Is There a “Low-Risk” Drinking Level for Youth? Exploring the Harms Associated with Adolescent Drinking Patterns

by

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B.Sc., University of New Brunswick, 2007

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

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in the Department of Psychology

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Abstract

Is there a low-risk drinking level for youth? The likelihood of engaging in risk behaviors (e.g. drinking and driving) as a function of alcohol use was examined in 540 youth from the Victoria Healthy Youth Survey, age 16-23 (M=19.5; 245 Males, 294 females). Logistic regression revealed that both the frequency and quantity of alcohol use matter in terms of determining one’s risk. Quantity of consumption in excess of the recommended ≤2 drinks/occasion (CAMH guidelines) substantially increases ones risk of harm; as does consumption >once a week. However, for those consuming at low quantity (≤ 2 drinks/occasion) and low or moderate frequency levels (≤ once a week) the risk did not exceed that experienced by abstainers and may be considered “low-risk”. It is suggested that youth require a special set of drinking guidelines that focus on quantity consumed/occasion followed by clear limits on the number of drinking days (frequency).
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Introduction

Alcohol consumption carries with it the risk of a host of adverse consequences. In the area of alcohol prevention and intervention, youth are considered to be an “at-risk” population, who are particularly susceptible to either the physical or the psychological effects of alcohol and are therefore more likely to experience adverse outcomes of drinking (ICAP, 2006). Youth are considered “at risk” for several reasons: First, due to developmental changes, youth have a greater sensitivity to ethanol-related impairments in brain plasticity, and heavy consumption in adolescence may affect the development of certain brain regions such as the hippocampus, which is involved in learning and memory (Brown, Tapert, Granholm, & Delis, 2000; Brown and Tapert, 2004; Spear, 2004). Second, youth lack experience with alcohol as well as the ability to gauge and enforce their own limits thus increasing the potential risk of harm from drinking (ICAP, 2006). Finally, compared to adults 25 years and older, youth are the population mostly likely to engage in risky patterns of alcohol use, typically characterized by the consumption of high quantities of alcohol per occasion, and therefore are the most likely to experience harms from their drinking (Health Canada, 2005). In light of the heightened risk of adverse consequences, it is important to identify how great the risk of harm is for youth at low, moderate, and high levels of alcohol consumption in order to develop effective prevention and intervention strategies.

Across the globe, many governments and professional groups have attempted to provide “low-risk” drinking guidelines for adults specifying a level of consumption which can be considered “safe” or “low-risk” for harm. Guidelines attempt to address both the risk of chronic harm, such as diseases, and acute harm, such as risk of injury
from traffic accidents, or social consequences (e.g. family conflict, financial problems),
by providing both a recommended weekly limit of total consumption and a recommended
daily limit (number of drinks/occasion; Bondy, Rehm, Ashley, Walsh, Single, & Room,
1999). In Canada, both Ontario (Centre for Addiction and Mental Health, CAMH; Bondy
et al., 1999) and British Columbia (Centre for Addictions Research of British Columbia,
CARBC, 2005) have developed low-risk drinking guidelines for adults. The CAMH
guidelines recommend no more than 2 standard drinks on any one day and up to 9
standard drinks a week for women and up to 14 a week for men (Bondy et al., 1999). The
CARBC guidelines specify no more than 4 drinks for females and 5 drinks for males on
any one day, and up to 10 drinks a week for women and up to 20 for men (CARBC
2005). National Canadian low-risk drinking guidelines are being drafted and currently are
consistent with CAMH guidelines (Stockwell, 2009).

Drinking guidelines are designed to address the risk of alcohol-related harm for
adults but do not take into account the wide variation in the types of risks and patterns of
alcohol consumption across the adult population. For example, young adults are a
population particularly at risk for acute alcohol-related harm, as opposed to the risk of
chronic harm for older adults (Stockwell, Zhao, & Thomas, 2009). Further, guidelines do
not currently exist for adolescents, who are not of legal drinking age but also frequently
engage in risky patterns of alcohol use and are at greater risk for alcohol-related harm
than adults (Health Canada, 2005). Adopting guidelines to address youth drinking is
complicated due to the mixed attitudes regarding underage drinking. There is ambiguity
regarding whether underage drinking is problematic merely because adolescents are
underage, or whether adolescents are especially susceptible to problems associated with
drinking (Arata, Stafford, and Tims, 2003). Further, harm reduction strategies, such as using low-risk drinking guidelines, that do not promote abstinence could result in a legal challenge as both Canadian federal and provincial laws prohibit the sale of alcohol and tobacco to minors (Poulin, 2006). In light of these issues, little research on the appropriateness of low-risk drinking guidelines for youth and young adults has been done and there is insufficient data thus far to allow a quantitative discussion of the relationship between different levels of alcohol consumption and the likelihood of harm for this adolescent and young adult population that could inform such guidelines.

This lack of data in part reflects that much research on alcohol-related harm has only examined relationships above some lower cut-off of drinking level (typically <5 drinks/occasion) which has overlooked the issue of levels of risks at lower levels of drinking (Room, Bondy, & Ferris, 1995). For example, the Canadian Addiction survey defines “light” drinkers as “usually fewer than 5 drinks/occasion”, and “heavy” drinkers as “usually 5 or more drinks/occasion” (Health Canada, 2005). In a study on alcohol use and injuries, “low” quantity of consumption was defined as “never five drinks at one time” (Cherpital, 1998). Further, many studies look at the frequency of binge drinking (consumption of 5 or more drinks/occasion), frequency of drunkenness, or ‘problem drinking’ (typically 5 or more drinks at one time) as measures of alcohol use (Poulin & Graham, 2001; Arata et al., 2003). Yet, these studies do not make a distinction between consuming at low and high levels of alcohol use, which may be associated with less risk.

Further, there is also substantial variation regarding what constitutes alcohol-related harm. Some studies focus only on physical health problems, such as the long-term risk of cancer or liver disease etc. (Rehm, Room, Graham, Monterio, Gmel,
Sempos, 1998). More recently, there has been an increase in studies focusing on social harms, such as experiences of school or family conflict, or occupational or financial problems (Ouellette, Gerrard, Gibbons & Reis-Bergan 1999, Bondy, 1996). However, experiences of physical health problems (or chronic harm) are unlikely in younger populations. Younger populations have been shown to be at much greater risk for experiencing acute harm or drinking in alcohol patterns consistent with risk for acute harm (Stockwell et al., 2009, Health Canada, 2005). The types of acute harm including in the development of low-risk drinking guidelines have traditionally focused on the risk of injuries (e.g. motor vehicle crashes), but have also began to include the adverse effects on social well-being (e.g. home life, work or financial problems; Bondy et al., 1999). Of concern however is that the measures used to assess acute harm do not usually employ operational definitions of risk or harm; leaving the definition of what constitutes harm up to individual respondent’s interpretation. For example, some survey questions ask: “was there ever a time that you felt your alcohol use had a harmful affect on: your friendships and social life? Physical health? Happiness? Home life or marriage? (Room et al., 1995). But using measures such as these may overestimate or underestimate the seriousness and long-term effects of the harms being experienced by individuals, as they do not account for the fact that some of these consequences may be transient, such as a hangover, while others are potentially more serious (e.g. injuries).

One type of acute harm that has not yet been examined in the context of developing drinking guidelines is the harm that can be experienced by engaging in high-risk behaviors. Alcohol use can have a serious health impact by increasing the likelihood of participating in risk behaviors that, in turn, can lead to other harms, such as suicide and
self-harm (Windle, Spear, Fuligni, Angold, Brown, Pine, et al., 2008), risky sexual behaviors (Bonomo, Coffey, Wolfe, Lyncskey, Bowes, & Patton, 2001; Derman, Cooper, Agocha, 1998; Fergusson and Lynsky, 1996; Windle et al., 2008) and the use of other drugs (Sutherland and Willner, 1998). These types of behaviors may be particularly important indicators of alcohol-related harm for adolescent and young adult populations.

Some studies have looked at specific harms or risk behaviors associated with alcohol consumption, such as harms from injuries or risky sexual behaviors. However, most studies examine these harms separately (alcohol and injuries, alcohol and sexual risks), which prevents comparison of the patterns of association for adolescents at risk for multiple types of harm (Bonomo, et al., 2001). Further, several risk behaviors may serve the same function and examining them together may aid us in better understanding patterns of risk.

In light of the fact that there is a paucity of literature on the risks associated with lower levels of alcohol consumption for this population, the objective of this study was to contribute to knowledge about the risk of harm for youth at different drinking levels, specifically low and moderate drinking levels. Further, because of the strong relationships found in the literature between engagement in high risk behaviors and alcohol consumption for this population, the likelihood of engaging in risk behaviors were examined as a measure of the likelihood of experiencing acute harm. I also investigated whether those consuming within the current CAMH drinking guidelines were at risk of engaging in these high-risk behaviors. The CAMH guidelines are examined because they have been endorsed by the Canadian Centre for Substance Abuse and Health Canada is currently considering the adoption of these guidelines in the
creation of National Canadian Adult Low-risk Drinking Guidelines.

Alcohol patterns for adolescents and young adults

Results from many national surveys indicate that rates of alcohol use and binge alcohol use (the consumption of five or more drinks/occasion) increase sharply between the ages of 12 and 21 (Masten, et al., 2008) but then decrease when individuals begin to take on adult roles (Bachman, O’Malley, & Schulenberg, 2002; Maggs & Schulenberg, 2004). The 2004 national Canadian Addictions Survey revealed that by the age of 24, 90.8% of Canadian youth have used alcohol, and 82.9% of these youth have used alcohol in the last year (Health Canada, 2005). Of these 82.9% of Canadian youth almost half of them (42.3%) reported drinking at low frequency levels (1-3 times/month) and over one third (33.8%) reported drinking at high frequency levels (1-3 times/week). Youth were also much more likely to drink 3-4 (29.0% vs. 18.6%) or 5 or more drinks per occasion than adult (33.7% vs. 12.6). Other reviews also report that youth between the ages of 12 and 20 years drink 5 drinks per occasion on average (Masten, et al., 2008; Substance Abuse and Mental Health Services Administration, 2006). The Canadian Addiction Survey also noted gender difference in drinking patterns: Males are more likely than females to drink more frequently and at higher quantities, and females are more likely to report moderate quantity (1-2 drinks) and low frequency drinking (≤1-3 times/month; Health Canada, 2005).

