The Risk for Injury: Investigating the Roles of Alcohol, Caffeine, Risk-Taking Propensity, and Gender

by

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B.A., University of British Columbia, 2012
M.Sc., University of Victoria, 2015

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Supervisory Committee

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ABSTRACT

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The combined use of alcohol and caffeine has been identified as a public health concern, and yet, our knowledge of this type of use and how it relates to the risk of incurring an alcohol-related injury remains limited. Study 1 is a systematic review examining and critically analyzing the literature on the combined use of alcohol with energy drinks and the risk of injury. Studies 2 and 3 use data from a controlled Emergency Department (ED) study that was collected over 1.5 years from 3 separate hospitals in British Columbia. There was a total of 2804 participants across the ages of 18-98. Given the strengths and limitations of these different methodologies, both case-crossover and case-control analyses were performed in order to test for consistency of results. Study 2 examined the temporal association between alcohol and caffeine and use (Alc+Caff) and the risk of injury, as well as the potential moderating role of risk-taking propensity and mediating role of Alc+Caff between risk-taking propensity and injury risk. The combined use of alcohol and caffeine was found to be associated with a higher risk of injury, even after controlling for dose of alcohol and caffeine, other substance use, location at time of injury, risk-taking propensity, and sociodemographic variables. Alcohol and caffeine use was also found to partially mediate the relationship between risk-taking propensity and injury. Study 3 examined gender

differences in the risk-relationship of Alc+Caff use and injury by testing the interaction between gender and Alc+Caff use and then examining the risk of injury following Alc+Caff use separately for men and women. Women were found to have a significantly higher risk of injury following alcohol use and Alc+Caff use relative to men. These results were found in both the case-crossover and case-control analyses. The findings from these studies indicate a relationship between Alc+Caff use and an increased risk of injury, especially for women, which is supported by previous research. The results are supportive of differential low-risk drinking guidelines for men and women. The findings also offer a significant contribution to our knowledge base, as the use of standardized measures and inclusion of multiple confounding variables allowed for the examination of the unique effect of Alc+Caff use. Alc+Caff use is associated with an increased risk of injury that cannot solely be explained by increased alcohol consumption, other substance use, risk-taking propensity, location at time of injury, or sociodemographic factors. Based on the epidemiological criteria of causation, the findings contribute evidence supportive of an inference of causality between Alc+Caff use and injury. The results of the current studies also offer suggestions for future research needed in this area, and provide recommendations for policy prevention and intervention efforts to reduce the harm associated with this type of consumption.

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Dedication

To Josh

Scribis Enim Locus

I look forward to writing the room with you till the end of our days

To Paxton

Your sweetness reminds me that beauty and wonder can be found in the smallest things and to never forget what is truly important in life

I love you both

Chapter 1

General Introduction

Injuries, both intentional and unintentional, are a serious public health concern. They are the single leading cause of death for Canadians under the age of 45, the fourth leading cause of death for all Canadians, and the fourth leading cause of hospitalizations. Furthermore, the economic burden associated with injuries is estimated to be over $26.8 billion per year (Public Health Agency of Canada, (PHAC), 2016). Given the substantial costs and harms associated with injuries, determining risk factors for injury has become a research priority.

One of the most prominent risk factors for injury identified by research is alcohol use, with injuries constituting 46% of the deaths attributable to alcohol (Rehm et al., 2004; Rehm et al., 2009). A substantial amount of literature demonstrates a strong relationship between alcohol use and injury, much of which comes from emergency department (ED) studies (Cherpitel, 2007). Methodological variations in ED studies have resulted in a wide variety of injury relative risk estimates associated with levels of alcohol use; however, the finding that alcohol is one of the strongest predictors of injury leading to Emergency Department treatment remains consistent (Cherpitel, 2007; Rehm et al., 2009; Rehm et al., 2004).

