual problems, having sexually transmitted diseases etc.) than their single counterparts (Stuart & Hinde, 2010). In addition, the protective influence of marriage has been found to fade once individuals divorce as previously married individuals resembled the single group in terms of risk behaviours (Stuart & Hinde, 2010).

2.8 Limitations of Existing Research and Contribution of Present Study

Despite a considerable number of studies having been conducted on the association between alcohol consumption and unsafe sex, there are several limitations that prompt the need for further research into this topic. Much of the research has primarily focused on adolescents rather than university students. Young adulthood represents a time of increased sexual exploration making it an ideal period to investigate the factors relating to unsafe sex. In addition, this study will improve upon the work of existing studies by assessing heavy episodic drinking (HED) rather than alcohol use vs. non-use to better understand the relationship between alcohol and engaging in unsafe sex.

As well, this study contributes to the literature by using responses collected from a large sample of university students to clarify associations between HED and unsafe sex. And lastly, most existing research has focused solely on alcohol consumption with limited focus on alcohol-related factors such as drinking motives and drinking settings. Few studies have explored this association in a multivariable analysis which provides a useful framework for exploring how multiple factors may be related to unsafe sex among young adults. This study will provide additional information on factors to target that will allow for the creation of more targeted intervention and prevention initiatives which, in turn, can help to reduce the increasing rates of STIs in Canada.

2.9 Theoretical conceptualization

The primary aim of this thesis is to assess the extent of alcohol-related unsafe sex among Canadian university students and to examine the association between alcohol-related unsafe sex and heavy episodic drinking as the primary explanatory variable as well as drinking motives, drinking location, drug use, age first intoxicated, campus activities, gender and age as secondary explanatory variables. Marital/cohabitation status will be controlled for in the analysis and gender will be assessed as an effect modifier in the association between heavy episodic drinking and unsafe sex. Figure 1 shows the theoretical conceptualization of the present study.

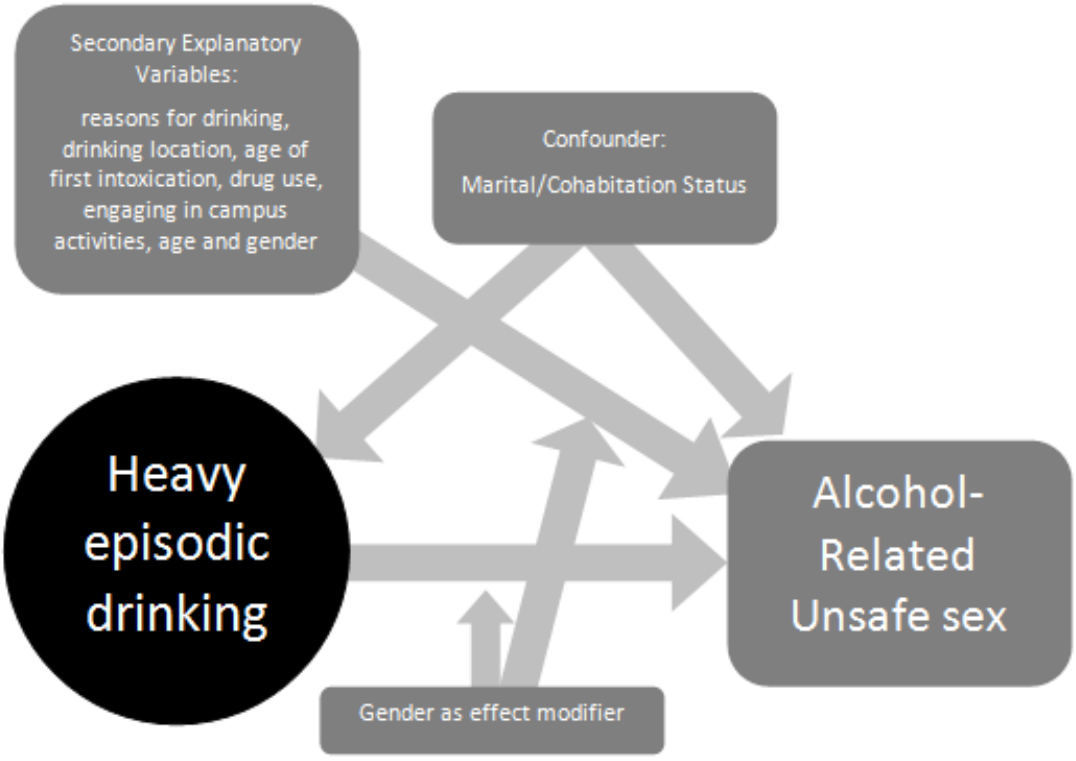

Figure 1. Theoretical conceptualization of unsafe sex in Canadian university students.

2.10 Thesis Objectives

The present thesis will focus on the following objectives:

Objective 1: To determine the extent of alcohol-related unsafe sex behaviour among undergraduate university students

Objective 2: Evaluate the associations between alcohol-related unsafe sexual behaviour and heavy episodic drinking, reasons for consuming alcohol, drinking location, age first intoxicated, illicit drug use, campus activities, gender, and age.

Objective 2.1: Examine unadjusted associations between alcohol-related unsafe sexual behaviour and heavy episodic drinking, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age.

Objective 2.2: Examine adjusted associations between alcohol-related unsafe sexual behaviour and heavy episodic drinking, and secondary explanatory variables while controlling for marital-cohabitation status.

Objective 2.3: Examine effect modification of gender by heavy episodic drinking and each of the secondary explanatory variables in relation to alcohol-related unsafe sex.

Chapter 3

3 Methods

The specific aims of this study were addressed using secondary data from the 2004 Canadian Campus Survey (CCS), a cross-sectional mail and online survey of 6,282 full-time university undergraduate students from universities across Canada. Funded by the Canadian Institutes of Health Research, the main goals of the CCS were to: 1) to understand the prevalence of alcohol and drug use as well as mental health and gambling problems and their association with student characteristics; 2) understand the environmental, social, and individual determinants of hazardous drinking; and 3) make comparisons with an earlier version of the survey that was distributed in 1998 to track changes over time in substance use patterns. The study was approved by the Research Ethics Boards (REB) of the Joint Centre for Addiction and Mental Health and University of Toronto and the University of Montreal as well as additional REBs at 15 universities that required separate approvals.

3.1 Participants

The target population for the CCS was young, full-time undergraduate students in the 2003-2004 academic year. The CCS employed a campus-stratified, single-stage selection of undergraduate students. The following set of inclusion criteria was applied to universities across Canada: (1) had a Registrar, (2) had more than 1000 full-time degree undergraduates, (3) had students physically attend classes (4) were publicly-funded, and (5) were non-military or non-theological. Online universities were excluded from the sample as the objective of the study was to assess the influence of campus climate on students.

Only undergraduate students were included in the study, except in the case where students were enrolled in professional schools (e.g. Law, Medicine etc.) but without an undergraduate degree. Part-time students were also excluded from the study as they

would not be as likely to spend a significant period of time on campus. At total of 350 students was then selected within each university with equal probability.

3.2 Exclusion Criteria

For the present analyses, participants were excluded from the study if they were age 26 or over. As discussed in the literature review, the aim of the present study was to focus on the young adult population as this age category is often marked by high levels of alcohol consumption and an increase in sexual exploration.

The present analyses were further restricted to participants who reported drinking alcohol in the past month. This restriction was necessary, as many variables that were pertinent to the present study, including drinking location and reasons for drinking, were only completed by participants who reported drinking in the previous month (79% of the total sample reported drinking at least once in the past month).

3.3 Data Collection

Subject recruitment took place in the spring of 2004. Permission was sought from each university to send out the questionnaire to students and obtain postal information. Postal addresses were used instead of university emails as not all enrolled students obtained university domain email accounts. A previous survey found that only 45% of undergraduate students utilized the University of Toronto email network as their primary Internet Service Provider and thus were less likely to participate (Freeman, 2003). The survey used a mixed-mode strategy, offering a web-based and mail-based survey. According to an experimental survey, mail versus web based questionnaires have not been shown to have any significant differences in terms of demographics, response rates, item completion and item completion errors among undergraduate students (Pealer, Weiler, Pigg, Miller, & Dorman, 2001).

In order to recruit participants, university and research staff were asked to generate a random sample of 350 students. On March 1st and 15th all students were mailed a package that included a cover letter describing the study goals with a link to the online questionnaire, and a paper copy of the questionnaire. Two reminder letters were also sent one week following each survey mailout. Data collection took place between March 1st to April 30th, 2004.

3.4 Questionnaire

The questionnaire was largely based on the 1998 Canadian Campus Survey (Gliksman, Demers, Adlaf, Newton-Taylor, & Schmidt, 2000) and Harvard's College Alcohol Student survey (Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998). The questionnaire consisted of 251 items covering six broad domains: alcohol consumption and patterns, heavy episodic drinking (HED), hazardous and harmful drinking, non-medical drug use, psychological distress, and gambling problems.

3.5 Ethical Considerations

An anonymous self-administered format was used due to the sensitive nature of the questions. Unique usernames and passwords were assigned to each student and used to enter the online questionnaire to ensure that participants' answers were identifiable only by PIN number and that each participant could only complete the survey once. Answers were completely confidential and participants could refuse to participate at any point in time. Respondents were assured that their participation would have no effect on their academic status.

3.6 Incentives

To increase participation, a lottery incentive was used. Students who completed their questionnaires by March 15th had a chance of winning one of two laptop computers. Students who completed their questionnaires by March 30th had a chance of winning one of six $500 cash prizes and one of ten $200 cash prizes.

3.7 Response Rate

In total, 69 campuses (64 universities) met the eligibility criteria and 45 campuses (40 universities) agreed to participate (63%) with 350 students randomly selected within each campus. Of the 15,353 questionnaires, 6,282 of them were deemed to be eligible (41%). The overall response rate including campus participation and student completion was 26.7%. As noted above, respondents over the age of 26 (689 respondents) and those who did not report drinking in the past month (1,133 respondents) were omitted from the final dataset. Therefore, the final total number of respondents used in the present analyses was 4,437.

3.8 Measures

3.8.1 Outcome Variable

3.8.1.1 Alcohol-Related Unsafe Sex

In the questionnaire, participants were given a list of 16 potential results of drinking and asked whether they had experienced these consequences since the beginning of the school year. To assess unsafe sex, participants were asked whether they "had unsafe sex because of drinking." Responses to this item were coded dichotomously (yes/no).

3.8.2 Primary Explanatory Variables

3.8.2.1 Heavy Episodic Drinking (HED)

HED was the primary explanatory variable of interest. The survey included the definition of one standard drink which was defined as one 341ml bottle of beer or cooler, or one 150ml glass of wine, or one mixed drink with 45ml of spirits, or one 341 ml beer, or wine or spirit cooler (not including alcoholic drinks with less than ½ percent alcohol or less). The survey asked "Now thinking about the last two weeks, how many times have you had four or more drinks in a row?" and "During the last two weeks, how many times have you had five or more drinks in a row?" The students were then given the following options to select from: "None", "Once", "Twice", "3 to 5 times", "6 to 9 times", or "10 or more times". These responses were used to measure HED frequency.

In accordance with the low-risk alcohol drinking guidelines discussed in the literature review, HED was defined as having consumed four or more drinks for females and five or more drinks for males. As such, a variable was computed based on the "four or more drinks" question for females and based on the "five or more drinks" question for males.

Drinking is often reported as a categorical or dichotomized variable to simplify the analysis and presentation of results (Certain et al., 2009; Nikula et al., 2009; Schroder et al., 2009). It is common to split variables at the median to form high and low groups. According to MacCallum, Zhang, Preacher, and Rucker (2002), justification for dichotomizing a variable may be given if a large number of observations are at the most extreme score, in this case, students who did not report HED in the past two weeks. Accordingly, the variable was dichotomized into two groups: those who did not report HED in the past two weeks and those who did report HED at least once in the past two weeks.

3.8.3 Variables of Secondary Interest

The secondary variables in the analysis are: reasons for consuming alcohol, drinking location, age of first drink, drug use, importance of campus activities, gender and age.

Marital status was examined as a potential confounder in the relationship between HED and unsafe sex.

3.8.3.1 Reasons for Consuming Alcohol

A portion of the survey was devoted to participants' three most recent drinking occasions, with detailed questions regarding type of occasion, drinking location, people present, and reasons for drinking. Participants were asked to think back to the last three occasions that they drank alcohol in the past month and for each occasion indicate an appropriate response. Reasons for consuming alcohol was assessed by the question: "Which was the most important reason for you to have consumed alcohol on this occasion?" with the following nine response options provided for each occasion: "to be sociable", "to add to the enjoyment of a meal", "to help me relax", "to forget my worries", "to feel less inhibited or shy", "to get high or drunk", "to celebrate", "to enjoy the taste", and "other". Only the responses for the most recent occasion were used in the analysis for ease of interpretation. As well, the nine options were grouped together into four broad categories in order to ensure a sufficient number of responses in each category: 1) coping motives (items "to help me relax" and "to forget my worries"); social motives (items "to celebrate"; "to be sociable"; "to feel less inhibited or shy"); 3) to get high or drunk (only one item "to get high or drunk"); and 4) enjoy meal/taste (items "to add to the enjoyment of a meal" and "to enjoy the taste" and "other").