With regards to patterns of alcohol consumption, the most common alcohol use patterns for youth age 12-23 are abstention, light drinking, and occasional heavy drinking (Maggs & Schulenberg, 2004). Approximately one fifth to over two thirds of youth fall into one of these 3 drinking patterns. One analysis of the Canadian Addictions Survey
(CAS) reported that approximately 40% of youth, especially those below the legal drinking age, maintain a drinking pattern that is light infrequent (drink less often than once a week, usually fewer than 5 drinks) and many fewer youth frequently drink alcohol at heavy levels (14.5%; drink once a week or more, usually 5 or more drinks). However, these rates are based only on measures of volume of drinking.

Stockwell et al’s, (2009) analyses of the Canadian Addiction Survey measured quantity consumed per occasion, in addition to volume of drinking, and found that approximately 90% of the alcohol consumed by underage youth (15-18) and young adults (19-24) is consumed in patterns that exceed the adult low-risk drinking guidelines set forth by the CAMH guidelines. However, the data also suggest that a relatively small number of regular heavy drinkers account for the majority of alcohol consumed. The patterns of consumption identified for youth and young adults suggest that the majority of youth age 15-24 (~64-78%) consume alcohol within the CAMH recommended levels for chronic harm and approximately 40-50% consumed alcohol at low risk levels for acute harm (3-4 drinks for males, and ≤3 drinks for females per occasion, Australian guidelines; National Health and Medical Research Council, 2001). However, when compared to any other age group (15-18, 25-39, 40-64, 65+), young adults (19-24) were the most likely to report drinking above the CAMH guidelines for chronic harm (11.8%) and above the Australian guidelines for acute harm (43%). Gender differences showed that males 15-24 are most likely to consume alcohol at high risk levels for acute harm (5-7 or 8+ drinks per occasion), whereas females were most likely to consume alcohol at low risk levels for acute harm (≤3 drinks per occasion).

In sum, the majority of youth and young adults consume alcohol less frequently
than adults do, but on occasions when they do drink, they tend to drink much more, particularly young males (Health Canada, 2005). Further, young drinkers (15-24) are more likely than older populations to drink in excess of low risk drinking guidelines; particularly the recommended quantity limits for acute harm (Stockwell et al., 2009).

**Alcohol-related harm**

There are significant individual differences in patterns of drinking, and more than one dimension of drinking that may contribute to risk or harm. Frequency of consumption, quantity consumed per occasion and overall intake or volume (total number of drinks consumed/week) all contribute to risk of harm. For example, acute harm (e.g. injury, poisoning) is associated with quantity of alcohol consumed per occasion, whereas, chronic harm (e.g. liver disease, cancer) is a function of the total volume of alcohol consumed (frequency and quantity) over a longer period of time (Stockwell, et al., 2009). Further, frequency is a marker for exposure, with increasing frequency resulting in an increased chance of experiencing harm. Research on adolescent alcohol use and harms varies greatly in the how alcohol use is measured, with the majority of studies either using volume of drinking (frequency x quantity) or frequency of binge drinking or drunkenness (Arata, et al., 2003; Room, et al., 1995). Regardless of this variation, research consistently demonstrates that the greatest risk of harm occurs for adolescents and young adults that consume alcohol at high frequencies, and high quantities (Health Canada, 2005; Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998; Esobedo, Chorba, & Waxweiler, 1995). In light of the high quantity of alcohol consumption reported by youth (Health Canada, 2005; Stockwell et al, 2009), it should come as no surprise that the rate of harms associated with this pattern of drinking are also
significantly higher for youth than adults.

One in three youth, compared to one in ten adults, report that their drinking has caused harms to themselves or others at some time in their lives (Health Canada, 2005). Youth reported higher proportions of harm than adults 25 years and older in all areas of harm examined (friendships and social life, physical health, home life or marriage, work, studies or employment opportunities, financial position, legal problems, and learning) with the most prevalent types of past-year reported harms being harms to their friendships and social life, physical health, and financial position (7.6%, 12.0% and 8.7%, respectively). The Canadian Addiction Survey reported that youth who drank heavily at least monthly were approximately 5 times as likely to experience harms as those who did not (Health Canada, 2005). Furthermore, younger youth, age 18-19 were more likely to experience harms from drinking than older youth (age 20-24) when drinking at comparable levels.

Wechsler, et al. (1998) identified a dose-response relationship between the frequency and quantity of alcohol use and the number of alcohol-related problems among college students. Non-binge drinkers were the least likely to report these problems, frequent binge drinkers (consumption of 5 or more drinks on one occasion) were the most likely, and occasional binge drinkers were intermediate in their reports of problems. Other studies have also noted that higher frequency and quantity of drinking are associated with greater consequences (Arata, et al., 2003; Health Canada, 2005). A study of 930 high school students found that the most negative consequences (e.g. getting into arguments, risky sexual behavior, or passing out, etc.) were associated with those who consumed more alcohol, binged at least twice in the past 2 weeks, reported more liberal
drinking norms, and had more friends who got drunk (Arata, et al., 2003).

There appears to be a clear relationship between patterns of alcohol use and risk of harm and risk appears to increase in a more or less linear manner with the amount consumed (Bondy et al., 1999). Yet, as mentioned, there is substantial variation between studies regarding what constitutes “alcohol-related” harm. Studies for alcohol-related harm for this population have typically focused on two types of harm: health-related harm and social harm. Social harms include behaving in ways one regretted, getting into arguments because of drinking, being unable to remember the evening (Ouellette, et al., 1999), or experiencing problems in school, family conflict, interpersonal conflict, occupational or financial problems (Bondy, 1996). Health-related alcohol harms are often categorized into chronic harm, typically associated with long-term drinking patterns and volume of drinking, and acute harm, associated with dose per occasion and as little as a single drinking episode. However, for this population most studies focus on the risk of acute health related harms including trauma, such as injuries, drinking and driving accidents, and assault (Hingson, Heeren, Zakocs, Winter, & Wechsler, 2005).

The literature has also extensively examined the relationship between alcohol consumption and engagement in risk behaviors that can lead to harm for this population. The most common risk behaviors examined include risky driving behaviors, such as drinking and driving or riding with a drunk driver (Leadbeater, Foran, and Grove-White, 2008; Esobedo, et al., 1995; Gruenewald, Treno, and Mitchell, 1996), risk of injuries from alcohol use, risk of suicide or self-harm (Spirito, Rasile, Vinnick, Jelalian, & Arrigan, 1997; Windle, et al., 2008), risky sexual behaviors, such as multiple sexual partners or a sexually transmitted infection (Bonomo et al, 2001; Derman, et al., 1998;
Fergusson and Lynsky, 1996; Windle et al., 2008), as well as the relationship between alcohol use and the use of other, more hazardous, substances (Sutherland and Willner, 1998). These were also the types of risk behaviors examined in this study. The relationship between each risk behavior and alcohol use is reviewed below.

*Risky driving behaviors*

Injuries sustained in motor vehicle accidents are the leading cause of death for youth and young adults (Center for Disease Control and Prevention (CDC), 2006). A significant proportion of these incidents are alcohol-related collisions. Based on the report “The Alcohol-Crash Problem in Canada” (Mayhew, Brown, Simpson, & Ottawa, 2002), 55.2% of the deaths from motor vehicle accidents for youth under 19 years of age were alcohol-related crashes. On average, 14% to 22% of youth in grades 9-12 self report drinking and driving at least once within the last 30 days (Grunbaum, Kann, Kinchen, Williams, Ross, Lowry, Koble, 2002; Adlaf, Mann, Paglia, 2003; Escobedo, et al., 1995). Further, 23%-40% of Canadian and American Youth (grade 7-12) self-report riding with a driver impaired by alcohol or cannabis (Poulin, Boudreau, Ashbridge, 2006; Grunbaum et al., 2002; Adlaf et al., 2003; CDC, 2006). In a recent study of British Columbia adolescents, Leadbeater, et al., (2008) found that 53.5% of students (grade 10-12) reported that they had ridden in a car with an adult who had been drinking alcohol and 23.5 % reported riding with a peer driver who had been drinking. Furthermore, 26% of students reported riding with an adult who had been smoking cannabis and 33% reported riding with a peer who had been smoking cannabis.

Studies have shown that the prevalence of drinking and driving increases substantially with high frequencies of alcohol use and binge drinking (Esobedo, et al.,
Furthermore, there is a significant relationship between heavier episodic drinking and higher rates of riding with impaired drivers (Gruenewald, et al., 1996). While research finds that the relative risk of being involved in a crash is greater for young people at all blood alcohol concentrations and levels of drinking (Esobedo, et al., 1995), it is unclear what levels of drinking put an individual at risk for engaging in these types of risk behaviors in the first place. Further, it is expected that high frequency and quantity of drinking will increase the risk of drinking and driving and/or riding with a driver who has been drinking or smoking cannabis. However, the risk of participating in these behaviors at low or moderate frequency and quantity drinking levels is not known.

Injuries

Serious injuries are highest in adolescence compared to any other age group. Substance use is directly related to many adolescent injuries and often results in more frequent and more serious injuries (Spirito, et al., 1997; Sindelar, Barnett, & Spirito, 2004). The short-term physiological effects of alcohol, such as diminished coordination and balance, increased reaction time, and impaired attention, perception and judgment, increase the risk of injury (Cherpitel, 1993). Further, nonfatal deliberate self-harm is common among young people, especially females (Schmidtke, Brahe, De Leo, 1996; Hawton, Rodham, Evans, Weatherall, 2002; Hawton & James, 2005). Studies on adolescent injuries (grade 9-12) find a high incidence of self-reported alcohol and drug use at the time of injury, particularly for unintentional injuries such as falls and cuts, and for intentional injuries such as gun and assault injuries (Spirito, et al., 1997). Data from an emergency department study indicates that adolescent alcohol use (age 13-19) accounts
for 5% of general emergency department (ED) admissions, and nearly 50% of trauma admissions (Sindelar, et al., 2004). Another ED study found that more than 1/3 of the adolescents, 12-18 years old, who presented with an injury, tested positive for alcohol (Zautcke, Furtado, Morris, Uyenishi, & Stein-Spencer, 2005).