Although the relationship between alcohol and injury is well documented, less is known about the role of other substances in the risk of injury, or other substances in combination with alcohol. There has been a trend in North America towards increased co-use of alcohol and caffeinated beverages, such as energy drinks (Alc+Caff use) (Howland et al., 2011; Kponee, Siegel, & Jernigan, 2014; Marczinski et al., 2012), and the available evidence suggests this type of use is associated with an increased risk of injury and also of engaging in risk-taking behaviors

(Beauchamp, Amaducci, & Cook, 2017; Brache & Stockwell, 2011; O'Brien et al., 2008; Thombs et al, 2010).

Caffeinated alcoholic beverages are the result of the popular practice of combining energy drinks with alcohol, either by hand, or in pre-mixed beverages sold in convenience and/or liquor stores. Energy drinks are caffeinated beverages that are intended to provide a burst of energy and/or enhance alertness. The principal stimulant ingredient in energy drinks is caffeine, though they may also include high doses of sugar (or a sugar substitute), B vitamins, amino acids (e.g. taurine or l-carnitine), and plant/herbal extracts (e.g. ginseng, milk thistle, gingko balboa). Alcohol is also commonly mixed with other caffeinated beverages, such as soda or espresso/coffee (i.e., specialty coffees). An increase in risk of injury related to Alc+Caff use is thought to be due to both increased alcohol consumption and a diminished sense of intoxication reported by those consuming alcohol with caffeinated drinks (Howland et al., 2011). Following some fatal incidents reported in the media involving alcoholic energy drinks, there have been calls from Health Canada and others for more research in this area (Terry, 2014; Smith, 2014). Despite the marked increase in Alc+Caff use and the potential potentiating effects of alcohol's use with stimulants, no controlled study has been conducted on injury risk related to combined use of these substances.

Given the public health burden of injuries and the well-established significance of alcohol as a risk factor for injury, increased understanding of how Alc+Caff use contributes to injury could have implications for both policy and clinical practice. Although some strategies are already in effect (i.e., mass media campaigns, police initiatives to enforce drunk-driving laws, and policies aimed at reducing the availability of alcohol), the knowledge base regarding effective, empirically supported prevention practices for alcohol-related injury is still relatively

new. Furthermore, many countries are currently working to determine the level of need and suitability of policy responses to Alc+Caff use. For example, the United States, Canada, Australia, and the United Kingdom have already made efforts to limit or ban the sale of some caffeinated alcoholic beverages (e.g., Four Loko), as well as limit the maximum amount of caffeine content in a single beverage container (e.g., 180mg per single serving container). However, hand-mixing caffeinated beverages with alcohol remains a common practice and in fact, can result in individual consuming beverages containing higher levels of caffeine than the limit set by the U.S. Food and Drug Administration (FDA) (Reissig, Strain, & Griffiths, 2009). These policies are a response to the evidence currently available and it is crucial that we begin to integrate and further our understanding of the risks and harms associated with the use of these substances. A better understanding on the process by which Alc+Caff use leads to injury, as well as other factors that may be involved (e.g., risk-taking propensity, increased alcohol consumption etc.), would greatly contribute to increasing this knowledge base. As such, it is the goal of the present study to examine the independent and shared contributions of alcohol and caffeine use to the risk of injuries leading to ED treatment.

In addition, the present study aims to examine the relationship between Alc+Caff use and injury using two methodologies: case-control and case-crossover risk estimates. In case-crossover designs, injured individuals serve as their own controls, controlling for stable risk factors such as their patterns of substance use and other behaviors in the past (Borges et al., 2004; Vinson et al., 1995); whereas in case-control designs non-injured ED patients are often used as quasi-controls (Cherpitel, 2007; Ye, Cherpitel, & Bond, 2010) or, in a few case-control studies, controls are recruited from the population of the ED catchment area. Previous research shows that estimates of the injury risk posed by alcohol use will vary depending on the

methodology used. For example, potential biases have been identified in both case-control and case-crossover analysis (Cherpitel et al., 2014; Ye et al., 2010); therefore, to try and develop a greater understanding of the relationship between Alc+Caff use and injury both case-crossover and case-control methods will be used and compared. Lastly, gender differences and risk-taking tendency will be examined as potential moderators and Alc+Caff use a potential mediating variable, as previous research suggests (Brache & Stockwell, 2011; Mcleod, Stockwell, Stevens, & Phillips, 1999; O'Brien et al., 2013; Stockwell et al., 2002) these are essential factors to consider when discerning the relationship between alcohol, Alc+Caff use and injury.