3.8.3.2 Drinking Location

The drinking location variable was included in the section on the last three drinking occasions. It was assessed by the question "Where did most of the drinking take place?" As with Reasons for Drinking, participants had to think back to the last three occasions in which they drank alcohol in the past month and only the responses for the most recent occasion was used in the analysis. The participants were provided with the following six options to check off for each occasion: "Someone's home", "University residence", "Fraternity or sorority house", "A restaurant", "A bar/disco/pub/tavern", and "Other". The six options were grouped together into four broad categories in order to ensure a sufficient number of responses in each category: 1) Fraternity/university (items

"Fraternity and sorority house" and "University residence"); 2) Someone's home (one item "Someone's home"); 3) Bar/disco/pub/tavern (one item); and 4) Restaurant/other (items "restaurant" and "other").

3.8.3.3 Age First Intoxicated

The age that participants were intoxicated for the first time was assessed by means of the question: "How old were you the first time you were drunk?" Participants were provided with an empty box in which to specify the age at which they were intoxicated for the first time. The participants' responses were used to create a dichotomous variable for age when they were first intoxicated. Students were categorized as either "under 13" or "13 and over or never drunk", consistent with coding of this variable in previous research (Calvert et al., 2010; Hollander, 2003). While some studies have used multiple categories to analyze age at first drink (e.g., under 13, 13 to 15, 16, 17, and 18 used by Hingson et al. (2003)), for ease of interpretation and in order to ensure that there was a sufficient number of participants in each category, the dichotomous measure was preferred.

A similar item on the questionnaire asked at what age the participants had their first drink (excluding sips). However, this variable was not used as for many, initial drinking experiences may have occurred while in the presence of family or as part of religious ceremonies. With this item, it would have been difficult to distinguish between self-initiated drinking and drinking that would occur at family gatherings (Robins & Rutter, 1992) and thus the age of first intoxication was chosen in lieu. The variable for age of first intoxication would provide more meaningful data in predicting risky behavior as individuals with an earlier onset of drinking to intoxication are more likely to engage in various forms of risky behaviour such as unplanned and unprotected sex (Hingson et al., 2003).

3.8.3.4 Drug Use

Drug use was assessed by the question, "When was the last time, if ever, that you used the following drugs?" A list of substances was provided and the following response options were provided for each drug: in the past 30 days, in the past 12 months but not in the past 30 days, in life but not in the past 12 months, or never in life. Respondents were

coded as having used drugs if they reported using in the past 12 months or the past 30 days.

Specific substances that were included in the list were as follows: “Marijuana (or hashish)”, “Crack cocaine”, “Other forms of cocaine”, “Barbiturates (prescription-type sleeping pills like Seconal, Nembutal, downs or Yellow Jackets)”, “Ritalin, Dexedrine or Adderall”, “Other amphetamines (methamphetamine, crystal meth, speed, uppers, ups)”, “Tranquillizers (prescription-type drugs like Valium, Librium, Xanax, Ativan, Klonopin)”, “Heroin”, “Other opiate-type prescription drugs (codeine, morphine, Demerol, Percodan, Percodet, Vicodin, Darvon, Darvocet)”, “LSD”, “Other psychedelics or hallucinogens like mushrooms, mescaline or PCP”, “Ecstasy (MDMA)”, “Other “party drugs” (Ketamine, Special K, GHB)”, “Anabolic steroids (either injections like Depo-testosterone Durbolin, or pills like Anadrol, Dianabol or Winstrol)”, and “Other performance-enhancing drugs (growth hormone, diuretics, ephedrine)”. The following drugs were excluded from the analysis as they were either not illicit drugs (when used with a prescription) or were not expected to be associated with unsafe sex: barbiturates, Ritalin, Dexedrine, Adderall, tranquilizers, opiate-type prescription drugs, anabolic steroids, and other performance enhancing drugs.

A categorical measure was then created that consisted of: 1) marijuana use only 2) any other illicit drug use (i.e., any use of another illicit substance, alone or in addition to marijuana) 3) no illicit drug use. The second category of drug use was created from pooling together variables to form a composite measure of drug use since relatively fewer students reported using drugs other than marijuana. In Canada and the United States, generally, marijuana is tried first (Fiellin, Tetrault, Becker, Fiellin, & Hoff, 2013) and is used more widely than other illicit drugs (Leatherdale & Burkhalter, 2012). The rationale for reporting marijuana use as separate from other drug use is due to this sequential nature of drug use initiation, as predictors of marijuana use are inherently different from predictors of other illicit drug use (Childs, Dembo, Belenko, Wareham, & Schmeidler, 2011). As well, different drugs are known to have different effects (Russett, 1984), and marijuana versus other illicit drug use may not have an equal association with unsafe sex (Menon & Pomerantz, 1997). Finally, several other studies have also reported marijuana

as separate from other drug use in their analyses (Menon & Pomerantz, 1997; Patrick, O'Malley, Johnston, Terry-Mcelrath, & Schulenberg, 2012).

3.8.3.5 Importance of Campus Activities

Participants were given a list of eight campus activities and asked: "how important is it for you to participate in the following campus activities?" The list of the campus activities included: parties, athletics, arts, academics (non-class conferences, lectures, symposia), political associations/organizations, recreational clubs, student associations/organizations, and cultural/ethnic/religious associations/organizations. Each of the items is rated on a four point scale (1 = *not important*; 2 = *somewhat important*; 3 = *important*; 4 = *very important*). An exploratory factor analysis was conducted using the principal components method in order to examine which campus activities could be clustered and simplify the regression analysis by reducing the number of variables. The factor analysis was conducted using the FACTOR procedure of SAS. Two factors were retained based on scree plot analysis and Kaiser criterion (retaining factors with eigenvalues ≥ 1) and accounted for 44.4% of the variance (Kaiser, 1960). This two-factor solution was then subjected to a varimax orthogonal rotation to explore whether the eight items could be grouped into the two distinct categories. Five of the items loaded onto a factor interpreted as "Academic Campus Activities" while the other three items loaded onto a factor interpreted as "Recreational Campus Activities". A benchmark loading greater than .5 was used. Factor loadings are reported in Table 1. The "Academic Campus Activities" factor was composed of cultural/ethnic/religious associations, political associations, student associations, art associations, and academics. The "Recreational Campus Activities" factor was composed of parties, athletics, and recreational clubs. However, recreational clubs represented a factorial complexity since this item cross-loaded onto both factors, meaning that it was not exclusively associated with any one factor. In developing the final scale, this last item was deleted in order to have a clean factor structure and for ease of interpretability of the scale (Matsunaga, 2010).

Table 1. Factor loadings for importance of campus activities

Factors	Factor Loadings	
	Factor 1	**Factor 2**
Factor 1 - Academic Campus Activities		
Cultural/ethnic/religious associations	.72	.04
Political associations	.72	.13
Student associations	.65	.39
Art associations	.61	.05
Academics	.61	.02
Factor 2 - Recreational Campus Activities		
Parties	-.03	.78
Athletics	.10	.77
Recreational clubs	.50	.56

The two factors were then modeled as continuous variables. The scores for the "Academic Campus Activities" factor were summed together to provide a total score for this scale, which ranged from 5 – 20. This scale was shown to have modest scale reliability with a Cronbach's alpha of 0.71 (Nunnaly, 1978). Individual mean imputation, found to be a valid imputation method (Shrive, Stuart, Quan, & Ghali, 2006), was used to account for missing data from the "Academic Campus Activities" scale. If participants responded to at least 80% of the items on the scale, a mean was calculated from the subject's completed responses for the missing values.

The scores for the "Recreational Campus Activities" factor was also summed together to provide a total score for this scale, which ranged from 2 – 8. While this scale might be viewed with caution because of the low Cronach's alpha (0.51), scale reliability is heavily influenced by scale length (Swailes & McIntyre-Bhatty, 2002); thus with only two items the alpha was deemed to be acceptable and the scale was retained. Imputations were not executed as one missing answer on the scale would account for over 20% in missing data.

3.8.3.6 Gender

Gender was examined as an explanatory variable and as a potential effect measure modifier in the relationships between unsafe sex and HED. The questionnaire asked participants whether they were male or female.

3.8.3.7 Age

Age was assessed by the question "How old are you?" Participants responded by providing their current age in years. As noted above, the sample was restricted to those aged 25 or younger in order to capture the young adult population. Therefore, ages ranged from 17 to 25.

3.8.4 Control Variables

3.8.4.1 Marital-Cohabitation Status

Marital and Cohabitation status was included into the analysis in order to control for potential confounding. Married and cohabitating individuals are less at risk for sexually transmitted diseases than their single counterparts (Stuart & Hinde, 2010). To assess marital status, respondents were asked "What is your current marital status?" and were provided with the following response options: "Never married", "Married or equivalent", "Divorced", "Separated", or "Widowed." In addition, participants were asked about their current living situation with the question "Excluding children, with whom are you currently living?" Participants responded to the question by choosing one of the following: "Alone", "with spouse/partner", "with parents", "with other family", "with friends/acquaintances", or "other."

A dichotomous variable was created based on these two items, with the categories, married or cohabiting versus other. Respondents were coded as married-cohabiting if they indicated in the first question that they were "married or equivalent" or indicated in the second question that they were residing "with spouse/partner".

3.9 Statistical Analyses

All statistical analyses were conducted using SAS version 9.3. Descriptive statistics of the sample were calculated for the outcome variable, explanatory variables, and control variable. Correlation analyses were conducted to assess the degree of association among all variables of interest. Furthermore, bivariate analyses were conducted using chi-square tests for categorical variables and t-tests for continuous variables in order to quantify the individual effect of the explanatory variables on the outcome variable. Unadjusted relative risks and their corresponding 95% confidence intervals were calculated as well. Logistic regression with backward elimination procedures were used to assess the effect of all the explanatory variables on the outcome variable, and testing for pre-specified multiplicative interaction terms, while controlling for confounders. Finally, only the statistically significant variables from the logistic regression analysis with backward elimination were added into the modified Poisson regression analysis to obtain relative risk estimates for the associations. A detailed description of all analytic techniques is provided in the sections below.

3.9.1 Modified Poisson Regression

Modified Poisson Regression with a robust error variance was used to estimate the relative risk from the final model of the logistic regression analysis with backward elimination (Zou, 2004). The relative risk is a widely used measure in epidemiologic literature and has a much more intuitive interpretation than the odds ratio (Lee, 1994). Odds ratios can be misleading as they can lead to an overestimation of the effect (Schmidt & Kohlmann, 2008). As well, even when the rare disease assumption is met, the odds ratio has still been shown to produce upwardly biased estimates (De Jong, 2013). A discrepancy between the odds ratio and relative risk can be found when there is a strong association between exposure and disease (Schmidt & Kohlmann, 2008). Relative risks are widely favoured over odds ratio in epidemiologic studies (Lee, 1994) and as such a modified Poisson regression analysis was applied to obtain the relative risks as suggested by Zou (2004). The statistical technique uses a sandwich error estimation implemented in SAS by the PROC GENMOD procedure with REPEATED statement (Zou, 2004).

3.9.2 Logistic Regression

Logistic regression with backward elimination was used in this present study. Backward elimination regression is a model building process used to assess the importance of each explanatory variable in explaining the outcome variable. The method of backward elimination involves eliminating redundant variables beginning with a full model, including all the variables, and sequentially eliminating variables with the largest p-values (Vittinghoff, Glidden, Shiboski, & McCulloch, 2012). The main advantage of backward elimination over other automatic variable selection procedures, such as forward and stepwise selection, is the lowered possibility of omitting negatively confounded sets of variables since the complete set of variables is included in the initial model (Vittinghoff et al., 2012). In contrast, forward selection begins with a null model then adds variables sequentially at each step that make large contributions to explaining the outcome variable; but may lead to omitting potentially important explanatory variables (Vittinghoff et al., 2012). Backward elimination is not available for Poisson regression thus only the final model from the logistic regression with backward elimination procedures was analyzed using modified Poisson regression.