In many population studies that compare injured to non-injured persons, the injured are significantly more likely to report drinking prior to the incident and more frequent, heavy, and problem drinking (Cherpitel, 1993; 1998; Hingson, Heeren, Jamanka, Howland, 2000; McLeod, Stockwell, Stevens, & Phillips, 1999). There is also an incremental increase in deliberate self-harm associated with an increase in the consumption of alcohol for both genders (Schmidtke, et al., 1996; Hawton et al., 2002; Hawton & James, 2005). Not only are injured patients (age 14+, M = 33.3 years) more likely to report drinking within 6 hours prior to the injury event, they are more likely to report alcohol consumption 3 months and 24 hours before the injury, as well as report a higher mean number of drinks consumed, and consumption at harmful levels at least once a month (McLeod, et al., 1999). For example, 17% percent of persons who drank to intoxication at least once a week in the last year were injured during that year compared with 0.01% of drinkers that never drank to intoxication (Hingson, et al., 2000). These findings indicate that while injuries are typically a result of acute alcohol use on a single occasion, patterns of alcohol use prior to the incident may also be a good indicator of the risk of injury.

Further, one study found that the risk of injury increased with an average daily volume of one drink, and with the consumption of 5 or more drinks daily more frequently than twice a year (Cherpitel, 1998). These patterns suggest that risk for injury may be
increased at even relatively low levels of consumption. Findings are inconsistent regarding the risk of injury at low levels of drinking. Whereas, some researchers have not been able to identify a clear lower limit of alcohol consumption for those 15 years or older below which there was no significant risk of harm (Room, et al., 1995; Cherpitel, 1998), others have identified very low levels of risk for light drinkers age 15 years and older (McLeod, et al., 1999), or have found no difference in risk of injury between light drinkers and abstainers for adolescents grade 7-12 (Poulin & Elliot, 1997).

*Risky sexual behaviors*

The average age of first intercourse for Canadian youth is 16.5 years, and over 50% of adolescents have had sex by the end of high school. This number increases to 80% by the age of 24 (Rotterman, 2005). Sexual activity during adolescence provides opportunities for mastery and growth, but also is associated with costly health consequences if not responsibility managed (Cooper, 2002). The 2002 Canadian Sexually Transmitted Infections Surveillance Report indicates that STI infection rates, especially rates of Chlamydia and gonorrhea, are on the rise among Canadian youth age 15-24 (Public Health Agency of Canada, 2007). These harmful health consequences are a result of participation in risky sexual behavior, which can be defined as any behavior that increases the probability of negative consequences associated with sexual contact, including AIDS, other sexually transmitted diseases, and unplanned pregnancy (Cooper, 2002). Risky sexual behaviors can be divided into 2 categories: 1. Indiscriminate behaviors, including having multiple partners, and having casual or unknown partners; 2. Failure to take protective actions, such as use of condoms or contraceptives.

Research on the link between alcohol use and risky sexual behaviors has found
that alcohol use among adolescents and young adults age 10-30 increases the probability that they will engage in sexual intercourse and risky sex (Derman, et al., 1998; Cooper, 2002; Halpern-Felsher, Millstein, & Ellen, 1996; Windle, et al., 2008). Research conducted by Fergusson, & Lynskey (1996) suggest that adolescents who misused alcohol (high frequency and quantity of alcohol use, and alcohol-related problems) reported higher rates of sexual intercourse, and were more likely to report multiple sexual partners (3 or more), and higher rates of unprotected intercourse than those who did not misuse alcohol. Furthermore, drinking puts adolescents, 16 years or younger, at risk for early age of first intercourse which is a well-established sexually transmitted infection (STI) risk factor (Fergusson and Lynsky, 1996; Fortenberry, 1995). However, the association of alcohol with some risky sexual behaviors, such as condom use and multiple sexual partners is inconsistent. Some studies have found that patterns of alcohol use, rather than amount of alcohol consumed just before intercourse, are associated with decreased likelihood of condom use (Leigh, 1993; Temple, Leigh, & Schafer, 1993). Several researchers have found that approximately 10% of youth age 16-25 reported either having not used contraceptives, condoms, or both as a result of drinking (Windle, & Windle, 2005; Bonomo et al., 2001). But, only modest associations have been found between the number of sexual partners and alcohol use (Fortenberry, 1995, Poulin, & Graham, 2001), with one study reporting that rates of multiple partners were 2 to 3 times greater for heavy episodic drinkers compared to non-heavy episodic drinkers (Graves, 1995).

*Risky substance use*
Finally, findings have indicated that the use of alcohol by adolescents has important implications for future drug involvement (Agrawal, Grant, Waldrom, Duncan, Scherrer, Lynskey, et al., 2006; Bailey, 1992). Heavy use of alcohol, frequent binge drinking, and drinking to intoxication are patterns most often associated with polydrug use (Chassin, Pitts, & Prost, 2002; Baily 1992). While abstinence is associated with the nonuse of any illicit drug, binge drinkers are at the highest risk for illicit drug use and polydrug use (Donovan & Jessor, 1983; Tucker, Ellickson, & Orlando, 2005; Sutherland and Willner, 1998). One study reports that heavy high school drinkers were three to four times more likely to use illicit drugs compared to less frequent drinkers (Fiegelman, Gorman, and Lee, 1998).

Polydrug use is of particular concern because there is strong evidence that patterns of multiple substance use are predictive of increased risk of harms (Collins, Ellickson, & Bell, 1999). For example, polydrug users are at greater risk for drinking and driving (Esobedo, et al., 1995), higher frequencies and greater varieties of all types of substance use, and engaging in other risky behaviors such as having unprotected sex (Fiegelman, et al., 2002). While most adolescent research on polydrug use has focused on concurrent polysubstance use (CPU); a style of ingestion where more than one drug is reported to have been consumed over recent weeks or months, there is less research investigating adolescent simultaneous polysubstance use (SPU), which is the ingestion of multiple drugs on a single occasion (Collins, et al., 1999). SPU is a particularly dangerous form of drug use because, relative to the use of the same substances in isolation (CPU), the additive or interactive effects of SPU are associated with a greater number of traffic accidents, higher levels of psychomotor impairment, increases in
toxicity, and a greater likelihood of death from overdose (Collins, et al., 1998).

Unfortunately, when alcohol is used heavily by adolescents it is most often used in combination with other licit and illicit substances, which carries a higher risk of adverse consequences (Bailey, 1992; Smit, Monshouwer, & Verdurmen, 2002; Martin, Clifford, & Clapper, 1992).

*The current study*

There is strong evidence that engagement in high-risk behaviors is linked to alcohol use for this population, especially for those consuming at elevated or high risk levels, typically characterized by high frequency and high quantity of drinking. However, only a small proportion of youth account for this consumption pattern (Stockwell, et al., 2009). Many studies focus on the small number of youth who are drinking both frequently and heavily or on the significant proportion of youth that are consuming alcohol at high quantity levels (typically the consumption of 4 or more drinks per occasion for females, and 5 or more drinks per occasion for males; Bondy et al., 1999). However, the likelihood of engaging in these behaviors experienced by the large number of adolescents and young adults consuming alcohol at lower risk levels of consumption (low frequency and low quantity) has yet to be quantified (Bondy et al., 1999). Further, while there is strong evidence of a link between alcohol use and these types of risk behaviors which lead to harm, these risks have not been examined in the context of low-risk drinking guidelines. It is unclear whether the current CAHM guidelines are associated with less risk of engaging in these types of risk behaviors.

In order to inform alcohol education strategies, it is important to identify the risk of harmful behaviors at all drinking levels. More specifically, to identify the likelihood of
engaging in risky or harmful behaviors relative to abstainers, and where the threshold of risk lies along the drinking continuum. This study investigated the risk of acute alcohol-related harm, more specifically, the likelihood of engaging in high risk behaviors that can lead to harm. These risk behaviors were chosen because, according the literature examined above, youth often experience harm from engagement in these types of risk behaviors. This study has strong support for studying the associations between these specific risk behaviors and alcohol use based on relationships identified in past literature (Windle, et al., 2008; Bonomo, et al., 2001; Derman, et al., 1998; Fergusson and Lynsky, 1996; Sutherland and Willner, 1998). Further, while it is important to recognize that causal relationships will not be reassessed within the context and design of this study, the associations between these risk behaviors and alcohol use at different levels of intake will be examined for young males and females, both above and below the legal drinking age in Canada. This information is one kind of input that can help in the development of sound evidence-based advice to give young people about drinking, in order to reduce their likelihood of experiencing alcohol-related harm. The 10 risk behaviors included in this study fall into 4 categories: risky driving behaviors (drinking and driving, riding with a drunk driver, riding with a high driver), injuries (having a serious injury and self-harm), risky sexual behaviors (having multiple sexual partners, not using sexual protection, having an sexually transmitted infection) and risky substance use (concurrent polysubstance use and simultaneous polysubstance use).

This study had three main objectives: 1. Determine if individuals who consume alcohol within the recommended drinking levels outlined in the Draft Canadian Low-Risk Drinking Guidelines are more likely than abstainers to engage in risk behaviors that
can lead to harm. 2. Quantify the level of risk associated with low, moderate and high frequency and quantity levels relative to those who are abstinent and determine if there is a threshold level of alcohol consumption at which risk becomes significantly acute. 3. Determine if there are any age or gender differences in risk as a function of alcohol consumption.

   It was hypothesized that youth consuming alcohol within both the recommended daily ($\leq 2$ drinks/occasion) and weekly (1-9 drinks/week for females, 1-14 drinks/week for males) limits would be at no greater risk for engaging in risk behaviors than abstainers. However, youth who exceed one or both recommended drinking limits would significantly increase their risk; with those who exceed both recommended drinking limits at the greatest risk.

   Additionally, we hypothesized that youth consuming alcohol at the highest frequency and quantity levels would be at the greatest likelihood for engaging in risk behaviors that can lead to harm compared to abstainers. However, in light of the paucity of research on risk associated with low or moderate drinking levels, and previous findings demonstrating that increasing alcohol consumption is associated with increasing risk, it was predicted that individuals consuming alcohol at low frequency and quantity levels may not be at significantly greater risk than abstainers. Further, in light of the close relationship between frequency and quantity, it was expected that there would be evidence of threshold levels of alcohol consumption (a specific level of frequency or quantity) at which the risk of engaging in these behaviors becomes significantly acute. Finally, based on reports from past findings (Health Canada, 2005), it was expected that males would be at significantly greater risk than females when consuming alcohol at
comparable levels and that those below the legal drinking age (16-18) would be a greater risk than those above the legal drinking age (19-23).