Alcohol Mixed with Caffeine and Risk of Injury

Alcohol can be combined, either simultaneously or subsequently, with a variety of caffeinated beverages ranging from low (e.g. soda) to high caffeine (e.g. energy drinks) content. The practice of mixing alcohol with caffeine has become a common practice among young adults worldwide (Howland et al., 2011; Marczinski et al., 2012), with evidence of increased risk of both intentional and unintentional injury following this type of use (O'Brien et al., 2008). Injury refers to physical harm or damage to a body, caused by either unintentional intent (e.g. falling, tripping, motor vehicle accidents, or intentional intent (e.g. violence, suicide). It has been estimated that the number of emergency department visits in the United States involving energy drinks nearly doubled between 2007 and 2011, with 13-16% of these admissions related to Alc+Caff use (Center for Behavioral Health Statistics and Quality, 2013). Much of the recent research in this area has focused on alcoholic energy drink use, likely due to the higher amounts of caffeine often contained in these beverages. However, a recent study indicated that the negative consequences for alcohol mixed with energy drinks were no different than those associated with alcohol mixed with other caffeinated drinks, suggesting that these two types of

consumption are equivalent in injury risk or may just be one in the same (Johnson, Alford, Stewart, & Verster, 2018).

The increase in risk of injury related to Alc+Caff may be due to multiple factors. At a pharmacological level, caffeine is considered a central nervous system (CNS) stimulant through its effects as an adenosine receptor antagonist. In other words, caffeine works to counteract the inhibitory effects of adenosine, which is responsible for neuroexcitability, neurotransmitter release, arousal, and spontaneous activity (Davis et al., 2002). In contrast, alcohol is considered to be a CNS depressant, primarily due to its potentiating effects on GABA and inhibitory effects on glutmatergic neurotransmission (Valenzuela, 1997). However, the effect of alcohol is better understood as being on a bell-curve, with the ascending limb producing euphoric and stimulant effect and the descending limb following peak blood alcohol concentration levels producing sedating or depressant effects (Martin et al., 1993). Alcohol has also been found to interact with adenosine. More specifically, alcohol can increase the extracellular levels of adenosine by both increasing adenosine release and decreasing reuptake (Fredholm & Wallman-Johnsson, 1996; Lopez-Cruz, Salamone, & Correa, 2013). Given that both of these drugs act on the transmission of adenosine and adenosine modulates several behavioral processes, it would follow that the interaction of alcohol and caffeine would influence the effects associated with the consumption of either of these drugs. Further, the effects of alcohol and caffeine on adenosine are opposing, which could help to explain the increasing popularity in this type of use. In particular, Ferre and O'Brien (2011) proposed a neurochemical mechanism for the increased alcohol consumption and alcohol-related consequences following the combined use of alcohol and caffeine. The authors argued that alcohol and caffeine work to mutually counteract the unwanted effects of both drugs through their effects on adenosine neurotransmission. By blocking adenosine receptors, caffeine

can antagonize the undesirable effects of alcohol (sedation, motor incoordination, somnogenic effects). At the same time, the increases in extracellular concentration of adenosine produced by alcohol works to attenuate the unwanted effects of caffeine (anxiogenic effects). This mutual antagonism of the undesirable effects, or what Ferre and O'Brien refer to as "the perfect storm", likely leads to the increased consumption of both drugs, thereby increasing the likelihood of experiencing alcohol-related consequences. The authors go on to further explain that during chronic alcohol consumption, the blocking of adenosine receptors by caffeine acts as a mechanism to counteract tolerance and reduce the withdrawal effects of alcohol. Additionally, caffeine induces dopamine release in the striatum, which is an integral area of the brain responsible for the stimulant and rewarding effects of drugs (Ferre & O'Brien, 2011; Volkow et al., 2004). This could result in caffeine potentiating the reinforcing effects of alcohol and may in fact help to explain the effect of consumers reporting an increased desire to drink alcohol during Alc+Caff consumption (Aldermark et al., 2011; Ferre & O'Brien, 2011; Mcketin et al., 2015).