3.10 Preliminary Analysis

A preliminary analysis was conducted to gain an understanding of the characteristics of the sample. Descriptive statistics, including frequency distributions, means and standard deviations were calculated for all study variables. Pearson's correlations were computed for associations among continuous variables, independent t-tests were computed for associations between dichotomous variables and continuous variables, analysis of variance tests were computed for associations between categorical and continuous variables, and chi-square tests were computed for associations among categorical variables. Furthermore, the relationships between all the explanatory variables were examined for the total sample by testing for multicollinearity as measured by variance inflation factor (VIF). Examining the VIF associated with each variable, a VIF higher than 10 was taken to indicate that multicollinearity existed in the variable (Neter,

Wasserman, & Kutner, 1985). Bivariate logistic regression analyses of each potential explanatory variable and outcome variable was conducted for the total sample to examine the unadjusted associations between these variables. These analyses were useful in supplementing diagnostics for the full model.

3.11 Analyses per Study Objectives

Objective 1: To determine the extent of alcohol-related unsafe sex behaviour among undergraduate university students

A proportion and its associated 95% confidence interval was calculated for undergraduate university students reporting alcohol-related unsafe sexual behaviour in the past school year.

Objective 2: Evaluate the associations between alcohol-related unsafe sexual behaviour and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age.

Objective 2.1: Examine unadjusted associations between alcohol-related unsafe sexual behaviour and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age.

In order to calculate descriptive statistics, variables associated with alcohol-related unsafe sex since the beginning of school year were assessed through chi-square tests for categorical variables and t-tests for continuous variables, for all study variables separately with the outcome variable for the total sample.

Then, unadjusted relative risks were computed, separately, using modified Poisson regression analysis, for the association between alcohol-related unsafe sexual behaviour since the beginning of the school year, modeled as the dependent variable, and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age modeled as the independent variables.

Objective 2.2: Examine adjusted associations between alcohol-related unsafe sexual behaviour and HED, and secondary explanatory variables while controlling for marital-cohabitation status

The adjusted relative risks of alcohol-related unsafe sex since the beginning of the school year associated with HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age while controlling for marital-cohabitation status in a sample of undergraduate university students were calculated using logistic regression with backward elimination for the total sample, then using modified Poisson regression for significant correlations. Alcohol-related unsafe sex was modeled as the dependent variable and HED in the past two weeks, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age modeled as the independent variables.

First, logistic regression using a backward elimination technique was used to identify which variables could be used in the modified Poisson regression analysis. Beginning with all explanatory variables, variables were removed from the model one by one with the least significant variables being dropped at the chosen significance level of 0.05. Statistically significant correlations were identified and then analyzed by modified Poisson regression to obtain relative risk estimates.

Objective 2.3: Examine effect modification of gender by HED and secondary explanatory variables in relation to alcohol-related unsafe sex

Logistic regression analyses were carried out in order to evaluate how gender modifies the relationship of alcohol-related unsafe sex with HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age. The magnitude and direction of multiplicative interactions were assessed by incorporating product terms into the bivariate models. Any significant interactions were then inserted into the logistic regression model with backward elimination.

Chapter 4

4 Results

The Canadian Campus Survey 2004 sampled a total of 6,282 full-time university undergraduate students. However, the final sample size in the present study was 4,214 primarily due to the exclusion of non-drinkers in the study. All analyses were conducted using all available data from students between the ages of 17 to 25 who reported drinking in the past month, who provided valid responses to the outcome variable, and did not have any missing data on any of the study variables of interest. Therefore, excluding missing data, students over 25 and students who did not report drinking alcohol in the past month, the final dataset for the analysis included 67% of the total sample from the original respondents. A detailed breakdown of the sample size derivation is shown in Figure 2.

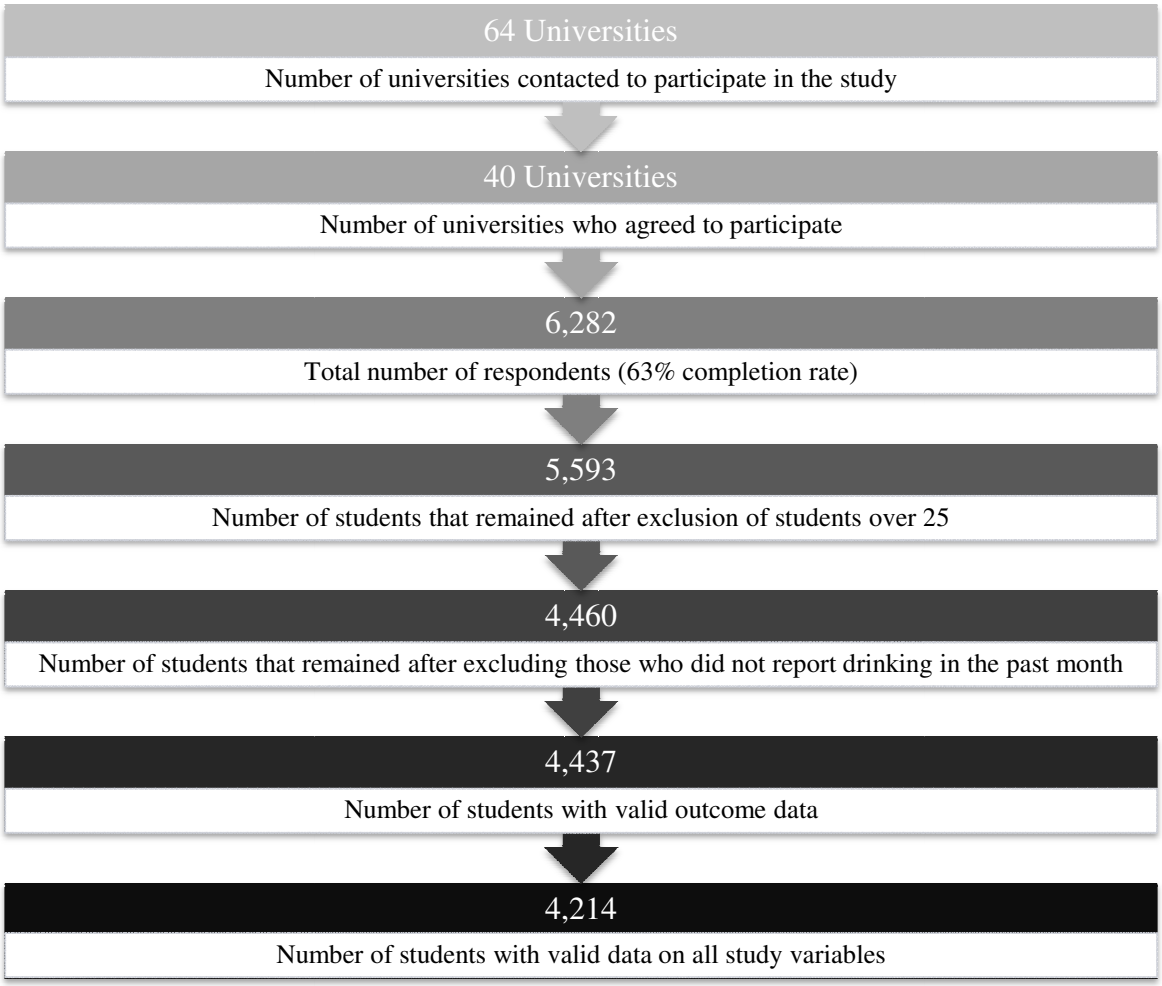

Figure 2. Sample size derivation

4.1 Missingness

Missingness was assessed for each study variable, only for respondents who provided valid outcome data and who met the inclusion criteria. A detailed analysis of missing data is provided in Table 2. As shown in the table, overall missing data were not a concern in this study with rates of missing data remaining under 5%. Rates were found to be greatest for Reasons for Consuming Alcohol (3.54%) and Drinking Location (1.60%).

As noted above, the present analyses were restricted to individuals who reported drinking in the past month because two main variables of interest (reasons for drinking and drinking location) were only asked of past month drinkers. To assess whether past month drinkers were significantly different from those who drank in the past year but not in the past month in terms of alcohol-related unsafe sex, a chi-square test was conducted. The results from the analysis showed that were no significant differences in the proportion reporting alcohol-related unsafe sex between these two groups ($p > 0.05$).

Table 2. Missingness on study variables of interest for the total sample of undergraduate university students with valid outcome data.

Variable	Total Sample (N = 4437)		
	N Valid	N Missing	%
Heavy Episodic Drinking	4417	20	.45
Reasons for Consuming Alcohol	4280	157	3.54
Drinking Location	4366	71	1.60
Age First Intoxicated	4436	1	.02
Drug Use	4413	24	.54
Importance of Campus Activities			
Academic Campus Activities*	4437	0	0
Recreational Campus Activities*	4437	0	0
Gender	4437	0	0
Age	4437	0	0
Marital/Cohabitation Status	4437	0	0

*with imputation

4.2 Sample Characteristics

Sample characteristics are presented in Table 3. The study sample was composed of 64.30% females and 35.70% males. The mean age of the students was 20.97 (SD: 1.82). About 7.37% (95% CI: 6.60% to 8.14%) of the population reported having unsafe sex due to alcohol since the beginning of the school year and nearly half reported HED at least once in the past two weeks (47.50%). Only 4.17% of students reported having been intoxicated for the first time under the age of 13. For the categorical variable, reason for drinking on the most recent occasion, more than half of the students reported social motives (55.58%) as a reason for consuming alcohol while the remaining students reported to enjoying the taste/having with meal/Other (28.67%), coping motives (8.76%), and to get high or drunk (6.99%). For the location of respondents' most recent drinking occasion, a large proportion of students reported drinking at someone's home (42.67%) or at a bar/disco/pub/tavern (35.48%), while the remaining reported drinking at a restaurant or other location (14.73%), or at a fraternity/university (7.12%). In terms of drug use in the past year, 31.43% reported using marijuana only and 12.55% reported using illicit drugs (including marijuana). The mean score for rating the importance of academic campus activities was 10.19 (SD: 2.98) out of a total of 20 maximum points. The mean score for rating the importance of recreational campus activities was 4.48 (SD: 1.55) out of a total of 8 maximum points. Finally, 11.07% of students were married or living with their partner.

Table 3. Characteristics of the study sample

Variable	Total Sample (N = 4437) Number (%) or Mean (SD)
Alcohol-Related Unsafe Sex	
Yes	327 (7.37 %)
No	4110 (92.63 %)
Heavy Episodic Drinking (HED)	
In the past 2 weeks	2098 (47.50 %)
No HED or not in the past 2 weeks	2319 (52.50 %)
Reasons for Consuming Alcohol	
Coping Motives	375 (8.76 %)
Social Motives	2379 (55.58 %)
Get High or Drunk	299 (6.99 %)
Enjoy Taste/with Meal/Other	1227 (28.67 %)
Drinking Location	
Someone's Home	1863 (42.67 %)
Bar/Disco/Pub/Tavern	1549 (35.48 %)
Fraternity/University	311 (7.12 %)
Restaurant or Other	643 (14.73 %)
Age First Intoxicated	
Under 13 Years	185 (4.17 %)
Over 13 Years or Never	4251 (95.83 %)
Drug Use in the Past Year	
Marijuana Only	1387 (31.43 %)
Illicit Drugs (including marijuana)	554 (12.55 %)
Abstainers	2472 (56.02 %)
Importance of Campus Activities	
Academic Campus Activities – **mean (SD)**	10.19 (2.98)
Recreational Campus Activities – **mean (SD)**	4.48 (1.55)
Gender	
Male	1584 (35.70 %)
Female	2853 (64.30 %)
Age – mean (SD)	20.97 (1.82)
Marital /Cohabitation Status	
Not Married or Living with Spouse/Partner	3946 (88.93 %)
Married or Living with Spouse/Partner	491 (11.07 %)

4.3 Associations among Study Variables

Pearson's correlations were computed for associations among continuous variables (Table 4), analysis of variance tests were computed for associations between categorical and continuous variables (Table 5) and chi-square tests were computed for associations among categorical variables (see Tables 6 through 11).

As expected, there were many significant associations among the study variables given the large sample size. The results from the Pearson's correlation showed that there were only small associations between continuous study variables. Next, results from the independent t-tests and analysis of variance tests showed significant associations between age and HED, age at first intoxication, reasons for drinking, drinking location, gender, and marital-cohabitation status. Heavy episodic drinkers, students drinking at a fraternity/university and females tended to be younger than their counterparts. As well, early drinkers, students reporting drinking for coping motives and to enjoy the taste or have with a meal, and married/cohabitating individuals tended to be older than their counterparts. For scores on rating the importance of engaging in academic campus activities, heavy episodic drinkers, students who reported drinking to get high or drunk, drug users, males, and students married or living with their partners scored lower than their counterparts. Additionally, students who reported drinking at a fraternity/university tended to score higher in rating the importance of engaging in academic activities than their counterparts. For scores on rating the importance of engaging in recreational campus activities, heavy episodic drinkers, early drinkers, students reporting drinking to get high or drunk, students drinking in at a fraternity/university, marijuana and drug users and students not married or cohabitating tended to score higher than their counterparts.