Methods

Sample characteristics

The present study was based on secondary data analysis of the Victoria Healthy Youth Survey (VHYS), a longitudinal survey of adolescents in Victoria British Columbia, collected at the University of Victoria in the spring of 2003, 2005, and 2007. Participants were chosen from a random sample of 9500 private telephone listings, where 1036 households with an eligible youth (between the ages of 12 and 18 years) were identified. Of these, 187 youth refused to participate, and 185 parents or guardians refused their youth’s participation. At time 1, a total of 664 youth between age 12 and 19 participated (M=15.5 years, SD=1.93 years). At time 2, there was an 87% response rate; Time 3 had an 81% response rate. The present study is based on the responses of the 540 youth from wave 3, ages 16-23 (M=19.5, SD=1.95); 245 males (45.4%) and 294 females (54.4%). Only wave three was chosen for this study because some of the dependent variables were measured only at this time point. Of the 540 participants, 175 were in high school (Grade 10-12), 202 were attending a post-secondary institution and 163 were not attending school. Approximately 40% (N=209) of participants reported working part-time, 32% (N=177) were working full time and 28% (N=154) were not working.

Procedure

The Healthy Youth Survey (HYS) was administered to each participant in-person by trained interviewers. The interviews were conducted either in the participant’s home, or another location that provided a safe environment. Informed consent was obtained from the parents or guardians, and from the youth. Interviews took approximately one
hour to complete. The Healthy Youth Survey consisted of two parts. The interviewer administered part one to the youth and recorded their answers regarding demographics, bullying, peer victimization, and relationships with parents and peers. The second part was read aloud and participants recorded their own answers to ensure confidentiality. These questions were about use of illegal substances and delinquent activities. Youth received a $25 gift certificate to a music or food store for their participation.

Measures

The dependent variables in the present study were 10 risk behaviors commonly engaged in by this population which have been found to be associated with alcohol consumption. For logistic regression analyses, all dependent variables were dichotomized into yes, “did engage in the risk behavior”, and no, “did not engage in the risk behavior”.

Drinking and driving (DD) was assessed via self-report on one item. Participants were asked, “During the last 30 days, how many times did you drive a car or other vehicle when you had been drinking alcohol?”

Riding with a drunk driver (RDD) was assessed via self-report on one item. Participants were asked, “During the past 30 days, how many times were you in a car or other vehicle when driven by someone, including your parents, who had been drinking alcohol?”

Riding with a “high” driver (RHD) was assessed via self-report on one item. Participants were asked, “During the past 30 days, how many times were you in a car or other vehicle when the driver (including yourself) had been using marijuana or other drugs?”
Serious injury (SI) was defined according to the response to the question “In the past 12 months, did you have any injuries (such as broken bones, bad cuts, or sprains), that were serious enough to limit your normal daily activities?”

Self harm (SH) was assessed via self-report on one item. Participants were asked, “Have you ever harmed yourself in a way that was deliberate but not intended as a means to take your life?”

Multiple sexual partners (MSP) was defined as reporting 3 or more sexual partners in the 12 months prior to the survey (n = 113; Fergusson & Lynskey, 1996).

Not using sexual protection (NP) was defined as not always using some form of protection (e.g. “male condom, female condom, glove, finger cot or dental dam”) during sexual intercourse.

Sexually transmitted infection (STI) was assessed via self-report on one item. Participants were asked, “Have you ever been told by a doctor or nurse that you had a sexually transmitted infection?”

Concurrent polysubstance use (CPU) was defined as the use of 2 or more drugs within the past 12 months. Participants were presented with a list of drugs (marijuana, hallucinogens, amphetamines, club drugs, inhalants, cocaine, heroin, dilaudid and oxycotin) and asked to report whether or not they have tried these drugs, how old they were when they first tried them, and how frequently they have used them in the past 12 months. Tobacco was excluded from the list due to the limited risk of harm experienced by using tobacco and other substances.

Simultaneous polysubstance use (SPU) was defined as the consumption of 2 or more drugs within a three hour time period. Participants were presented with a chart and
asked to indicate the first time they ever used each of the pairs of substances together. Any combination of the following drugs: alcohol, marijuana, cocaine, hallucinogens, amphetamines, and club drugs. Participants were considered to be simultaneous polysubstance users if they reported ever using 1 or more pairs of substances simultaneously. Combinations including tobacco as one of the two substances were excluded from this variable due to the limited risk of harm experienced by using tobacco and in combination with other substances.

The independent variables in the present study comprised 2 demographic variables (age and gender) and three alcohol use variables (volume, quantity and frequency). Alcohol use is most often defined as some combination of how frequently respondents drink, and how much they typically consume on a single drinking occasion. However, there is substantial variation in how these variables are categorized (Escobedo, et al, 1995; Arata, et al., 2003; Cherpitel, 1998; Poulin & Graham, 2001; Costa, Jessor, & Turbin, 1999). In this study, frequency of drinking was assessed by one item: “How often in the past 12 months have you had a drink of beer, wine, liquor, or any other alcoholic beverage?” Participants responded on a five-point scale (1 = Never, 2 = A few times/year, 3 = A few times/month, 4 = once a week, 5 = more than once a week). However, in light of the small number of individuals engaging in risk behaviors when consuming alcohol “a few times/year”, those that consume alcohol “a few times/year” were combined with those who drink “a few times/month” to create a new variable called “≤ a few times/month”. In the present study, frequency is categorized as abstainers, ≤ a few times/month, once a week or more than once a week.
Quantity was assessed as a continuous variable with participants being asked to specify how many drinks they usually have on a given drinking occasion. Quantity was categorized as abstainers, 1-2 drinks/occasion, 3-4 drinks/occasion, and 5 or more drinks/occasion to allow investigation of the risk associated with low, moderate or high quantity levels relative to those that abstain. Categories were specified according to the CAHM Low-Risk Drinking Guidelines (Bondy et al., 1999), which specify that both males and females should consume no more than 2 drinks/occasion.

Volume is a measure of the average number of drinks an individual consumes per week and is typically calculated using the quantity-frequency (QF) method (Stockwell, et al., 2009). Using this method, each individual’s reported frequency of alcohol consumption was multiplied by their reported quantity of use to determine the average number of drinks consumed in the last year. This variable was divided by 52 to determine the average number of drinks/week consumed by each participant. Volume was then categorized according to the recommended weekly limits specified in the CAHM Low-Risk Drinking Guidelines (Bondy et al., 1999): 1 = abstainers, 2 = within the guideline (1-9 d/wk for females, 1-14 d/wk for males) 3 = above the guideline (10+ d/wk for females, 15+ d/wk for males).

Statistical Analysis

Using SPSS 16.0 (Kirkpatrick & Feeney, 2009), logistic regression (Wright, 1997) was used to examine the relative importance of age, gender and alcohol use in predicting the likelihood of engaging in risk behaviors. Odds ratios and 95% confidence intervals were used as estimates of the likelihood of engaging in risk behaviors at different levels of alcohol consumption. First, the CAMH guidelines were assessed in
relation to each risk behavior, controlling for age and gender. These findings were used to create a composite risk score, including only the risk behaviors that were found to be related to alcohol consumption in this sample. The CAMH guidelines were then reassessed using this composite risk score. Finally, the composite risk score was used to explore the gradient of risk at different levels of frequency and quantity separately, controlling for age, gender, and the opposing dimension of alcohol use, as well as the interaction between frequency and quantity. All models included age and gender as covariates and abstainers, males, and youth age 16-18 were used as the reference groups.

Results

Table 1 presents the proportion of respondents consuming alcohol at each level of frequency, quantity and volume, as well as age and gender differences in patterns of alcohol use. Of the 540 participants, 91.7% (N=494) reported consuming alcohol in the past 12 months and the greatest proportion of participants reported a frequency of consumption of \( \leq \) a few time/month (44.4%), a quantity of consumption of 5+ drinks/occasion (44.4%). Approximately 75% of participants reported consuming within the recommended volume levels outline in CAMH drinking guidelines (Bondy et al., 1999). Patterns of alcohol use were found to vary according to both age and gender, more males reported drinking at high frequency (>once a week; OR: 1.74; 95% CI: 1.17-2.57; p<0.01) and high quantity levels (5+ drinks/occasion; OR: 1.82; 95% CI: 1.28-2.57; p<0.001) and more females reported drinking at low frequency (\( \leq \) a few times/month; OR: 1.81; 95% CI: 1.27-2.57; p<0.001) and low quantity levels (1-2 drinks/occasion; OR: 1.72; 95% CI: 1.15-2.59; p<0.01). For age, almost 3 times more participants under the legal drinking age (16-18 years old) reported abstaining from alcohol use (OR: 3.32;
95% CI: 1.72-6.41; p<0.001) or drinking at low frequency levels (≤ a few times/month: OR: 2.08; 95% CI: 1.46-2.97; p<0.001) compared to those above the legal age. A greater proportion of participants above the legal drinking age reported consuming alcohol at high frequency levels (>once a week; OR: 3.26; 95% CI: 2.12-5.01; p<0.001). There were no age differences for quantity of alcohol use, however, those above the legal drinking age (19-23) were almost twice as likely to consume alcohol above the recommended volume guidelines (OR: 1.83; 95% CI: 1.12-2.99; p<0.05). In sum, 16.5% of respondents were drinking at levels that exceeded the recommended volume levels and 67.5% of respondents were drinking at levels that exceeded the recommended quantity level.
<table>
<thead>
<tr>
<th>Alcohol use</th>
<th>N (%)</th>
<th>16-18</th>
<th>19-23</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>45 (8.3)</td>
<td>31</td>
<td>14***</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>≤ a few times/month</td>
<td>240 (44.4)</td>
<td>123</td>
<td>117***</td>
<td>91</td>
<td>148***</td>
</tr>
<tr>
<td>Once a week</td>
<td>103 (19.1)</td>
<td>37</td>
<td>66</td>
<td>48</td>
<td>55</td>
</tr>
<tr>
<td>&gt; once a week</td>
<td>151 (28.0)</td>
<td>36</td>
<td>115***</td>
<td>81</td>
<td>70**</td>
</tr>
<tr>
<td><strong>Quantity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>45 (8.3)</td>
<td>31</td>
<td>14***</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>1-2</td>
<td>131 (24.3)</td>
<td>52</td>
<td>79</td>
<td>46</td>
<td>84**</td>
</tr>
<tr>
<td>3-4</td>
<td>125 (23.1)</td>
<td>47</td>
<td>78</td>
<td>47</td>
<td>78</td>
</tr>
<tr>
<td>5+</td>
<td>239 (44.4)</td>
<td>97</td>
<td>142</td>
<td>128</td>
<td>111***</td>
</tr>
<tr>
<td><strong>Volume</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>45 (8.3)</td>
<td>31</td>
<td>14***</td>
<td>24</td>
<td>21</td>
</tr>
<tr>
<td>Within guideline</td>
<td>400 (74.1)</td>
<td>166</td>
<td>234</td>
<td>180</td>
<td>220</td>
</tr>
<tr>
<td>(F=1-9d/wk, M=1-14d/wk)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above guideline</td>
<td>89 (16.5)</td>
<td>27</td>
<td>62*</td>
<td>39</td>
<td>50</td>
</tr>
<tr>
<td>(F=10+d/wk, M=14+d/wk)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *p<0.05, **p<0.01, ***p<0.001, a comparison of the proportion of participants consuming alcohol at different levels as a function of age and gender. Those age 16-18 and males were the reference groups.
Table 2 shows the proportion of respondents engaging in the 10 risk behaviors. For most of the risk behaviors, the proportion of respondents ranged from 20-30%. However, only 10% of respondents reported drinking and driving or having an STI, over 40% of respondents reported not always using sexual protection, and over 60% reported using two substances simultaneously. Participants above the legal drinking age were significantly more likely to report drinking and driving than those below the legal drinking age (OR: 2.47, p<0.01) and females were significantly more likely to report engaging in self-harm and having an STI than males (OR: 2.71 and 5.18, p<0.001). However, males were more likely to drink and drive, ride with a high driver, have a serious injury and use substances simultaneously than females.