While the pharmacologic interaction of alcohol caffeine is one of complexity, it is further complicated by additional factors including rate of ingestion, dosage, and individual variability in metabolism, tolerance, and sensitivity to alcohol and caffeine. The metabolism of caffeine in particular can be affected by many variables. For example, alcohol, grapefruit juice, cruciferous vegetables, pregnancy, and the use of oral contraceptives in women can prolong the half-life of caffeine, whereas cigarette smoking nearly doubles the rate of caffeine metabolism (Arnaud, 1993; Fredholm et al., 1999). Similarly, the amount of and the level of fat content in the gastrointestinal tract can influence the rate of absorption of alcohol into the blood stream (Zakhari, 2006). While alcohol is primarily metabolized in the liver at a steady rate, a small amount is metabolized in the stomach by the enzyme alcohol dehydrogenase (ADH). Given that

women have levels of ADH in their stomach relative to men, a larger proportion of ingested alcohol reaches their bloodstream (Ferre & O'Brien, 2011; Zakhar, 2006). Lastly, blood alcohol concentrations can also vary based on body weight, percentage of body water, use of medications, and the rate of drinking (Ferre & O'Brien, 2011). Given the potential complex interplay of multiple factors, studying the interaction effects of these substances poses a challenge. Nonetheless, the neurochemical mechanism proposed by Ferre and O'Brien (2011) offers an explanation for the risky effects associated with the combined use of alcohol and caffeine.

The interaction between alcohol and caffeine on adenosine transmission has likely led to the popular belief that caffeine can antagonize the intoxicating effects of alcohol. This belief may help to explain an increased risk of injury, as it has been argued that an increased risk of injury may be due to both increased alcohol consumption and a diminished sense of perceived intoxication (Howland et al., 2011). Some researchers have theorized that the psychostimulant effects of caffeine may work to attenuate the depressant effects of alcohol, thereby masking the physiological and psychological sedative experiences commonly associated with alcohol consumption (Ferreira et al, 2006; Marczinski et al., 2006; Howard, 2011). This masking of the sedative effects, sometimes referred to as an "awake drunk state", may result in the consumer underestimating their level of intoxication, which may lead to more hazardous drinking practices, increased risk-taking, and poorer risk assessment (Brache & Stockwell, 2011; Ferreira et al., 2006). In fact, a recent review indicated that Alc+Caff use is associated with binge drinking, increased drug and other substance use, being a passenger in a car with an intoxicated driver, and being in higher risk public settings after dark (Beauchamp, Amaducci, & Cook, 2017). In addition, research suggests that consuming caffeine with alcohol increases the desire and

motivation to consume more alcohol (Marczinski et al., 2013, 2016; Peacock & Bruno, 2013), which again places an individual at a higher risk of incurring an injury.