Additionally, results from the chi-square tests showed significant associations between HED and marital-cohabitation status, age first intoxicated, reasons for drinking, drinking location, and drug use. A smaller proportion of married/cohabitating students reported HED than non-married/cohabitating students (37.01% vs. 48.80%). As well, more early drinkers compared to late drinkers (67.76% vs. 46.61%) and more drug users compared to marijuana users and abstainers (72.83% vs. 60.94% and 34.38% respectively) reported HED. In addition, more students citing getting high or drunk as reasons for drinking and

students reporting drinking at a fraternity/university reported HED than their counterparts.

Chi-square tests also showed significant associations between age first intoxicated and gender, marital-cohabitation status, reasons for drinking, and drug use. More males than females reported early initiation into drinking (5.37% vs. 3.51%). As well, more married/cohabitating students compared to non–married/cohabitating students (6.92% vs. 3.83%) and more drug users than marijuana users and abstainers (9.57% vs. 4.83% and 2.59% respectively) reported early initiation into drinking. Lastly, fewer students citing social motives as reasons for drinking reported early initiation into drinking compared to their counterparts.

Results of the chi-square tests also showed associations between reasons for consuming alcohol and gender, marital-cohabitation status, drinking location and drug use. More males cited coping motives (10.70% vs. 7.68%) and drinking to get high or drunk (8.02% vs. 6.41%) as reasons for drinking than females; whereas more females cited social motives (57.70% vs. 51.79%) as reasons for drinking than males. More married/cohabitating students reported drinking to enjoy the taste than non-married/cohabitating students (43.88% vs. 26.77%) while more non-married/cohabitating students reported drinking to get high or drunk (7.44% vs. 3.38%) and social motives for drinking (57.02% vs. 44.09%) than married/cohabitating students. More students drinking in someone's home reported coping motives as reasons for drinking than their counterparts. As well, more students drinking in a bar-disco/pub/tavern and students drinking at a fraternity/university reported social motives as reasons for drinking than their counterparts. Furthermore, more students drinking at a restaurant or other establishment reported drinking to enjoy the taste or have with a meal. More drug users than marijuana users and abstainers reported coping motives as reasons for drinking (11.07% vs. 9.38% and 7.86% respectively). As well, more drug users than marijuana users and abstainers reported drinking to get high or drunk as reasons for drinking (13.55% vs. 9.16% and 4.41% respectively). Furthermore, more drug abstainers reported drinking to enjoy the taste or have with a meal than marijuana and other drug users (31.20% vs. 26.73% and 22.14% respectively).

For drinking locations, results from the chi-square tests showed that more females reported drinking in a bar/disco/pub/tavern (36.96% vs. 32.82%) and in a restaurant or "other" (15.25% vs. 13.78%) than males; whereas more males reported drinking at someone's home (44.74% vs. 41.52%) and at a fraternity/university (8.65% vs. 6.27%) than females. As well, more married/cohabitating students reported drinking at someone's home (52.69% vs. 41.42%) and at a restaurant or "other" (18.39% vs. 14.27%) than non-married/cohabitating students; whereas more non-married/cohabitating students reported drinking at a bar/disco/pub/tavern (36.60% vs. 26.45%) and at a fraternity/university (7.70% vs. 2.48%) than married-cohabitating students. Furthermore, fewer drug abstainers compared to marijuana and drug users reported drinking in someone's home (41.83% vs. 43.27% and 44.51% respectively), at a bar/disco/pub/tavern (34.05% vs. 37.57% and 37.00% respectively) and at a fraternity/university (6.38% vs. 8.04% and 7.69% respectively), however, more drug abstainers compared to marijuana and drug users reported drinking at a restaurant or "other" (17.74% vs. 11.11% and 10.81%).

Lastly, results from the chi-square tests showed significant associations between drug use and gender as well as significant associations between gender and marital-cohabitation status. More males than females used marijuana (34.46% vs. 29.75%) and illicit drugs (14.62% vs. 11.41) in the past year. Finally, more married/cohabitating students compared to non-married/cohabitating students were female (69.25% vs. 63.68%).

Overall, many associations were found among the drinking variables. Results of these analyses necessitated a test for multicollinearity among study variables (see next section).

Table 4. Correlation matrix of continuous variables of interest

	1	2	3
1. Age	1.000	-0.063*	-0.023
2. Recreational Campus Activities		1.000	0.257*
3. Academic Campus Activities			1.000

* p <.0001

Table 5. Association between categorical and continuous variables of interest

	Age T-value or F-Value [b] Mean (SD)	**Academic Campus Activities** T-value or F-Value [b] Mean (SD)	**Recreational Campus Activities** T-value or F-Value [b] Mean (SD)
Heavy Episodic Drinking	3.87 **	3.12*	-15.81**
In the past 2 week	20.85 (1.80)	10.04 (2.98)	4.85 (1.57)
No HED or not in the past 2 weeks	21.06 (1.83)	10.32 (2.97)	4.13 (1.45)
Reasons for Consuming Alcohol[a]	23.84**	7.54**	14.17**
Coping Motives	21.06 (1.82)	10.30 (2.97)	4.52 (1.60)
Social Motives	20.83 (1.80)	10.30 (3.02)	4.55 (1.56)
To Get High or Drunk	20.55 (1.77)	9.46 (2.75)	4.72 (1.55)
Enjoy Taste/with Meal/Other	21.30 (1.82)	10.10 (2.94)	4.24 (1.50)
Drinking Location[a]	70.25**	2.69*	23.28**
Someone's Home	21.05 (1.84)	10.06 (2.93)	4.39 (1.55)
Bar/Disco/Pub/Tavern	21.02 (1.73)	10.23 (3.03)	4.55 (1.56)
Fraternity/University	19.59 (1.55)	10.51 (2.97)	5.07 (1.46)
Restaurant or Other	21.26 (1.79)	10.27 (3.01)	4.25 (1.52)
Age First Intoxicated	2.91*	0.34	3.59*
Under 13 Years	21.35 (1.84)	10.26 (3.05)	4.88 (1.59)
Over 13 Years or Never	20.95 (1.81)	10.19 (2.98)	4.46 (1.55)
Drug Use in the Past Year[a]	2.29	3.48*	36.90**
Marijuana Only	20.93 (1.81)	10.11 (2.91)	4.70 (1.56)
Drug Use (including marijuana)	21.12 (1.81)	9.94 (3.05)	4.71 (1.64)
Abstainers	20.95 (1.82)	10.28 (3.00)	4.30 (1.51)

* $p < 0.05$, ** $p < .0001$

[a] Denotes categorical variable

[b] Analysis of variance tests were calculated for categorical variables and t-values were calculated for dichotomous variables

Table 5 (Continued)

	Age T-value or F-Value [b] Mean (SD)	**Academic Campus Activities** T-value or F-Value [b] Mean (SD)	**Recreational Campus Activities** T-value or F-Value [b] Mean (SD)
Gender	5.49 **	-2.26*	12.85**
Male	21.17 (1.84)	10.05 (2.91)	4.88 (1.60)
Female	20.86 (1.79)	10.26 (3.02)	4.25 (1.48)
Marital/Cohabitation Status	14.21**	-2.11*	-5.66**
Not Married or Living with Spouse/Partner	20.83 (1.78)	10.22 (3.00)	4.52 (1.55)
Married or Living with Spouse/Partner	22.04 (1.73)	9.92 (2.85)	4.10 (1.50)

* p< 0.05, ** p<.0001

[a] Denotes categorical variable

[b] Analysis of variance tests were calculated for categorical variables and t-values were calculated for dichotomous variables

Table 6. Associations among categorical variables of interest (HED)

	Heavy Episodic Drinking		
	HED in the past 2 week N (%)	No HED or not in the past 2 weeks N (%)	Chi-square test
Gender			2.083
Male	772 (48.95%)	805 (51.05%)	
Female	1326 (46.69%)	1514 (53.31%)	
Marital/Cohabitation Status			24.236**
Not Married or Living with Spouse/Partner	1917 (48.80%)	2011 (51.20%)	
Married or Living with Spouse/Partner	181 (37.01%)	308 (62.99%)	
Age First Intoxicated			31.465**
Under 13 Years	124 (67.76%)	59 (32.24%)	
Over 13 Years or Never	1973 (46.61%)	2260 (53.39%)	
Reasons for Consuming Alcohol			254.195**
Coping Motives	173 (46.26%)	201 (53.74%)	
Social Motives	1225 (51.71%)	1144 (48.29%)	
To Get High or Drunk	231 (77.52%)	67 (22.48%)	
Enjoy Taste/with Meal/Other	383 (31.27%)	842 (68.73%)	
Drinking Location			81.985**
Someone's Home	830 (44.74%)	1025 (55.26%)	
Bar/Disco/Pub/Tavern	818 (52.94%)	727 (47.06%)	
Fraternity/University	185 (59.49%)	126 (40.51%)	
Restaurant or Other	224 (35.00%)	416 (65.00%)	
Drug Use in the Past Year			411.891**
Marijuana Only	841 (60.94%)	539 (39.06%)	
Drug Use (including marijuana)	402 (72.83%)	150 (27.17%)	
Abstainers	846 (34.38%)	1615 (65.62%)	

* p< 0.05, ** p<.0001

Table 7. Associations among categorical variables of interest (age first intoxicated)

	Age First Intoxicated		
	Under 13 Years N (%)	Over 13 Years or Never N (%)	Chi-square test
Gender			8.814*
Male	85 (5.37%)	1499 (94.63%)	
Female	100 (3.51%)	2752 (96.49%)	
Marital/Cohabitation Status			10.480*
Not Married or Living with Spouse/Partner	151 (3.83%)	3794 (96.17%)	
Married or Living with Spouse/Partner	34 (6.92%)	457 (93.08%)	
Reasons for Consuming Alcohol			9.948*
Coping Motives	20 (5.33%)	355 (94.67%)	
Social Motives	78 (3.28%)	2300 (96.72%)	
To Get High or Drunk	16 (5.35%)	283 (94.65%)	
Enjoy Taste/with Meal/Other	63 (5.13%)	1164 (94.87%)	
Drinking Location			1.155
Someone's Home	82 (4.40%)	1781 (95.60%)	
Bar/Disco/Pub/Tavern	61 (3.94%)	1487 (96.06%)	
Residence or Fraternity/Sorority House	10 (3.22%)	301 (96.78%)	
Restaurant or Other	26 (4.04%)	617 (95.96%)	
Drug Use in the Past Year			57.322**
Marijuana Only	67 (4.83%)	1320 (95.17%)	
Drug Use (including marijuana)	53 (9.57%)	501 (90.43%)	
Abstainers	64 (2.59%)	2407 (97.41%)	

* $p < 0.05$, ** $p < .0001$

Table 8. Associations among categorical variables of interest (reasons for consuming alcohol)

	Reasons for Consuming Alcohol				
	Coping Motives	Social Motives	To Get High or Drunk	Enjoy Taste/with Meal/Other	Chi-square test
Gender					20.630*
Male	164 (10.70%)	794 (51.79%)	123 (8.02%)	452 (29.48%)	
Female	211 (7.68%)	1585 (57.70%)	176 (6.41%)	775 (28.21%)	
Marital/Cohabitation Status					65.651**
Not Married or Living with Spouse/Partner	334 (8.78%)	2170 (57.02%)	283 (7.44%)	1019 (26.77%)	
Married or Living with Spouse/Partner	41 (8.65%)	209 (44.09%)	16 (3.38%)	208 (43.88%)	
Drinking Location					249.823**
Someone's Home	183 (10.16%)	856 (47.50%)	122 (6.77%)	641 (35.57%)	
Bar/Disco/Pub/Tavern	121 (8.04%)	1006 (66.84%)	117 (7.77%)	261 (17.34%)	
Fraternity/University	25 (8.33%)	192 (64.00%)	34 (11.33%)	49 (16.33%)	
Restaurant or Other	43 (6.92%)	295 (47.50%)	20 (3.22%)	263 (42.35%)	
Drug Use in the Past Year					85.852**
Marijuana Only	125 (9.38%)	729 (54.73%)	122 (9.16%)	356 (26.73%)	
Drug Use (including marijuana)	58 (11.07%)	279 (53.24%)	71 (13.55%)	116 (22.14%)	
Abstainers	189 (7.86%)	1359 (56.53%)	106 (4.41%)	750 (31.20%)	

* $p < 0.05$, ** $p < .0001$

Table 9. Associations among categorical variables of interest (drinking location)