Table 2 shows the odds of engaging in each of the 10 risk behaviors as a function of consuming alcohol within or above the recommended drinking levels outlined in CAMH Guidelines (Bondy et al., 1999) relative to the risk for abstainers. In light of the fact that the guidelines provide both a weekly volume limit and a daily quantity limit, a new variable was created to assess this risk: 1= abstainers, 2= within both the volume and quantity guidelines, 3 = exceed the quantity guideline but within the volume guideline, 4 = exceed both guidelines. Males and females were assessed according to their respective guidelines. Abstainers were the reference group. However, for those risk behaviors where abstainers had a cell size of less than 5, abstainers were recoded to also include those that drink on average <1 drink/wk.
<table>
<thead>
<tr>
<th>Variables</th>
<th>N(%)</th>
<th>DD (11.4)</th>
<th>RDD (26.0)</th>
<th>RHD (35.4)</th>
<th>SI (17.0)</th>
<th>SH (21.0)</th>
<th>MSP (11.8)</th>
<th>NP (17.0)</th>
<th>STI (27.5)</th>
<th>CPU (66.4)</th>
<th>SPU (40.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>-</td>
<td>58(11.4)</td>
<td>138(26.0)</td>
<td>187(35.4)</td>
<td>175(32.5)</td>
<td>91(17.0)</td>
<td>113(21.0)</td>
<td>220(41.0)</td>
<td>47(11.8)</td>
<td>136(27.5)</td>
<td>350(66.4)</td>
</tr>
<tr>
<td>16-18</td>
<td>227</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>19-23</td>
<td>313</td>
<td>2.47**</td>
<td>1.30</td>
<td>0.71</td>
<td>1.11</td>
<td>0.80</td>
<td>1.15</td>
<td>0.95</td>
<td>1.20</td>
<td>0.74</td>
<td>1.42</td>
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<tr>
<td></td>
<td>(58.0)</td>
<td>(1.27-</td>
<td>(0.85-</td>
<td>(0.47-</td>
<td>(0.76-</td>
<td>(0.49-</td>
<td>(0.75-</td>
<td>(0.66-</td>
<td>(0.60-</td>
<td>(0.48-</td>
<td>(0.93-</td>
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<tr>
<td></td>
<td></td>
<td>4.80)</td>
<td>1.97)</td>
<td>1.07)</td>
<td>1.63)</td>
<td>1.28)</td>
<td>1.77)</td>
<td>1.36)</td>
<td>2.37)</td>
<td>1.16)</td>
<td>2.17)</td>
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<td></td>
<td></td>
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<tr>
<td>Males</td>
<td>245</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<td>1.00</td>
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</tr>
<tr>
<td>Females</td>
<td>294</td>
<td>0.44**</td>
<td>0.89</td>
<td>0.62**</td>
<td>0.61**</td>
<td>2.71***</td>
<td>0.92</td>
<td>0.74</td>
<td>5.18***</td>
<td>1.05</td>
<td>0.55**</td>
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<td></td>
<td>(54.4)</td>
<td>(0.24-</td>
<td>(0.60-</td>
<td>(0.42-</td>
<td>(0.42-</td>
<td>(1.62-</td>
<td>(0.61-</td>
<td>(0.52-</td>
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<td>(0.68-</td>
<td>(0.36-0.84</td>
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<td></td>
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<td>0.78)</td>
<td>1.34)</td>
<td>0.93)</td>
<td>0.88)</td>
<td>4.52)</td>
<td>1.41)</td>
<td>1.05)</td>
<td>11.49</td>
<td>1.61)</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>45</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Within guidelines</td>
<td>135</td>
<td>4.84*</td>
<td>1.38</td>
<td>5.22***</td>
<td>0.63</td>
<td>1.25</td>
<td>0.98</td>
<td>2.18</td>
<td>1.27</td>
<td>3.20*</td>
<td>2.83*</td>
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<tr>
<td></td>
<td>(25.0)</td>
<td>(1.22-</td>
<td>(0.52-</td>
<td>(2.20-</td>
<td>(0.31-</td>
<td>(0.43-</td>
<td>(0.43-</td>
<td>(1.0-4.71)</td>
<td>(0.27-</td>
<td>(1.21-</td>
<td>(1.23-</td>
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<tr>
<td></td>
<td></td>
<td>19.13)</td>
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<td>3.64)</td>
<td>2.24)</td>
<td></td>
<td>6.05</td>
<td>8.42)</td>
<td>6.49)</td>
</tr>
<tr>
<td>Exceed quantity</td>
<td>270</td>
<td>5.60**</td>
<td>1.96</td>
<td>11.36***</td>
<td>0.79</td>
<td>1.41</td>
<td>0.89</td>
<td>2.68**</td>
<td>3.22</td>
<td>8.21**</td>
<td>13.52***</td>
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<td>guideline</td>
<td>(50.0)</td>
<td>(1.66-</td>
<td>(0.79-</td>
<td>(5.44-</td>
<td>(0.41-</td>
<td>(0.52-</td>
<td>(0.41-</td>
<td>(1.29-</td>
<td>(0.92-</td>
<td>(3.77-</td>
<td>(6.06-</td>
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<tr>
<td></td>
<td></td>
<td>18.95)</td>
<td>4.87)</td>
<td>23.71)</td>
<td>1.54)</td>
<td>3.87</td>
<td>1.92)</td>
<td>5.57)</td>
<td>11.31</td>
<td>17.90)</td>
<td>30.13)</td>
</tr>
<tr>
<td>Exceed guidelines</td>
<td>89</td>
<td>6.99**</td>
<td>5.82***</td>
<td>28.52***</td>
<td>0.98</td>
<td>3.24*</td>
<td>0.79</td>
<td>1.92</td>
<td>4.06*</td>
<td>22.55***</td>
<td>60.56***</td>
</tr>
<tr>
<td></td>
<td>(16.5)</td>
<td>(1.95-</td>
<td>(2.20-</td>
<td>(12.61-</td>
<td>(0.46-</td>
<td>(1.11-</td>
<td>(0.32-</td>
<td>(0.85-</td>
<td>(1.10-</td>
<td>(9.60-</td>
<td>(18.57-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.16)</td>
<td>15.36)</td>
<td>64.5)</td>
<td>2.09)</td>
<td>9.46)</td>
<td>1.93)</td>
<td>4.35)</td>
<td>15.02</td>
<td>52.98)</td>
<td>197)</td>
</tr>
</tbody>
</table>

Note: For variables with a cell size less than 5, including DD, RHD, STI, and CPU the reference group also included those consuming 1d/wk. Males and Females are analyzed according to their respective drinking guidelines. DD = drinking and driving, RDD = riding with a drunk driver, RHD = riding with a high driver, SI = serious injury, SH = self-harm, MSP = multiple sexual partners, NP = not using protection, STI = sexually transmitted infection, CPU = concurrent polysubstance use, SPU = simultaneously polysubstance use. *p > 0.05, **p > 0.01, ***p > 0.001
Research question one investigated whether those consuming alcohol within the recommended drinking guidelines were more likely to engage in risk behaviors than abstainers. Table 2 reveals that for 4 of the 10 risk behaviors, including DD, RHD, CPU and SPU, even individuals consuming alcohol within both of the recommended drinking levels were still at significantly higher risk than abstainers. In total, eight of the ten risk behaviors examined, DD, RDD, RHD, SH, NP, STI, CPU and SPU, were significantly related to alcohol consumption. Neither reporting a serious injury or multiple sexual partners were related to alcohol use in this sample. In general, the findings show evidence of a linear relationship between alcohol use and engagement in risk behaviors. As the level of alcohol consumption increased, the odds of engaging in each risk behavior also increased. Those that exceeded both drinking guidelines were at the highest risk of engaging in these behaviors.

The findings from Table 2 were used to create a composite risk score. All risk behaviors that were found to be associated with alcohol use in Table 2 were used to create the variable: “1 or more risk behaviors”. This composite risk score was used in all further analyses to increase statistical power. Further, low-risk guidelines are not typically developed for specific risks, but overall risk. Therefore, all subsequent analysis determined the risk of engaging in 1 or more risk behaviors as a function of alcohol consumption.