	Drinking Location				
	Someone's Home	Bar/Disco/Pub/ Tavern	Fraternity/ University	Restaurant or Other	Chi-square test
Gender					16.735*
Male	698 (44.74%)	512 (32.82%)	135 (8.65%)	215 (13.78%)	
Female	1165 (41.52%)	1037 (36.96%)	176 (6.27%)	428 (15.25%)	
Marital/Cohabitation Status					46.747**
Not Married or Living with Spouse/Partner	1608 (41.42%)	1421 (36.60%)	299 (7.70%)	554 (14.27%)	
Married or Living with Spouse/Partner	255 (52.69%)	128 (26.45%)	12 (2.48%)	89 (18.39%)	
Drug Use in the Past Year					40.871**
Marijuana Only	592 (43.27%)	514 (37.57%)	110 (8.04%)	152 (11.11%)	
Drug Use (including marijuana)	243 (44.51%)	202 (37.00%)	42 (7.69%)	59 (10.81%)	
Abstainers	1016 (41.83%)	827 (34.05%)	155 (6.38%)	431 (17.74%)	

* $p < 0.05$, ** $p < .0001$

Table 10. Associations among categorical variables of interest (drug use)

	Drug Use in the Past Year			
	Marijuana Only	Drug Use (including marijuana)	Abstainers	Chi-square test
Gender				26.775**
Male	542 (34.46%)	230 (14.62%)	801 (50.92%)	
Female	845 (29.75%)	324 (11.41%)	1671 (58.84%)	
Marital/Cohabitation Status				2.596
Not Married or Living with Spouse/Partner	1245 (31.72%)	498 (12.69%)	2182 (55.59%)	
Married or Living with Spouse/Partner	142 (29.10%)	56 (11.48%)	290 (59.43%)	

* p< 0.05, ** p<.0001

Table 11. Associations among categorical variables of interest (gender)

	Gender		
	Male	Female	Chi-square test
Marital/Cohabitation Status			5.884*
Not Married or Living with Spouse/Partner	1433 (36.32%)	2513 (63.68%)	
Married or Living with Spouse/Partner	151 (30.75%)	340 (69.25%)	

* p< 0.05, ** p<.0001

4.4 Tests for Multicollinearity

In the present study, VIF and tolerance (1/VIF) was carried out for each independent variable to measure multicollinearity. Table 12 shows the variables along with their respective VIF and tolerance values. High VIF values indicate the extent to which a given independent variable is inter-correlated with other variables in the model. The results of the multicollinearity test show that VIF values were no greater than 1.22 for any independent variable or confounder. None of these values are over the critical level of 10, the recommended maximum level suggested by Hair, Anderson, Tatham, and Black (1998). Therefore, elimination of any variables due to multicollinearity was unnecessary.

Table 12. Results of multicollinearity test

Variable	Variance Inflation Factor
Heavy Episodic Drinking	1.191
Reasons for Consuming Alcohol	1.115
Drinking Location	1.085
Age First Intoxicated	1.019
Drug Use in the Past Year	1.081
Importance of Campus Activities	
Academic Campus Activities	1.097
Recreational Campus Activities	1.218
Gender	1.065
Age	1.086
Marital/Cohabitation Status	1.069

4.5 Analyses per Study Objective

Objective 1: To determine the extent of alcohol-related unsafe sex behaviour among undergraduate university students

A proportion was calculated for undergraduate university students reporting unsafe sexual behaviour in the past 12 months. The proportion of undergraduate university students reporting having had unsafe sex due to alcohol consumption was 7.37% (95% CI: 6.60% to 8.14%), reflecting 327 out of 4,437 students in the sample.

Objective 2: Evaluate the associations between alcohol-related unsafe sexual behaviour and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age.

Objective 2.1: Examine unadjusted associations between alcohol-related unsafe sexual behaviour and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age.

Variables associated with alcohol-related unsafe sex were evaluated by conducting chi-square tests for categorical variables and t-tests for continuous variables with the outcome variable. The results of the analysis are presented in Table 13. As well, modified Poisson regression analyses were conducted separately on the explanatory variables and alcohol-related unsafe sex with the results of the analyses presented in Table 14. There were no differences in average age between students reporting alcohol-related unsafe sex and those who did not report having unsafe sex (21.1 years vs. 21.0 years, $p = 0.164$). Similarly, there was no difference between males and females in the proportion reporting unsafe sex (8.14% vs. 6.94%, respectively, $p = 0.141$).

The results of the test statistic showed that alcohol-related unsafe sex was associated with HED (RR: 2.68; 95% CI: 2.12 - 3.37, $p < .001$). Heavy episodic drinkers (10.96%) were found to be significantly more likely to engage in unsafe sex than non-heavy episodic drinkers (4.10%). As well, significant differences were found for reasons for drinking and drinking location ($p < .001$ & $p = 0.006$ respectively). In particular, students who reported coping motives for drinking alcohol (10.67%; RR: 2.01; 95% CI: 1.38 - 2.93, $p < .001$)

and drinking to get high or drunk (16.72%; RR: 3.16; 95% CI: 2.23 - 4.46; p <.001) on the most recent occasion were significantly more likely to report unsafe sex than students who reported drinking to enjoy taste/have with meal/other (5.30%). However, students who reported social motives for drinking (6.77%) were not significantly more likely to report unsafe sex than those who reported drinking to enjoy taste/ have with meal/other. Additionally, students who reported drinking in a bar/disco/pub/tavern (8.65%; RR: 1.64; 95% CI: 1.14 - 2.36; p = 0.008) and drinking at a fraternity/university (9.97%; RR: 1.89; 95% CI: 1.18 - 3.01; p = 0.008) on their most recent drinking location were significantly more likely to report engaging in unsafe sex than those who reported drinking at a restaurant or "other" (5.29%). However, students who reported drinking at someone's home (6.60%) were not significantly more likely to report unsafe sex compared to students who reported drinking at a restaurant or "other". Significant differences were also found for age first intoxicated (RR: 1.82; 95% CI: 1.23 - 2.68; p = 0.003); students who reported early-age of intoxication (12.97%) were significantly more likely to report unsafe sex than students who reported a late-age of intoxication (7.13%). Furthermore, statistically significant differences were found between the two groups for drug use in the past year (p <.001) and marital-cohabitation status (p <.001). Students who reported using marijuana (9.88%; RR: 2.74; 95% CI: 2.12 - 3.55; p <.001) and illicit drugs (17.87%; RR: 4.96; 95% CI: 3.79 - 6.51; p <.001) in the past year were significantly more likely to engage in unsafe sex than students who abstained (3.60%) from drug use.

As well, students who engaged in alcohol-related unsafe sex on average scored higher in rating the importance of recreational campus activities (24% increase per unit; p <.001); the mean score among students reporting unsafe sex was 5.00 (SD: 1.59), and among students who did not report engaging in unsafe sex the mean score was 4.43 (SD: 1.54). However, no statistically significant differences were found between the two groups in rating the importance of academic campus activities. Finally, students who reported being not married or cohabitating with their partner (7.86%; RR: 2.27; 95% CI: 1.41 - 3.66; p <.001) were significantly more likely to report having unsafe sex than students who were married or living with a partner (3.46%).

Table 13. Characteristics associated with alcohol-related unsafe sex for undergraduate university students

	Total Sample (N=4437)			
	Unsafe Sex (N = 327) **Number (%) or Mean (SD)**	**No Unsafe Sex** (N = 4109) **Number (%) or Mean (SD)**	**Chi-square or T-value[b]**	**P-Value**
Heavy Episodic Drinking[a]				
In the past 2 week	230 (10.96%)	1868 (89.04%)	76.1818	**<.0001**
No HED or not in the past 2 weeks	95 (4.10%)	2224 (95.90%)		
Reasons for Consuming Alcohol[a]				
Coping Motives	40 (10.67%)	335 (89.33%)	53.1750	**<.0001**
Social Motives	161 (6.77%)	2218 (93.23%)		
To Get High or Drunk	50 (16.72%)	249 (83.28%)		
Enjoy Taste/with Meal/Other	65 (5.30%)	1162 (94.70%)		
Drinking Location[a]				
Someone's Home	123 (6.60%)	1740 (93.40%)	12.4804	**0.0059**
Bar/Disco/Pub/Tavern	134 (8.65%)	1415 (91.35%)		
Fraternity/University	31 (9.97%)	280 (90.03%)		
Restaurant or Other	34 (5.29%)	609 (94.71%)		
Age First Intoxicated[a]				
Under 13 Years	24 (12.97%)	161 (87.03%)	8.8710	**0.0029**
Over 13 Years or Never	303 (7.13%)	3948 (92.87%)		

[a] Denotes categorical variable

[b] Chi-square statistics were calculated for categorical variables and t-values were calculated for continuous variables

Table 13 (Continued)

	Total Sample (N=4437)			
	Unsafe Sex (N = 327) **Number (%) or Mean (SD)**	**No Unsafe Sex** (N = 4109) **Number (%) or Mean (SD)**	**Chi-square or T-value**	**P-Value**
Drug Use in the Past Year[a]				
Marijuana Only	137 (9.88%)	1250 (90.12%)	153.8022	**<.0001**
Drug Use (including marijuana)	99 (17.87%)	455 (82.13%)		
Abstainers	89 (3.60%)	2383 (96.40%)		
Gender[a]				
Male	129 (8.14%)	1455 (91.86%)	2.1623	0.1414
Female	198 (6.94%)	2655 (93.06%)		
Age	21.10 (1.76)	20.96 (1.82)	1.39	0.1642
Importance of Campus Activities				
Academic Campus Activities	10.11 (3.07)	10.20 (2.97)	-0.52	0.6043
Recreational Campus Activities	5.00 (1.59)	4.43 (1.54)	6.34	**<.0001**
Marital/Cohabitation Status[a]				
Not Married or Living with Spouse/Partner	310 (7.86%)	3636 (92.14%)	12.3483	**0.0004**
Married or Living with Spouse/Partner	17 (3.46%)	474 (96.54%)		

[a] Denotes categorical variable
[b] Chi-square statistics were calculated for categorical variables and t-values were calculated for continuous variables

Table 14. Unadjusted relative risks of alcohol-related unsafe sex since the beginning of the school year associated with each explanatory variable

	Total Sample (N=4437)			
	Estimated Regression Coefficient	**Standard Error**	**P-Value**	**Relative Risk (95% CI)**
Heavy Episodic Drinking				
In the past 2 week	0.9844	0.1182	**<.0001**	2.6761 (2.1228 - 3.3736)
No HED or not in the past 2 weeks				Ref
Reasons for Consuming Alcohol				
Coping Motives	0.6999	0.1921	**0.0003**	2.0135 (1.3818 - 2.9341)
Social Motives	0.2449	0.1427	0.0861	1.2775 (0.9658 - 1.6897)
To Get High or Drunk	1.1495	0.1767	**<.0001**	3.1567 (2.2326 - 4.4632)
Enjoy Taste/with Meal/Other				Ref
Drinking Location				
Someone's Home	0.2220	0.1883	0.2383	1.2486 (0.8633 - 1.8059)
Bar/Disco/Pub/Tavern	0.4923	0.1862	**0.0082**	1.6360 (1.1358 - 2.3566)
Fraternity/University	0.6340	0.2385	**0.0079**	1.8851 (1.1811 - 3.0087
Restaurant or Other				Ref
Age First Intoxicated				
Under 13 Years	0.5989	0.1983	**0.0025**	1.8201 (1.2339 - 2.6847)
Over 13 Years or Never				Ref
Drug Use in the Past Year				
Marijuana Only	1.0092	0.1319	**<.0001**	2.7435 (2.1183 - 3.5532)
Drug Use (including marijuana)	1.6021	0.1383	**<.0001**	4.9635 (3.7850 - 6.5089)
Abstainers				Ref

Table 14 (Continued)

	Total Sample (N=4404)			
	Estimated Regression Coefficient (Standard Error)		**P-Value**	**Relative Risk (95% CI)**
Importance of Campus Activities				
Academic Campus Activities	-0.0093	0.0185	0.6157	0.9907 (0.9554 - 1.0274)
Recreational Campus Activities	0.2118	0.0335	**<.0001**	1.2359 (1.1573 - 1.3199)
Gender				
Male	0.1600	0.1087	0.1412	1.1735 (0.9483 - 1.4522)
Female				Ref
Age	0.0404	0.0279	0.1476	1.0412 (0.9858 - 1.0998)
Marital/Cohabitation Status				
Not Married or Living with Spouse/Partner	0.8193	0.2445	**0.0008**	2.2690 (1.4053 - 3.6637)
Married or Living with Spouse/Partner				Ref

Objective 2.2: Examine adjusted associations between alcohol-related unsafe sexual behaviour and HED, and secondary explanatory variables while controlling for marital-cohabitation

Logistic regression using backward elimination was used to identify which factors (HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, gender, and age) were associated with alcohol-related unsafe sex since the beginning of the school year while controlling for marital-cohabitation status in a sample of undergraduate university students. The final model was then reanalyzed using modified Poisson regression to obtain relative risks.

First, logistic regression with backward elimination procedures was performed fitting a model with all the variables and dropping the least significant variable successively until only the statistically significant ($\alpha = 0.05$) variables remained in the final model. Results from the analysis are shown in Table 15. The results from the model indicated that alcohol-related unsafe sex was associated with HED ($p < .001$), reasons for drinking (i.e., coping motives ($p = 0.022$) and to get high or drunk ($p < .001$)), marijuana use ($p < .001$), and illicit drug use ($p < .001$), recreational campus activities ($p < .001$), and age ($p = 0.018$), after controlling for marital-cohabitation status. The final results from the logistic regression model with backward elimination were then reanalyzed using modified Poisson regression. The results from the analysis are shown in Table 16. Modified Poisson regression was used to obtain adjusted relative risks and 95% confidence intervals and the results were consistent with the findings from the logistic regression analysis. Alcohol-related unsafe sex was significantly associated with HED (RR = 1.609, 95% CI = 1.240 - 2.088; $p < .001$) compared to those who did not engage in HED. Furthermore, participants who cited coping motives (RR: 1.547, 95% CI = 1.059 - 2.260; $p = 0.024$) and to get high or drunk (RR: 1.870, 95% CI = 1.295 - 2.700; $p < .001$) as reasons for drinking were significantly more likely to report alcohol-related unsafe sex compared to participants citing enjoying taste/having with meal/other as a reason for drinking. However, citing social motives for drinking was not found to be significantly associated with alcohol-related unsafe sex, again, in comparison to enjoying taste/with

meal/other. Marijuana users (RR: 2.204, 95% CI: 1.683 - 2.887; p <.001) and illicit drug users (RR: 3.397, 95% CI: 2.519 - 4.580; p <.001) were also more likely to report alcohol-related unsafe sex than drug abstainers. And finally, alcohol-related unsafe sex was associated with scores on rating the importance of engaging in recreational campus activities (14% increase per unit; p <.001) and age (7% increase per year; p = 0.018).

Table 15. Final logistic regression model (after backward elimination) examining the associations between alcohol-related unsafe sex and explanatory variables while controlling for marital-cohabitation status

	Total Sample (N=4,193)			
	Estimated Regression Coefficient	**Standard Error**	**Odds Ratio (95% CI)**	**P-Value**
Heavy Episodic Drinking				
In the past 2 week	0.5279	0.1408	1.695 (1.286 - 2.234)	**0.0002**
No HED or not in the past 2 weeks	-	-	Ref	-
Reasons for Consuming Alcohol				
Coping Motives	0.5033	0.2200	1.654 (1.075 - 2.546)	**0.0221**
Social Motives	0.0508	0.1588	1.052 (0.771 - 1.436)	0.7490
To Get High or Drunk	0.7278	0.2151	2.071 (1.358 - 3.157)	**0.0007**
Enjoy Taste/with Meal/Other	-	-	Ref	-
Drinking Location				
Someone's Home				
Bar/Disco/Pub/Tavern				
Fraternity/University			Eliminated	
Restaurant or Other				
Age First Intoxicated				
Under 13 Years				
Over 13 Years or Never			Eliminated	
Drug Use in the Past Year				
Marijuana Only	0.8689	0.1478	2.384 (1.785 - 3.185)	**<.0001**
Drug Use (including marijuana)	1.3788	0.1688	3.970 (2.852 - 5.527)	**<.0001**
Abstainers	-	-	Ref	-

Table 15 (Continued)

	Total Sample (N=4,193)			
	Estimated Regression Coefficient	**Standard Error**	**Odds Ratio (95% CI)**	**P-Value**
Importance of Campus Activities				
Academic Campus Activities			Eliminated	
Recreational Campus Activities	0.1501	0.0393	1.162 (1.076 - 1.255)	**0.0001**
Gender				
Male			Eliminated	
Female				
Age	0.0811	0.0342	1.085 (1.014 - 1.160)	**0.0177**
Marital/Cohabitation Status				
Not Married or Living with Spouse/Partner	0.7676	0.2692	2.155 (1.271 - 3.652)	**0.0043**
Married or Living with Spouse/Partner	-	-	Ref	-

Table 16. Modified Poisson Regression for adjusted relative risks of alcohol-related unsafe sex associated with HED and secondary explanatory variables, controlling for marital-cohabitation status

	Total Sample (N=4,246)			
	Estimated Regression Coefficient	**Standard Error**	**Relative Risks (95% CI)**	**P-Value**
Heavy Episodic Drinking				
In the past 2 week	0.4755	0.1330	1.6089 (1.2398 - 2.0878)	**0.0003**
No HED or not in the past 2 weeks			Ref	
Reasons for Consuming Alcohol				
Coping Motives	0.4363	0.1933	1.5469 (1.0590 - 2.2595)	**0.0240**
Social Motives	0.0491	0.1439	1.0503 (0.7923 - 1.3924)	0.7329
To Get High or Drunk	0.6260	0.1874	1.8701 (1.2952 - 2.7002)	**0.0008**
Enjoy Taste/with Meal/Other			Ref	
Drug Use in the Past Year				
Marijuana Only	0.7902	0.1377	2.2039 (1.6826 - 2.8865)	**<.0001**
Drug Use (including marijuana)	1.2229	0.1525	3.3971 (2.5194 - 4.5804)	**<.0001**
Abstainers			Ref	
Importance of Campus Activities				
Recreational Campus Activities	0.1290	0.0340	1.1377 (1.0644 - 1.2160)	**0.0001**
Age	0.0708	0.0299	1.0734 (1.0123 - 1.1383)	**0.0179**
Marital/Cohabitation Status				
Not Married or Living with Spouse/Partner	0.6432	0.2492	1.9025 (1.1674 - 3.1006)	**0.0099**
Married or Living with Spouse/Partner			Ref	

Objective 2.3: Examine effect modification of gender by HED and secondary explanatory variables in relation to alcohol-related unsafe sex

Separate logistic regression analyses were conducted to evaluate whether gender modifies the relationship between alcohol-related unsafe sex and each of the explanatory variables. Only significant effect modifiers were to be entered into the logistic regression model with backward elimination. Overall, no statistically significant multiplicative interactions were found between gender and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, campus activities, or age and were thus not included in the logistic regression analysis with backward elimination procedures.

Table 17. Assessment of multiplicative interaction between alcohol-related unsafe sex and explanatory variables by gender for undergraduate university students

	Total Sample (N=4,437)			
Gender Interaction Terms	**Estimated Regression Coefficient**	**Standard Error**	**P-Value**	**OR (95% CI)**
Heavy Episodic Drinking X Gender	-	-	0.1606	-
Reasons for Consuming Alcohol X Gender	-	-	0.2829	-
Drinking Location X Gender	-	-	0.5804	-
Age First Intoxicated X Gender	-	-	0.3288	-
Drug Use in the Past Year X Gender	-	-	0.3802	-
Academic Campus Activities X Gender	-	-	0.9201	-
Recreational Campus Activities X Gender	-	-	0.2680	-
Age X Gender	-	-	0.6853	-
Marital/Cohabitation Status X Gender	-	-	0.9136	-

Chapter 5

5 Discussion

This study examined, through cross-sectional data from the 2004 Canadian Campus Survey, the prevalence and correlates of alcohol-related unsafe sex among young undergraduate university students. Reasons for consuming alcohol, drinking location, age first intoxicated, drug use, importance of campus activities, gender, and age were also examined as possible factors associated with unsafe sex. This study replicated past research by finding an association between alcohol use and unsafe sex but also extended existing knowledge by identifying additional risk factors associated with unsafe sex.

There were two primary objectives of this study. The first objective was to determine the extent of alcohol-related unsafe sex behaviour among undergraduate university students. This objective was carried out by calculating the proportion and its associated 95% confidence interval for undergraduate university students reporting alcohol-related unsafe sexual behaviour in the past school year.

The second objective of the study was to evaluate the associations between alcohol-related unsafe sexual behaviour and heavy episodic drinking (HED), reasons for consuming alcohol, drinking location, age first intoxicated, drug use, importance of campus activities, gender, and age. This objective was accomplished by calculating unadjusted relative risks and descriptive statistics using modified Poisson regression, and chi-square tests for categorical variables and t-tests for continuous variables associated with unsafe sex, separately. Next, adjusted associations with alcohol-related unsafe sex were calculated using logistic regression with a backward elimination technique and modified Poisson regression analysis to obtain relative risk estimates. Lastly, effect modification of gender by all variables was computed using logistic regression in order to assess whether factors of unsafe sex were different for males and females.

5.1 Consideration of Findings

5.1.1 Extent of Alcohol-Related Unsafe Sex

The proportion of undergraduate university students reporting having had unsafe sex due to alcohol consumption since the beginning of the school year was estimated to be at 7.37% (95% CI: 6.60% to 8.14%). Previous studies that have determined the proportion of students having alcohol-related unsafe sex in the past year have found that about 10% of university students reported the behaviour (Hingson et al., 2003; Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). Thus, the present figure of 7.37% might be considered to be similar but somewhat lower than previous estimates. It is important to note that these estimates were not weighted to account for non-response. Therefore caution should be taken when interpreting these estimates.

Prevalence estimates of unsafe sex may be underestimated in the current study. This may be due to the measure of unsafe sex, which is based on the broadly-worded question "have you had unsafe sex because of drinking" leaving the definition of "unsafe" up to participant interpretation. Students may consider the use of birth control as "safe" sex, even though they offer no protection against STIs. As well, a large percent of individuals also believe in withdrawal as a safe sex practice (Rogow & Horowitz, 1995). Furthermore, many individuals who are in monogamous relationships abandon the use of condoms because they believe that condom use is not essential to safe sex when they have trust in their partner (Flood, 2003). Additional implications of the study outcome question will be discussed in the limitations section of this chapter.

5.1.2 Factors Associated with Unsafe Sex

The second objective of the study was to evaluate the associations between alcohol-related unsafe sex and HED, reasons for consuming alcohol, drinking location, age first intoxicated, drug use, importance of campus activities, gender, and age.

5.1.2.1 HED

The results of the present study indicated that HED was significantly associated with unsafe sex. First, the bivariate analyses showed that HED was positively associated with

unsafe sex and these findings are consistent with studies on the global association between alcohol use and unsafe sex (Broman, 2007; Nikula et al., 2009; Wechsler et al., 1995). For example, in a study of young adults, students who drank once a week or more were significantly more likely to report non-use of condoms at their last intercourse than their counterparts who drank less than once a week (Nikula et al., 2009).

In addition, in the present study, HED remained significant in the final multivariable model after controlling for marital/cohabitation status. This was also seen in similar studies testing this association; in a study by Nikula et al. (2009), drinking once a week or more was still found to be significantly associated with non-use of condoms even after controlling for marital/cohabitation status and other sociodemographic factors. Comparing the reported odds ratios from the present study and the those of Nikula et al.'s (2009) study show a positive indication that the magnitude of the association between the two studies was similar (OR: 1.70, 95% CI: 1.286 - 2.234 vs. OR: 1.59, 95% CI: 1.10 – 2.30).

The results from the present study support the theory of Alcohol Myopia by Steele and Josephs (1990) who postulated that alcohol causes the individual to only focus on those cues in the environment that are most salient and immediate to them. An intoxicated individual does not process all incoming relevant information and only focuses on impelling cues, such as sexual arousal, rather than focusing on the consequences of their unprotected sex (MacDonald et al., 2000a).

However, this observed association between HED and unsafe sex may be attributed to an underlying third variable. This association may be fully or partially accounted for by thrill seeking or impulsive personality factors such that individuals with these personality traits are more likely to excessively consume alcohol and engage in risky sexual behaviours (Justus, Finn, & Steinmetz, 2000). Furthermore, the association between HED and unsafe sex could also be partly determined by drinking expectancies. Learning theory explains that individuals store memories about prior experiences of alcohol's effects on their behavior that would then lead alcohol to be a cue that would activate unsafe sexual behaviours (LaBrie et al., 2002).

5.1.2.2 Reasons for Consuming Alcohol

The results of the present study indicated that in both bivariate and multivariate analyses, reasons for drinking were positively associated with unsafe sex. Notably, compared to drinking to enjoy taste/have with meal/other, coping motives and drinking to get high or drunk as reasons for drinking were found to be significantly associated with an increased likelihood of reporting unsafe sex, while social motives for drinking were not found to have a significant association with unsafe sex compared to drinking to enjoy taste/have with meal/other.

Previous literature relating to motivations for drinking and unsafe sex is limited. One study, conducted by Abdala et al. (2013) looked at drinking to enhance mood and drinking to facilitate sex but did not find an association with unprotected sex with non-main partners. Although this study did not find a positive association, it is not possible to compare these findings to the present study as a different set of motivations was assessed for the present study.