In light of the findings in Table 2, the CAMH guidelines were adapted to test whether the creation of more restrictive guidelines would be associated with less risk. Table 3 presents the likelihood of engaging in 1 or more risk behaviors as a function of consuming within vs. above the CAMH drinking guidelines and the adapted (more
restrictive) guidelines. The adapted guidelines were created by cutting the current recommended volume guidelines in half (females = 1-5 drinks/wk; males = 1-7 drinks/wk). Data are presented in Table 3 for the total sample, as well as stratified by gender in light of the difference in recommended drinking levels laid out in the guidelines. Interactions between age, gender, and alcohol use were tested, but were not significant and thus were excluded from the model. Abstainers served as the reference group.
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>CAMH drinking guidelines</th>
<th>Adapted guidelines*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N(%)</td>
<td>Odds Ratio and 95% CI</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>Males</td>
</tr>
<tr>
<td>Overall</td>
<td>450</td>
<td>1.00</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16-18</td>
<td>182(40.4)</td>
<td>1.00</td>
</tr>
<tr>
<td>19-23</td>
<td>269(59.6)</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.72-1.97)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>213(47.3)</td>
<td>1.00</td>
</tr>
<tr>
<td>Female</td>
<td>237(52.7)</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.36-1.01)</td>
</tr>
<tr>
<td>Alcohol use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>22(4.9)</td>
<td>1.00</td>
</tr>
<tr>
<td>Within guidelines</td>
<td>97(21.6)</td>
<td>2.82**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.37-5.81)</td>
</tr>
<tr>
<td>Exceed 1 guideline</td>
<td>245(54.4)</td>
<td>10.26***</td>
</tr>
<tr>
<td>Exceed guidelines</td>
<td>86(19.1)</td>
<td>30.38***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(8.12-112.5)</td>
</tr>
</tbody>
</table>

*a The adapted guidelines specify that females should consume no more than 1-5 drinks/wk and males no more than 1-7d/wk. The recommended quantity level remains the same (2 drinks/occasion). *p<0.05, **p<0.01, ***p<0.001
Overall, those consuming within the recommended drinking levels, for both the CAMH and adapted guidelines, were still at significantly higher risk of engaging in 1 or more risk behaviors relative to abstainers. Logistic regression revealed a clear gradient between the likelihood of engaging in 1 or more risk behaviors and increasing use of alcohol for both the CAMH guidelines (OR: 2.82, 10.26 and 30.38, p<0.001) and adapted guidelines (OR: 2.83, 8.45, 36.73, p<0.001). Even those consuming within both the recommended volume and quantity levels were at 2.8 times greater risk (p<0.01) of engaging in 1 or more risk behaviors than abstainers (See Table 3).

Table 3 shows that age and gender were not independent risk factors for engaging in 1 or more risk behaviors once alcohol use was taken into account. However, analyses were also stratified by gender due to the difference in the recommended drinking guidelines. These findings revealed that males were not at significantly greater risk than abstainers as long as they consumed alcohol within both recommended drinking levels. However, males who exceeded the recommended quantity level were at 8 times greater risk of engaging in 1 or more risk behaviors relative to abstainers. The risk for males exceeding both quantity and volume guidelines could not be calculated because there were no males, exceeding both guidelines, who were engaging in 0 behaviors (reference group). It can be assumed from the patterns of risk shown thus far that males drinking at this level were at the highest risk for engaging in 1 or more risk behaviors. In contrast, the findings for females suggests that even those consuming within both of the recommended drinking levels were still at 4 times greater risk (p<0.01) of engaging in 1 or more risk behaviors than abstainers, for both the CAMH and adapted guidelines (See
Table 3). Females consuming alcohol at levels that exceeded both of the recommended drinking limits were at the highest risk.

In sum, Table 3 shows that males who consumed alcohol within both the recommended quantity and volume levels can maintain a low level of risk for engagement in risk behaviors. Further, the findings suggest that the current recommendations for males may be appropriate for this young adult population (19-23) and older adolescents (16-18) as no age differences in risk were found. Females however are at substantially higher risk of engagement in 1 or more risk behaviors than abstainers even when consuming within the adapted guidelines, which specifies no more than 1-5 drinks/wk and \( \leq 2 \) drinks/occasion. Further, making the current drinking guidelines more restrictive did not demonstrate a substantial decrease in risk.

The absolute risk of engaging in 1 or more risk behaviors as a function of consuming within vs. above the guidelines was calculated to provide insight into the size of the extra risk associated with exceeding the CAMH drinking guidelines (See Figure 1). Figure 1 shows that compared to the risk for abstainers, the risk of engaging in 1 or more risk behaviors increased by about 30% for those consuming within both guidelines. The risk for those that exceed one guideline increased by 40-50%, and for those that exceed both guidelines, there is 100% chance of engaging in 1 or more risk behaviors. Of note, is that the risk of engaging in 1 or more risk behaviors for abstainers is about 40%, indicating that alcohol is not the only contributing factor to this risk. However, the substantial increases in risk as a function of increasing consumption indicate that it is still a key contributing factor.
Figure 1. The probability of engaging in 1 or more risk behaviors as a function of consuming within vs. above the recommended drinking guidelines.
Research question two investigated the level of risk associated with consuming alcohol at low, moderate or high frequency and quantity levels. Results are presented in Table 4. Taking into account all demographic variables and the frequency of alcohol consumption, consuming more than 2 drinks/occasion was found to be an independent risk factor for engaging in 1 or more risk behaviors (See Model 1, Table 4). Those consuming at moderate quantity levels (3-4 drinks/occasion) were at 2.7 times higher risk than abstainers (p<0.05) and those consuming 5+ drinks/occasion were at the highest risk (OR: 4.98, p<0.01). However, those consuming at low quantity levels (1-2 drinks/occasion), which is consistent with the recommended guideline levels, were not at significantly higher risk than abstainers; suggesting consumption at this level may be considered “low-risk”.

Controlling for age, gender and quantity, consuming at a frequency level of more than once a week was also found to be an independent risk factor for engagement in 1 or more risk behaviors (See Model 1, Table 4). While there was a pattern of increasing risk associated with increasing frequency, those consuming at low or moderate frequency levels (≤ a few times/month or once a week) were not at significantly higher risk of engaging in 1 or more risk behaviors compared to abstainers. Those consuming more than once a week were at 4.5 times higher risk of engaging in 1 or more risk behaviors than abstainers (p<0.05). Of note, no interaction effects were found between age, gender and alcohol use, nor was there any evidence of independent effects of age or gender after controlling for alcohol use. The gradient of risk for engaging in 1 or more risk behaviors as a function of the frequency and quantity of alcohol consumed is presented in Figure 2a and 2b.
<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N(%)</th>
<th>Unadj. OR(95% CI)</th>
<th>Adj. OR (95%CI)</th>
<th>Adj. OR (95%CI)</th>
<th>Adj. OR (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td>Model 1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Model 2&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>16-18</td>
<td>182(40.4)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>19-23</td>
<td>269(59.6)</td>
<td>1.51</td>
<td>1.01</td>
<td>1.02</td>
<td>1.03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.96-2.39)</td>
<td>(0.60-1.72)</td>
<td>(0.60-1.73)</td>
<td>(0.61-1.75)</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>213(47.3)</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Female</td>
<td>237(52.7)</td>
<td>0.63</td>
<td>0.67</td>
<td>0.67</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.39-1.00)</td>
<td>(0.39-1.14)</td>
<td>(0.39-1.14)</td>
<td>(0.39-1.11)</td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>22(4.9)</td>
<td>1.00</td>
<td>1.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1-2 drinks</td>
<td>95(21.1)</td>
<td>2.76**</td>
<td>1.12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.37-5.55)</td>
<td>(0.46-2.73)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3-4 drinks</td>
<td>109(24.2)</td>
<td>7.12***</td>
<td>2.70*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.25-15.62)</td>
<td>(1.01-7.19)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5+ drinks</td>
<td>225(49.9)</td>
<td>16.80***</td>
<td>4.98**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7.58-37.23)</td>
<td>(1.72-14.39)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Frequency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstainers</td>
<td>22(4.9)</td>
<td>1.00</td>
<td>-</td>
<td>1.00</td>
<td>-</td>
</tr>
<tr>
<td>≤ a few times/month</td>
<td>190(42.1)</td>
<td>3.97***</td>
<td>-</td>
<td>1.08</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2.05-7.70)</td>
<td>(0.44-2.66)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Once a week</td>
<td>94(20.8)</td>
<td>10.92***</td>
<td>-</td>
<td>2.00</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4.44-26.85)</td>
<td>(0.60-6.62)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>&gt;once a week</td>
<td>145(32.2)</td>
<td>25.27***</td>
<td>-</td>
<td>4.53*</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9.26-68.97)</td>
<td>(1.27-16.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FxQ</td>
<td>-</td>
<td>1.64***</td>
<td>-</td>
<td>-</td>
<td>1.17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.41-1.90)</td>
<td></td>
<td></td>
<td>(0.86-1.59)</td>
</tr>
</tbody>
</table>

<sup>a</sup>Model 1 has been adjusted for age and gender and either frequency or quantity. <sup>b</sup>Model 2 has been adjusted for age, gender, frequency and quantity. p<0.05, **p<0.01, ***p<0.001
Figure 2a. The odds of engaging in 1 or more risk behaviors as a function of consuming at low, moderate or high quantity levels, controlling for age, gender and frequency.
Figure 2b. The odds of engaging in 1 or more risk behaviors as a function of drinking frequency, controlling for age, gender and quantity.
Finally, it was asked whether there was a threshold level of alcohol consumption at which the risk of engaging in 1 or more risk behaviors becomes significantly acute. While Model 1 (Table 4) examined whether quantity had a unique effect holding frequency constant and whether frequency had a unique effect holding quantity constant, it did not allow us to examine whether individuals are at risk for a given level of frequency and quantity. The interaction between frequency and quantity was tested in Model 2 to determine whether the influence of quantity on risk behavior varies across frequency level. Table 4 shows that there was no evidence of a significant interaction between frequency and quantity. However, statistical power to detect interactions is typically quite low and in light of the *a priori* hypothesis, simple slope analysis was used to localize any significant effects (Aiken & West, 1991). To do this, each level of frequency was dummy coded and 4 separate regression models were run in which each group in turn served as the comparison group. This method allowed the proper test of each of the other 3 frequency levels simple slopes. Included in each regression model were age, gender, the dummy code for the three groups that were not the reference group (coded as 0), quantity and the interaction between the dummy codes and quantity (e.g., \( Y = b_0 + b_1(age) + b_2(gender) + b_3(D1) + b_4(D2) + b_5(D3) + b_6(\text{quantity}) + b_7(D1 \times \text{quantity}) + b_8(D2 \times \text{quantity}) + (D3 \times \text{quantity}) \)).

Simple slope analysis revealed a significant effect for those that consume alcohol \( \leq \) a few times/month (\( p<0.001 \)) and once a week (\( p<0.05 \)), indicating that, for that given level of frequency, there is a relationship with quantity in which the risk of engaging in 1 or more risk behaviors is significantly increased. For those that drink \( \leq \) a few times/month, every one unit increase in quantity of alcohol consumed was associated
with a 2 times higher risk of engaging in 1 or more risk behaviors (OR: 2.06, 95% CI: 1.36-3.15, p<0.001). For those that drink once a week, every one unit increase in quantity of alcohol consumed was associated with a 2.7 times higher risk of engaging in 1 or more risk behaviors (OR: 2.74, 95% CI: 1.12-6.68, p<0.05). To further understand the risk relationships, additional logistic regression analyses were run in which the data was selected only for those that drink ≤ a few times/month and then for those that drink once a week, controlling for age and gender, to determine the specific levels of quantity for each given frequency level which are associated with increased risk. Figure 3 shows the risk of engaging in 1 or more risk behaviors as a function of drinking quantity, for given levels of frequency.
Figure 3. The odds of engaging in 1 or more risk behaviors for as a function of drinking quantity for given levels of frequency, controlling for age and gender.
For those that drink ≤ a few times/month, consuming alcohol at moderate (3-4 drinks/occasion) and high levels (5+ drinks/occasion) was associated with 2 (OR: 2.33, 95% CI: 1.09-5.00, p<0.05) and 4 times higher risk (OR: 4.11, 95% CI: 1.74-9.70, p<0.001) respectively compared with those consuming only 1-2 drinks/occasion. For those who consume alcohol once a week, those consuming at high quantity levels were at 9.4 times higher risk of engaging in 1 or more risk behaviors than those consuming at low quantity levels (OR: 9.43, 95% CI: 1.63-54.49, p<0.05). Only modest effects (p=0.08) were found for those consuming at moderate quantity levels. This lack of significance could be a function of small cell sizes, as the odds ratio for those consuming at moderate quantity levels was 5.34. In sum, the evidence from these interactions confirms the inseparable relationship between frequency and quantity. Fluctuations in both result in changing patterns of risk. Further, consuming at low frequency levels does not reduce ones likelihood of engaging in 1 or more risk behaviors unless individuals also maintain low quantity levels. Regardless of frequency, increasing quantity substantially increases ones risk of engaging in 1 or more risk behaviors.

The final objective of this study was to determine if there are age or gender differences in the risk of engaging in 1 or more risk behaviors when consuming alcohol at comparable levels. As mentioned, there were no significant interactions between age or gender and alcohol use. While there was evidence of some age and gender differences in terms of their respective patterns of alcohol use, as well as the types of risk behaviors engaged in, overall, there was no independent age or gender effects in the likelihood of risk after accounting for alcohol use.
Discussion

Eighty-three percent of youth and young adults reported engaging in 1 or more risk behaviors. The prevalence of most of the risk behaviors was consistent with findings from past research (Poulin et al. 2006; Grunbaum et al., 2002; Adlaf et al., 2003; Leadbeater et al., 2008; Rotterman, 2005; Health Canada, 2005). Further, the drinking patterns found in our population were consistent with those reported in the national Canadian Addiction survey (Health Canada, 2005; Stockwell, et al., 2009) indicating that this sample may be representative of a normative Canadian adolescent population. As expected based on other studies (Health Canada, 2005; Arata et al., 2003; Wechsler et al., 1998; Windle & Windle, 2005; Room et al., 1995) the findings revealed a clear gradient in risk between risk behaviors and increasing patterns of alcohol use, independent of age or gender. Further, as expected, those that consumed alcohol at the highest quantity (5+ drinks/occasion) and highest frequency level (>once a week), as well as those that exceed both the recommended drinking levels, were at the greatest risk of engaging in risk behaviors that can lead to harm.

Unexpectedly, those consuming alcohol within both the respective guidelines were at significantly greater risk for engaging in risk behaviors than abstainers. However, upon stratifying these analyses, females were at significantly greater risk when consuming within the guidelines, but not males. These findings suggest that the current CAMH guidelines may be appropriate for males, as long as males are consuming alcohol with both of the recommended drinking limits. However, the current guidelines for females are not appropriate, and cutting the current female guidelines in half did not decrease the risk; suggesting that there may not be “low-risk” level of alcohol
consumption for females. Further, while the statistical analysis did not reveal a significant
increase in risk for males when they consumed within both of the recommended
guidelines, males still had an OR of 1.5, indicating a 50% increase in risk compared to
abstainers. Calculating the absolute risk provided us more insight into whether or not a
particular level of consumption is acceptable and according to Figure 1, the probability
for males consuming within both drinking guidelines increases by approximately twenty-
two percent; the increase for females at this level was approximately twenty-seven
percent. The probability for those exceeding these guidelines ranged from 36-44%
increase compared to abstainers for males and 42-56% increase over abstainers for
females. These findings suggest that there is an increase in risk for males consuming
within the guidelines relative to the risk for abstainers – although we cannot be certain
this is solely due to alcohol use. The lack of significance in the models may be a lack of
power in the sample.

As predicted, those that consume alcohol at low quantity (1-2 drinks/occasion) or
low frequency levels (≤ a few times/month), were not at significantly greater risk than
abstainers; nor were those consuming at moderate frequency levels (once week). Only
alcohol consumption at moderate or high levels of quantity (3-4 or 5+ drinks/occasion)
and high frequency levels (>once a week) were found to be independent risk factors for
engaging in 1 or more risk behaviors. Further, as expected, a close relationship was found
between frequency and quantity which revealed that, while consuming at low frequency
and quantity may minimize risk, consuming at low or moderate frequency levels and
moderate or high quantity levels substantially increases the likelihood that youth will
engage in risk behaviors. There was no evidence that increasing quantity increases risk if
the drinker was already consuming at high frequency levels, indicating that consuming >once a week, regardless of quantity, substantially increases one’s risk of harm as well. These findings suggest that both frequency and quantity of consumption matter in terms of determining one’s risk, and while consuming at both low frequency and quantity levels may be considered a “low-risk” level of consumption for this population, increasing quantity of consumption in excess of the recommended ≤ 2 drinks/occasion outlined in the CAMH guidelines, substantially increases ones risk of harm; as does consumption >once a week.

Among the strengths of the present study are the inquiry into all three components of alcohol use typically examined (volume, frequency and quantity), the specific examination of the risk associated with low levels of consumption and the investigation of risk associated with consuming within vs. above the CAMH drinking guidelines and the explicit examination of tangible and well-defined risk behaviors. However, the major limitation of this study is that it is cross-sectional and the associations between alcohol use and risk behaviors are based on the self-report of two separate items. This fails to establish the co-occurrence of alcohol use and these specific risk behaviors and do not clearly indicate a direct link between the two behaviors. In light of these limitations, the present study cannot inform on alcohol use as a cause of engaging in these high risk behaviors. Case-control or experimental studies would be needed to ultimately determine a causal link.

Further, the lack of evidence for a drinking level associated with zero risk, including abstainers, confirms that we cannot assume that alcohol is the only contributing risk factor for engaging in these risk behaviors. Other correlational variables, such as peer
pressure, exposure to high-risk contexts, high levels of sensation seeking, or levels of
socialization, as found in other studies, may moderate or mediate the identified
relationships between alcohol consumption and these risk behaviors (Fergusson &
Lynskey, 1996; Arata et al., 2003). Further, unmeasured confounding effects could be
exaggerating the risk associated with different drinking levels and a literal translation of
these findings into guidelines may be too stringent. There may also be an issue of
multicollinearity as there was a significant positive correlation, \(r(540) = 0.52, p = 0.000\),
between frequency and quantity which could result in an underestimation of the risk
associated with consuming alcohol at the low or moderate frequency and quantity levels,
when both dimensions are used in the same analysis. However, studies that controlled for
some of these confounding factors have still identified that alcohol was associated with
an increase in risk and it can be reasonably assumed here, in light of the highly
significant findings that are consistent with past research, that alcohol consumption does
play an important role in determining risk.

Other limitations include: using a composite score for risk, which assumes that
there is an equal risk of engaging in all of these behaviors and that all of these behavior
are associated with an equal risk of harm. However, this poses the question of whether
relative weights need to be given to difference types of adverse consequences. Finally, it
is important to note that the CAMH drinking guidelines are not designed nor meant for
16-18 year olds and thus the appropriateness of them for this population should be
examined with caution. Yet, these guidelines are meant for those above the legal drinking
age, including those ages 19-23 in this sample. Further, this study showed few differences
between those 16-18 and 19-24 in terms of their likelihood of engaging in risk behaviors
at comparable drinking levels – giving good reason for examining the guidelines with this older adolescent population.

This study is one of the first to examine whether or not the current guidelines are specifically appropriate for a population of older adolescents (16-18) and young adults (19-23) and whether guidelines could be used to decrease the likelihood of engaging in risk behaviors that are most likely to lead to harm for this population. To date much of the research on alcohol-related harms for this population have asked only in general terms if one has experienced “harm” as a result of alcohol consumption typically asking “was there ever a time that you felt your alcohol use had a harmful effect on: your friendship or social life? physical health? happiness? home life? work? financial position?” Alternatively, studies have focused mainly on social harms (e.g. behaving in ways one regretted or getting into arguments because of drinking), or acute health-related harms, such as injuries and assault (Ouellette, et al., 1999; Bondy, 1996; Hingson et al., 2005; Arata et al., 2003). These studies have the potential to be misleading as individuals are not always able to make the link between their alcohol use and experiences of harm, or may choose not to disclose this. Further, not operationally defining harm may overestimate or underestimate the experiences “harm” being reported because it overlooks the fact that some consequences may be transient, such as a hangover, while others are potentially more serious and lasting in their effects.