Evidence from the present study suggests that drinking to relax or forget worries and drinking to get drunk play an important role with respect to unsafe sex. Coping motives for drinking could indicate that a student is using alcohol in order to cope with stress or tension. A study by Hall, Moreau, Trussell, Barber (2013) found that women who experienced psychological stress were less likely to use contraception. As well, students who drink to get high or drunk believe that it is widely acceptable for young adults to engage in excessive drinking as they perceive a lack of responsibility (Coleman & Cater, 2007). A perceived lack of responsibility may be related to unsafe sex. Lastly, social motives for drinking was not found to be significantly associated with unsafe sex. Perhaps students who drink for social motives are less likely to consume excessive amounts of alcohol because they may be attempting to create a balance between wanting to increase social confidence by drinking but also avoid embarrassment by limiting alcohol intake (Coleman & Cater, 2007).

Although the present study found a positive association between reasons for drinking and unsafe sex, this topic is understudied and would benefit from further investigation.

Particularly, future studies should include event-level data assessing how drinking motivations at the time of the sexual event influence the likelihood of unsafe sex.

5.1.2.3 Drinking Location

The bivariate analyses showed that drinking location was positively associated with unsafe sex. Specifically, students who reported drinking in a bar/disco/pub/tavern and at a residence or fraternity/sorority house were more likely to report having unsafe sex than those who drank at a restaurant or “other". One study by Staras et al. (2012) found that adolescents who had unprotected sex were more likely to meet their partner in a public place, such as in a bar, nightclub or on the street, versus in a school.

Despite being highly significant in the bivariate analysis, drinking location was not found to be significant in the multivariate analysis. It was not possible to compare the results of this study with other studies in the literature as to our knowledge no previous study has examined unsafe sex and drinking locations in a college age population. The lack of association between unsafe sex and drinking location in the multivariable model may suggest that the link between drinking locations and unsafe may be explained by the significant relationship between drinking location and HED ($p<.001$). Individuals who drink at certain establishments, such as bars, are more likely to be heavy drinkers. HED or binge drinking was not examined in Staras et al.'s (2012) study and may have accounted for the discrepancies in the findings. Previous studies have noted that venues such as bars and clubs (Clapp, Reed, Holmes, Lange, & Voas, 2006; Demers et al., 2002; Stockwell, Lang, & Rydon, 1993) as well as sorority and fraternity parties (Scott-Sheldon, et al., 2008) were significantly associated with heavy drinking. Overall, the findings of the present study do not provide support for a direct association between drinking venues and unsafe sex.

5.1.2.4 Age at First Intoxication

The proportion of undergraduate university students reporting having been drunk before the age of 13 was estimated to be at 4.17 % (95% CI: 3.58% to 4.76%). This rate is somewhat comparable with the data in the literature. For example, Hingson et al. (2003)

found that 3% of students reported intoxication before age 13 and Calvert et al. (2010) found that 15% of students reported having had their first drink before 13 years of age.

Despite being significantly associated with alcohol-related unsafe sex in the bivariate analysis, age at first intoxication was not found to be significant in the multivariate analysis. This finding is not consistent with prior research as studies looking at the association between age at first drink or age first drunk and unsafe sex have found a positive association even when controlling for current drinking patterns (Calvert et al., 2010; Hingson et al., 2003). For example, according to Hingson et al. (2003), the earlier in age at which individuals were first intoxicated, the greater the likelihood that they reported having unprotected sex in the past year due to drinking even when controlling for frequency of binge drinking and other characteristics.

These conflicting findings may suggest that the prevalence of unsafe sex associated with age at first intoxication was accounted for by the remaining significant variables in the model. For example, previous studies did not account for participants' reasons for drinking as another factor explaining unsafe sexual behavior in their multivariable analyses. Reasons for drinking was also found to be significantly intercorrelated with age at first intoxication ($p = 0.019$). Age of intoxication was also significantly associated with HED, marital/cohabiting status, drug use, age and importance of recreational activities. These variables were found to explain alcohol-related unsafe sex in the final multivariable model. Thus, these variables, alone or in combination, may have explained, at least partially, the significant bivariate association found between age of first intoxication and alcohol-related unsafe sex. However, the roles of age at first intoxication should not be completely dismissed in explaining unsafe sexual behaviour due to the abovementioned inconsistencies in the literature. Further research is required in order to examine these associations.

5.1.2.5 Drug Use

Evidence from the present study suggested that drug use was important in explaining unsafe sex among young adults. Marijuana and illicit drug use was significantly associated with unsafe sex in both the bivariate and multivariate model. These findings

are consistent with other studies on this association (Abdala et al., 2010; Anderson & Mueller, 2008; Benotsch, Koester, Luckman, Martin, & Cejka, 2011; Patrick et al., 2012; Simons et al., 2010). For example, in a study by Patrick et al. (2012), marijuana use in the past 30 days and illicit drug use in the past year was associated with a decreased frequency of condom use in the past year.

Furthermore, as with alcohol, drug use may cause disinhibited behaviour (Spinella, 2003) which in turn would also impact sexual behaviour. However, as was previously discussed with HED, the association between drug use and unsafe sex may be fully or partially accounted for by an underlying third variable, such as thrill seeking or impulsive personality factors (Schafer, Blanchard, & Fals-Stewart, 1994; Winters, Botzet, Fahnhorst, Baumel, & Lee, 2008).

5.1.2.6 Importance of Campus Activities

Importance of engaging in campus activities was found to be positively associated with unsafe sex, only for recreational activities. According to the results of the analysis, recreational campus activities but not academic campus activities was found to be significant at both the bivariate and multivariate level. Students who rated involvement in recreational campus activities with greater importance were more likely to report engaging in unsafe sex.

Due to the paucity of research on various campus activities and unsafe sex, it was not possible to compare results of the present study with prior research. However, there has been research on affiliation with on-campus activities such as athletics (Kokotailo et al., 1996; Wetherill & Fromme, 2007) and fraternity and sorority organizations (Scott-Sheldon et al., 2008). For example, Wetherill and Fromme (2007) found that collegiate athletes, relative to non-athletes, had greater instances of unsafe sex. Furthermore, because students are engaging in social activities they may be more likely to be interacting with a greater number of potential sexual partners than students who place a lower importance on involvement in recreational activities.

The association between recreational campus activities and unsafe sex may stem from an underlying factor, such as a sensation-seeking personality, that would lead an individual to engage in both behaviours. Another equally important finding in this relationship was that academic campus activities was not negatively associated with unsafe sex considering research showing that greater academic involvement is negatively associated with risk behaviours (Costa, Jessor, & Turbin, 2007). This lack of finding is perhaps due to students only reporting on the importance of engaging in the activity rather than on their actual involvement. Further research is needed to examine how engaging in the various sorts of campus activities, specifically athleticism and campus parties, influences risky sexual behaviour.

5.1.2.7 Gender

The results indicated that gender was not found to be associated with alcohol-related unsafe sex at the bivariate and multivariate level. Studies examining this association have shown inconsistent results with some studies showing an increased risk of unsafe for men compared with women (Hittner & Kennington, 2008; LaBrie et al., 2002; Poulson, Eppler, Satterwhite, Wuensch, & Bass, 1998) and others showing no gender differences (Rehm et al., 2012). For example, Hittner et al. (2008)'s study found that males were significantly more likely than females to have sex without the use of a condom while high or drunk. However, the studies that have found gender differences in unsafe sex also found sex differences in binge drinking rates. A bivariate analysis conducted using chi-square test in the present study did not reveal a gender difference in HED.

5.1.2.8 Age

Age was found to be positively associated with unsafe sex, but only at the multivariate and not at bivariate level. The significant association at the multivariate level may be explained by a third variable included in the multivariate model. Additional analyses were conducted to identify whether a particular variable that was found to be significant in the multivariable model altered the effect found for age. These analyses revealed that the relationship between age and unsafe sex only became significant once marital-cohabitation status was controlled for in the model. Notably, increasing age was found to

be significantly associated with marital/cohabitation status ($p < .001$) in the preliminary analyses. Thus, there may be a suppression effect whereby the effect of age is only apparent when cohabiting/marital status is accounted for.

Studies looking at the association between age and unsafe sex at the multivariate level have also found a significant association (Bailey et al., 2012; Patrick et al., 2012; Randolph et al., 2009; Walsh et al., 2013). For example, Bailey et al. (2012) found that age was inversely associated with a dual use of condoms along with another form of birth control; increasing age led to a decreased use of contraception. Comparing the reported odds ratios from the present study and the those of Bailey et al.'s (2012) study show a positive indication that the magnitude of the association between the two studies was similar (OR: 1.09, 95% CI: 1.014 - 1.160 vs. OR: OR = 1.22, 95% C.I. = 1.075 - 1.389).

This association between increasing age and greater likelihood of unsafe sex may seem contradictory at first since students' knowledge of safe sex practices would not be expected to decrease with age. However, as students become older they may have multiple, serial sexual relationships (MacDonald et al., 1990) and in the interest of maintaining the relationship they may communicate commitment to their partner by engaging in unsafe sex (Willig, 1997). Though age only accounted for a small effect, these results are still important and may reflect a need for future studies to investigate the necessity of partner communication on safer sex in addition to HIV and STI knowledge.

5.1.3 Marital /Cohabitation Status as a Confounder

Marital/cohabitation status was found to be negatively related to engaging in alcohol-related unsafe sex at the bivariate and multivariate levels. Individuals who were married/cohabitating with a partner were less likely to report engaging in unsafe sex. Previous studies have not assessed unsafe sex but have found that marital status was positively related to non-use of condoms. A study conducted by Patrick et al. (2012) found that married participants reported less frequent condom use that did unmarried participants. Similarly, a study conducted by Oswalt, and Wyatt (2014) found that 30 day contraceptive use was higher among single individuals compared to individuals who were married or in a domestic partnership. This difference in study findings is related to the

measurement of the outcome variable (see Study Limitations). Individuals who are married or cohabitating may be less likely to view non-use of condoms as "unsafe" sex for the reason that, as was mentioned previously, individuals communicate commitment to their partner by engaging in unsafe sex (Willig, 1997).

5.1.4 Gender Differences in Factors Associated with Unsafe Sex

The present study also assessed gender differences in all factors associated with unsafe sex, including: HED, reasons for drinking, drinking location, age at first intoxication, drug use, importance of campus activities, and age. The results indicated that there was no evidence of multiplicative interaction by gender between any of the explanatory variables and unsafe sex. These findings are consistent with results obtained by Rehm et al.'s (2012) study which found no evidence that gender modified the relationship between alcohol consumption and intention of engaging in unprotected sex.

5.2 Study Strengths

The present study had several strengths worth noting. The findings make an important contribution to the literature by not only replicating but extending past research on alcohol use and unsafe sex as well as exploring additional factors associated with unsafe sex that were not previously examined. There have been very few if any studies done on campus activities, drinking location, reasons for drinking and their relation with unsafe sex. These results can thus be used as a foundation for further research in this area.

The proportion of people who said they engaged in alcohol-related unsafe sex is consistent with that recorded in other studies on young adults (Hingson et al., 2003; Wechsler et al., 1994). Furthermore, the present study measured HED, not just alcohol use in comparison to some studies in the existing literature (Leigh, 2002; Leigh et al., 2008; Schroder et al., 2009). This distinction is important as HED captures the consumption of a large number of drinks per occasion which approximates drinking to intoxication rather than measures which only capture how often people drink generally. This finding can provide a basis for further development of intervention strategies.

As well, many investigations assessed intentions of risky sexual behaviour (MacDonald et al., 2000b; Rehm et al., 2012; Zawacki, 2011) and did not measure actual behaviour as was done for this study. Focusing on condom use intentions may not translate to actual condom use as intention of risk behaviours that are measured in a lab may not reflect real world decision making.

Another important strength of this study is that marital-cohabitation status was assessed in order to control for potential confounding by this variable. As expected, marital status was significantly associated with unprotected sex, with unsafe sex less likely among those who were married or cohabiting as compared with individuals who were not married/cohabiting. Individuals who were married or cohabiting likely know of their partner's sexual history or would be willing to have children and thus would not find it necessary to use protection. Furthermore, individuals who were married/cohabitating with their partner are most likely to have been in a long-term relationship with their partner where sexual histories are known and thus be less willing to use protection. Marital status/cohabiting was also associated with HED, with people who were married/cohabiting less likely to engage in this pattern of drinking. Thus, it was important to assess whether the association between HED and alcohol-related unsafe sex remained significant controlling for marital status.

An additional strength of this study was the utilization of random sampling methods. Random sampling requires that each member of the target population have an equal chance for inclusion in the study. Random sampling is an unbiased attempt at sample selection and therefore improves the external validity of the study.

Other strengths include utilizing a large sample size which provided adequate power to detect small effect sizes in the multivariable model. And lastly, the present study included a nationally representative sample of university students which increases generalizability of the findings.