Instead, this study focused on the relationship between high risk behaviors commonly engaged in by this population and patterns of alcohol use. Many studies have identified a significant relationship between these types of risk behaviors and alcohol use separately, yet they have never been examined together. While, statistical correlation
between these risk behaviors and alcohol consumption does not indicate a direct link between the two behaviors, nor do findings imply a causal relationship, it is important to examine whether there is a level of alcohol consumption that is associated with an acceptably low level of increased risk of engaging in these types of concrete and specific behaviors for several reasons. First, serious incidents of harm for this population often occur as a result of engaging in these types of risk behaviors (Bondy et al., 1999; Smith, 1999; Lunetta, Penttila & Sarna, 2001; Room et al., 1995; Rehm, Ashley, & Dubois, 1997). Second, these risk behaviors are tangible activities that participants have control over and therefore, advice on how to minimize this risk can be used specifically by individuals to alter their behavior and decrease their risk.

The findings suggest that the guidelines for males may be appropriate for minimizing the risk of harm that can result from these types of behaviors for this population of 16-23 year olds. Further, maintaining a low or moderate frequency/low quantity level of consumption may also minimize the risk of engaging in these types of risk behaviors for both males and females. However, there appears to be no such thing as a drinking pattern with zero risk and for these types of risk behaviors, even a proportion of abstainers are at risk, indicating that alcohol is not the only contributing factor for these types of harm. Therefore, the issue becomes determining what is the actual size of the extra risk? The absolute risk revealed that even males and females consuming within both guidelines show approximately a 22-27 percent increase in the probability of engaging in 1 or more risk behaviors. This twenty-five percent increase in the size of risk could suggest that more stringent guidelines are needed for both males and females – perhaps no more than 2 drinks/occasion, no more than once a week.
For most of the risk behaviors, the relations found between alcohol use and engagement in risk behaviors are consistent with those found in past studies; increasing alcohol consumption is associated with increasing risk (Esobedo et al., 1995; Gruenewald et al., 1996; Schmidtke et al., 1996; Hawton et al., 2002; Fortenberry, 1995; Rotterman, 2005; Fiegelman, et al., 2002; Donovan & Jessor, 1983; Tucker et al., 2005; Sutherland & Willner, 1998). However, this study failed to demonstrate alcohol use as an independent risk factor for experiencing a serious injury, or having multiple sexual partners, after controlling for age and gender. The literature on the association between patterns of alcohol use and risk of injury has consistently shown that the risk of injury increases with increasing alcohol consumption (McLeod et al., 1999; Cherpitel, 1993; Cherpitel, 1998; Hingson et al., 2000). This discrepancy could be a function of the high rates of injuries that occur with this population in general or a function of the types of injuries our sample is reporting. About half of the injuries reported in the present study were a result of sport injuries (10.2%) and falling/tripping (6.5%), followed by ‘other’ which was made up mostly of accidental injuries that occurred around the home (ie. cuts, burns, heavy lifting & playing around). Findings suggest that the association between alcohol use and injuries can vary according to the type of injury (Cherpitel, 1993). For example, persons with violence-related injuries are more likely to be frequent heavy drinkers and to report more frequent drunkenness, drinking consequences, and symptoms of alcohol dependence, than those with other types of injuries (Cherpitel, 1993).

Further, very few participants reported alcohol (3.5%) or drugs (1.9%) as being a contributing factor to their injury and only 8% reported going to the emergency room for their injury. Emergency rooms studies have a greater potential to identify alcohol related
injuries because injuries that are alcohol related are often more severe, resulting from vehicle accidents, overdose, or falls that occur while intoxicated. The discrepancy between this study and other findings is most likely a function of the types of injuries this sample reported, the severity of these injuries, and the percentage of our sample reporting alcohol/drug related injuries.

The literature on the effects of alcohol on risky sexual behaviors, especially multiple sexual partners has been inconsistent. Several studies have found associations based on bivariate comparisons. Fergusson and Lynskey (1996) for example examine the relation between alcohol misuse and sexual risk taking behaviors among 953 15-16 year olds and found that those who reported misusing alcohol had odds of multiple sexual partners 6-7 times than of those who did not misuse alcohol. However, after adjustment for correlated risk factors such as family social position, novelty seeking and affiliation with delinquent peers, this associated was no longer significant. Further, Poulin and Graham (2001), who looked at the influence of substance use on high-risk sexual behaviors for 9997 students grades 9-12, failed to find an independent effect of alcohol use on multiple sexual partners once controlling for other types of substances (e.g. cannabis), but did find that having unplanned sexual intercourse while under the influence of alcohol was a risk factor for multiple sexual partners. These studies suggest that there may be some relationship between alcohol use and multiple sexual partners, but it varies considerably as a function of the other predictors included in the models. Therefore, alcohol use may not be a reliable predictor of multiple sexual partners, as evidenced in this study.
Consistent with other studies (Room et al., 1995, Poulin & Graham, 2001), the present study has found that the probability of engaging in risk behaviors rises steadily with participant’s volume, frequency and quantity of alcohol consumption, with those consuming at the highest levels being at most risk and no clear lower threshold of drinking below which there is no risk, or a threshold level of alcohol consumption at which the risk becomes significantly acute. The lack of a threshold means that there is no one ideal level of consumption for avoiding risk behaviors. However, the most important findings of the present study is that there was evidence of some levels of alcohol consumption at which the risk did not exceed that experienced by abstainers. More specifically, those consuming at low quantity and low or moderate frequency levels, as well as males who drink within both of the recommended drinking limits, were not at significantly greater risk of engaging in risk behaviors than abstainers. While this does not imply that the level of risk associated with these low levels of consumption is acceptable, it does indicate that consuming alcohol within these levels can minimize risk relative to that of an abstainer. Measuring the risk relative to abstainers provides an important bench mark of risk in which to compare drinkers to, as there is little evidence that there is no risk associated with any level of alcohol consumption, or that alcohol consumption is the only contributing factor to these types of risk.

Room et al. (1996) compared 3 sets of low-risk drinking guidelines in terms of the proportions of respondents (age 15+) reporting harm from their drinking among those who had kept within the guideline in the previous 7 days. Room et al. (1996) showed that it is important for guidelines to address patterns of consumption (number of drinks/occasion) as well as total intake (volume) in determining the prevalence of
consequences. Including recommendations for the number of drinks consumed/occasion addresses adverse consequences of alcohol use that go beyond the chronic health effects the volume or total intake limits are intended to address and recommending specific daily limits become particular important for adolescent and young adult populations who drink in patterns consistent with experiencing acute harm (low frequency/high quantity; Health Canada, 2005) rather than chronic harm.

The findings in this study appear to demonstrate that the current recommended quantity level of \( \leq 2 \) drinks/occasion is appropriate for this population of older adolescents and young adults. The clear increase in risk that results for both males and females who exceed this quantity limit demonstrates the importance of patterns of consumption in predicting risk. Further, there was no evidence that decreasing the recommended volume limits decreased risk, indicating that most of the risk for these types of adverse consequences, or for this population, is associated with quantity of consumption rather than overall volume. While more stringent volume guidelines may decrease risk, the evidence here suggests that quantity is a key determining factor for minimizing these types of risk.

In light of these findings, it could be suggested that young adults (age 19-24) require a special set of drinking guidelines that focus on patterns of drinking rather than total intake and are more restrictive than the general adult drinking guidelines. Additionally, the lack of age differences in risk for those below vs. above the legal drinking age may suggest that guidelines could be created that would appropriate for older adolescents (16-18 years olds) as well. The number of drinks consumed per occasion is an important indicator of patterns of consumption; however, the frequency of
consumption, as shown in the present study, is also important. To date, guidelines in Canada and other countries do not provide a recommended level for frequency of consumption. Yet, providing a recommended frequency for this young population (in additional to a quantity limit) may be more appropriate than volume since their patterns of consumption are not consistent with measures of volume nor do volume limits address the types of harm this population is most likely to incur. Further, the present study suggests that consuming alcohol at a frequency of more than once a week, regardless of quantity, substantially increases the likelihood of risk behaviors for this population. Therefore, providing a recommended volume limit, which suggests that consumption more than once a week is ‘low-risk’, may be an inappropriate recommendation for this vulnerable population. More research needs to be conducted to determine what level of frequency could be considered “safe” or “low-risk” for both young adult and adult populations. However, it appears that for young people the most important communication is around quantity consumed/occasion followed by clear limits on the number of drinking days (frequency). For example, alternative recommendations for young people based on these findings may be: for women, no more than two drinks/day, no more than once/week; for males, not more than two drinks/day, no more than 2 times/week.

In conclusion, this study is the first simultaneously investigating the likelihood of multiple types of risk behaviors with this population and examining risk behaviors as a type harm that have not previous been noted in the development of low-risk drinking guidelines. In broad terms, it confirms what is already known, high levels of alcohol consumption are associated with an increased likelihood of engaging in these risk
behaviors and that quantity per occasion is an important risk factor for acute outcomes. However, in this study it was possible to begin to quantify the degree of risk associated with different levels of alcohol consumption, especially low and moderate levels of consumption and give insight into the appropriateness of the current CAMH low-risk drinking guidelines for this population of youth and young adults which are being used to inform the development of national Canadian drinking guidelines.

Clearly, this single study cannot negate the work and research that has gone into drafting these adult low-risk drinking guidelines nor can it provide estimates of risk or recommend “low-risk” drinking levels that are solely sufficient for adapting or creating guidelines specific to this population. At the very least, minimal risk levels have been identified, yet we cannot be a hundred percent confident that this risk due to alcohol. However, this study does lend support to recognizing that a new method of addressing the substantial alcohol-related risk for this vulnerable population needs to be considered; creating specific drinking guidelines for this population may be one option. More specifically, guidelines that focus on recommending “low-risk” quantity and frequency limits rather than volume, or even more stringent volume limits (with fixed quantity levels), may be more appropriate for this population. The present study provides some evidence of “low-risk” drinking levels for this population, but future research is needed to thoroughly examine a greater variety of harms experienced by this population as well as determine the level of risk that can be considerable acceptable before additional guidelines are created.
References