5.3 Study Limitations

Despite the strengths of this study, there are several important limitations that need to be taken into consideration. One limitation of the present study relates to the measurement of the outcome variable. The CCS only asked participants if they had unsafe sex, not whether they were using condoms, leaving the definition of "unsafe" up to the participant to determine. This limitation is important as some individuals may believe that they are engaging in "safe" sex if they are using oral contraceptives even though they do not protect against HIV and STIs. One study found that women who used oral contraceptives were less likely to use a condom while in a steady relationship (Parks, Hsieh, Collins, Levonyan-Radloff, & King, 2009). Therefore, it is possible that the rate of unsafe sex is underestimated in the present study. As well, another important consideration in measurement of unprotected sex is whether the individual used the condom correctly as this is imperative to preventing the spread of disease.

Another limitation of the outcome variable is that it pertained to alcohol-related unsafe sex, not to unsafe sex generally. Thus the present study pertains to unsafe sex that occurs when drinking and the conclusions do not extend to unsafe sex that does not involve alcohol. The sample was restricted to recent drinkers who may be more likely to engage in HED and thus would be more likely to experience unsafe sex.

A further limitation of this study is that due to the cross-sectional nature of this study, causal inferences cannot be made about the relationship between unsafe sex and HED or other explanatory variables. Moreover, unsafe sex and HED were assessed as separate global measures and, as such, we were not able to investigate the precise role of alcohol in sexual events. Previously, studies reporting on the relationship between alcohol use and risky sex have fallen into three broad categories: (1) Global Association Studies, (2) Situational Association Studies and (3) Event-Level Analyses. (1) Global association studies (as with the present study) examine subjects' overall alcohol use (e.g. frequency or quantity) in relation to their general sexual behaviour (e.g. engaging in unprotected sex). However, such studies cannot infer a direct, causal link between substance use and sexual behaviour since they do not provide information about the two behaviours co-occurring on the same occasion. Positive associations have generally been found in

studies that employ this approach (Halpern-Felsher, Millstein, & Ellen, 1996). (2) Situational association studies examine unprotected intercourse by measuring either the frequency of condom use in a specified time period or as a dichotomous measure of whether or not condoms were used in the specified time period. Substance use is measured as either the number of times an individual engaged in sexual activity while using alcohol or as a dichotomous measure of whether or not the subject used alcohol while engaging in sexual activity. Despite providing an improvement over global association studies, there are inherent limitations in situational association studies since they do not establish whether alcohol was used on the same occasion as the incident of unprotected intercourse (Halpern-Felsher et al., 1996). (3) Event-level analyses examine a critical incident, and focus on the co-occurrence of alcohol use and sexual behaviours during a specific sexual incident (e.g. the first or most recent sexual experience). Information is gathered about safe or unsafe sex and the presence of alcohol during these specified events. These studies are thus considered the most rigorous studies as they ensure that alcohol use and high risk sex occurred on the same occasion thus strengthening casual inferences (Leigh, 2002).

Another limitation of this study is that skip patterns used in the 2004 CCS survey required a restriction of analyses to students who drank alcohol in the past month. Therefore, the results of this study are only generalizeable to recent drinkers (i.e., those who had consumed alcohol in the previous month). The majority (79%) of the CCS sample were recent drinkers who may be more likely to have sex and consequently be more likely to report unsafe sex. More research is needed on the role of alcohol in alcohol-related unsafe sex for people who are not recent or frequent drinkers. Additionally, information is needed on the number of times a person has sex to partial out the frequency of sexual activity.

One other key limitation of this study is that although we included cohabitation status, relationship status was not assessed. Prior research has identified partner type as a moderator of the alcohol and unsafe sex association (Certain et al., 2009; Kiene, Barta, Tennen, & Armeli, 2009; Patrick, 2013; Scott-Sheldon, Carey, & Carey, 2010). These studies have found that single students were more likely to use condoms after drinking

than those in a relationship. A study by Levonyan-Radloff, Parks, and Collins (2012) found that unprotected sex was more likely to occur in steady relationships compared with new partners. Individuals in a steady relationship see their partners as posing little health risk (Parks et al., 2009; Willig, 1997) and are also less likely to negotiate condom use (Brown & Vanable, 2007).

An additional limitation is that some researchers have suggested that the association between alcohol and unsafe sex is explained by an underlying third variable. Many studies have identified sensation-seeking (Chandra, Krishna, Benegal, & Ramakrishna, 2003; Justus et al., 2000), sexual arousal clouding one's judgement (Shuper & Fisher, 2008), lower agreeableness (Turchik, Garske, Probst, & Irvin, 2010) and impulsivity (Zuckerman & Kuhlman, 2000) as key factors related to unsafe sex, which were not assessed in the CCS survey.

In addition, the present study relied on retrospective self-report data which can influence results by increasing recall errors. Generally, recent events are recalled more accurately than past events. For example, students may not be able to recall the exact age they first became intoxicated. Additionally, students may not recall if a sexual event that co-occurred with alcohol involved condom use. An additional limitation is that social desirability bias may influence results. Individuals may not be likely to admit that they had engaged in unsafe sex. Furthermore, it is possible that individuals who are more likely to admit to HED are also more likely to admit to unsafe sex.

An additional limitation was that the overall response rate including campus participation and student completion was 26.7%, as mentioned in the methods section. The overall response rate is quite low and raises concerns about whether respondents differed from non-respondents. As well, since the study only included students, another potential concern is whether young adult students differed from non-students in terms of alcohol-related unsafe sex. One study found that non-students compared to college students were significantly more likely to report lifetime STD rates (4.4% compared to 3.3%) (Wu et al., 2009).

5.4 Implications for STI and AIDS Prevention

The results of the present study suggest that the prevalence of unsafe sex might be lessened by reducing the frequency of alcohol and drug use in young adults. Over half of students reported binge drinking in the past two weeks and nearly half of students reported using some type of drug in the past year, indicating a possible need for prevention programming to focus on HED and drug use.

An important finding in this study is that student's reasons for drinking have a unique influence on alcohol-related risky sexual behavior, even after controlling for heavy drinking. Specifically the results indicated that students who reported drinking to help them relax or forget about their worries or who reported drinking to get high or drunk were most at risk for having unsafe sex. This may suggest a need for intervention programs to focus on helping individuals become relaxed or forget about their worries in other ways besides alcohol. As well, because many students also believe that they need to drink for the purpose of getting drunk, prevention programs may be needed to dispel myths that excessive drinking is a necessary component of young adulthood.

One example of an intervention is the Brief Alcohol and Screening Intervention for College Students (BASICS). The program consists of two one-hour sessions. During the first session the students meet with a prevention specialist and are provided with alcohol education to identify patterns of alcohol use and consequences associated with alcohol use (DiFulvio, Linowski, Mazziotti, & Puleo, 2012). In addition, students complete an online questionnaire and receive a self-monitoring tool. During the second session, students receive a personalized feedback report that compares the student’s drinking behaviours to other students on campus and are provided with strategies to reduce alcohol-related consequences. Students in the intervention groups significantly decreased their alcohol consumption at follow-up (DiFulvio et al., 2012).

Other approaches may be needed that focus on promoting condom use when drinking. An example of an intervention is the decisional balance intervention developed for students who reported both infrequent condom use and heavy drinking (LaBrie, Pedersen, Thompson, & Earleywine, 2008). This intervention had participants generate a

comparative list of potential gains and losses for using condoms and rate their level of importance. This is especially beneficial for students who feel ambivalent towards using condoms as it encourages them to think of reasons to use condoms. After a 30-day follow-up, participants reported increases in actual condom use (LaBrie et al., 2008). This same intervention could also be improved by encouraging students to construct a balance sheet for alcohol consumption as well. Furthermore, a study conducted by Lewis et al. (2014) has shown that alcohol interventions combined with information on safe sex and contraceptive practices were the only effective interventions at reducing both alcohol consumption and alcohol-related unsafe sex compared to control groups.

5.5 Recommendations for Future Research

Future studies on the association of alcohol and unsafe sex need to obtain event-level data, where participants are asked to recall specific drinking occasions and report their drinking behavior and risky sexual behavior, in order to provide more precise estimates of the link between alcohol and unsafe sex.

One type of event analyses involves a laboratory study in which establishing causality is done by varying exposure, in this case Blood Alcohol Content (BAC), through experimental manipulation. Subjects are usually given either alcohol or a placebo. Some studies also used an active placebo, leading the participant to believe that they are consuming alcohol in order to control for the belief that alcohol would affect their behaviour. Doing so separates the pharmacological effects of alcohol from the effects of expectation (Leigh, 1990). However, caution must be taken when interpreting results of lab experiments. The major issue with event-analyses conducted in a laboratory is that they only assess whether a participant intends to use condoms rather than focusing on actual condom use behaviour (Rehm et al., 2012). As well, the artificial conditions limit the "in-the-moment" risk behaviour intentions that might occur in the real world at a bar or nightclub when rational decision making is not practiced. Furthermore, the BAC in experimental studies is usually capped at 0.10mg/ml which limits the researchers' ability of studying subjects who consume extensive amounts of alcohol (Rehm et al., 2012). It is highly likely that in real-life situations of sexual behaviour involving alcohol use, individuals reach much higher levels of intoxication than what is typically studied in laboratory studies (George et al., 2009). Randomized control trials are the most rigorous method for determining whether a cause-effect relationship exists, however, due to these inherent limitations, strong conclusions cannot be made about the likelihood of engaging in sexual behaviour.

Another type of event analysis uses within-subject design where participants serve as their own controls. This type of design controls for the effect of individual differences (e.g. sensation seeking, risk taking) that might affect the relationship between alcohol use and sexual risk behaviour (Halpern-Felsher et al., 1996). Generally studies that employ this type of design compare a participants' behaviour on two (or more) occasions where

sexual intercourse took place, with and without alcohol, and observe condom usage on each occasion. For example, diary studies allow the researcher to collect information on participants for an extended length of time. Diary methods are preferred because participants record events on the day that they occur thus reducing memory loss and recall bias.

Very few studies have employed a multiple event-level analysis and despite the advantages of using multiple event-level data, there are many concerns related to this type of methodology. Studies that have employed this type of methodology suffer from low to modest sample sizes due to the nature of the study. These studies produce less conclusive results than studies with larger sample sizes which would have greater power to demonstrate an association between alcohol and risky sex. Researchers must not only consider whether alcohol was used but also how much, unfortunately this standard has not been widely adopted. Another drawback is that the diary method can lead to a sensitization effect since participants are recording a large quantity of events which could result in increased self-awareness or a habituation effect leading to a decreased inclination towards responding in a socially desirable manner as time goes on (Kiene et al., 2009). Lastly, the vast majority of diary studies have examined only female participants and there are many reasons to believe that men may be less likely to be concerned about the dangers of unprotected sex (Amaro, 1995).

Even though there are some drawbacks to multiple-event level data, it is still the most rigorous method of evaluating the association between alcohol and unsafe sex. Some of these limitations can be overcome by increasing sample size and determining how much alcohol was consumed on each occasion.

Future studies should employ a within-subject design to compare an individual's condom use on more than one occasion and rule out any individual differences between participants (Cooper, 2006). As well, future studies must also compare these multiple events for each subject with and without alcohol (including quantity consumed). In addition, as outlined in the limitations section, future studies need to have a more precise definition of unsafe sex and must also take into account the relationship status of

participants. Overall, these recommendations will aid in understanding the dynamics of the relationship between alcohol use and risky sexual behaviour in the young adult population and contribute towards developing prevention programming.

5.6 Conclusion

Overall, findings from this study are consistent with Steele and Josephs's (1990) theory of Alcohol Myopia who proposed that alcohol's pharmacology causes an individual to only focus on impelling cues, such as sexual arousal making it difficult to allocate attention to inhibiting cues emphasizing the costs of unprotected sex. As with previous studies, drug use has also been found to be associated with unsafe sex, especially among illicit drug users, suggesting a need for intervention programs to focus on alcohol as well as drug use in prevention programs for unsafe sex.

Furthermore, the assessment of secondary explanatory variables with unsafe sex found that age, campus activities, reasons for drinking and drug use also play a role in explaining unsafe sex within the young adult population, suggesting that there are many factors associated with alcohol-related unsafe sex. These findings can have important implications for interventions; for example, interventions could include having prevention programming at campus events, particularly at recreational campus activities in order to reduce unsafe sex. However, further research is needed to assess if these additional factors are related to unsafe sex in event-level analyses.

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The University of Western Ontario
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2012-2014 M.Sc.

Honours and Awards:

Merit Scholarship
York University Entrance Scholarship
2007

Schulich Graduate Scholarship
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Global Opportunities Exchange Program
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Related Work Experience

Epidemiology Practicum
Middlesex-London Health Unit
2014

- Wrote report using survey data to identify the sociodemographic characteristics associated with cell phone use while driving to help guide public health activities, programs, and policy.
- Cleaned, coded, and analyzed data using SPSS for cell phone use survey data.
- Created annual graphical summaries of health indicator surveillance charts of health status in the Middlesex-London region related to chronic disease mortality.
- Presented research findings at a meeting with the London Middlesex Road Safety Committee.