The impact of caffeine on subjective intoxication or impairment is still debated, with some research supporting decreases in subjective intoxication (Heinz et al., 2013; Howland et al., 2011; Ferreira et al., 2006; Marczinski et al., 2006), and others finding no evidence of this effect (Azcona et al., 1995; Marczinski et al., 2011; Peacock et al., 2013). In contrast, more evidence is for found increased subjective ratings of stimulation following the consumption of caffeine (Attwood et al., 2012; Marczinski et al., 2011, 2012; McKetin et al., 2015; Peacock et al., 2013). Within this line of thinking, it may be that the adenosine antagonistic effects of caffeine function to prolong the physiological state consistent with the ascending limb of the alcohol intoxication curve (Crane, Schlauch, & Miller, 2019; Marczinski & Fillmore, 2014). Either by increasing levels of stimulation and/or ameliorating sedative effects experienced on the descending limb, this may result in the consumer being alert longer and thereby prolonging their drinking episode (Marczinski et al., 2012), both of which could lead to higher alcohol consumption and being in higher risk situations at night The perpetration of interpersonal violence is most likely to occur during the ascending limb of the alcohol intoxication curve (Crane, Schlauch, & Miller, 2019), therefore prolonging this state could lead to an increased likelihood of experiencing a violence-related injury. In contrast, decisions to drive are most often made on the descending limb (Jones, 1990), and the decreased subjective feelings of sedation may lead to Alc+Caff consumers be more likely to decide to drive (Thombs et al., 2010). Such behavioral changes caused by Alc+Caff consumption are all associated with a higher likelihood of the consumer incurring an injury (Room et al, 2005; WHO, 2009).

In addition, while some research suggests Alc+Caff use may produce subjective effects, such as a reduction in subjects' perception of intoxication, it does not reduce BAL level or related psychomotor deficits (Ferreira et al., 2006). Therefore, some negative effects of alcohol intoxication may be attenuated when mixed with caffeinated drinks, but overall impairment still exists. However, there have been mixed findings in both animal and human research regarding the ability of caffeine to attenuate the negative effects of alcohol, with attenuation of some psychomotor functions but not others (Ferre & O'Brien, 2011; Lopez-Cruz et al., 2013; Marczinski & Fillmore, 2003). More specifically, some research has found caffeine to improve alcohol-induced impairment on reaction time, divided attention, psychomotor speed, motor coordination, information processing, and recall memory (Alford, Hamilton-Morris, & Verster, 2012; Azcona et al., 1995; Drake et al., 2003; Ferre & O'Brien, 2011; Mcketin et al, 2015 (*review)*; Roehrs, Greenwald, & Roth, 2004); however, other research reports no effect of caffeine improving alcohol-induced impairment (Attwood et al., 2012; Ferreira et al., 2006; Howland et al., 2011; Liguori & Robinson, 2001; Marczinski et al., 2011, 2012; Mcketin et al., 2015 (*review*). The reasons for these mixed findings are likely due to many factors including: variability in the dose of alcohol and caffeine, source of caffeine, and methodology, as well as small sample sizes and lack of control for caffeine withdrawal or sensitivity (Fudin & Nicastro, 1988; Heinz et al., 2013).

Another line of research has focused on the alcohol and caffeine interactions on decision-making and impulsivity. Findings indicate a caffeine-induced reduction in alcohol-related impairment on reaction time with no effect on accuracy (Marczinski & Fillmore, 2003; Marczinski et al., 2011; Martin & Garfield, 2006). These findings have led some researchers to argue that the combined consumption of alcohol and caffeine results in these consumers "making

bad decisions quicker" (Heinz et al., 2013). Furthermore, expectancies of alcohol and caffeine use have been found to play a potential role in level of behavioral impairment following the co-consumption of these beverages. For example, in a study by Fillmore and Vogel-Sprott (1996) the ironic effects of expectancy were demonstrated; consumers who expected caffeine to compensate for alcohol impairment actually showed higher levels of impairment. The authors argued that this was due to the fact when consumers expect an antagonistic effect of caffeine, they do not engage in other compensatory strategies to reduce their level of behavioral impairment. Similarly, another study reported that a stronger expectation that Alc+Caff use could help to avoid negative alcohol-related consequences was associated with consumers using fewer protective behavioral strategies (Linden-Carmichael, Barraco, Stamates, 2015). Fewer engagement in protective behavioral strategies that can help consumers to limit alcohol use or related problems will in turn, increase one's likelihood of experience alcohol-related problems.

In sum, the current literature tends to support a relationship between Alc+Caff use and increased risk of injury; however, there are no controlled studies specifically examining the causal link between this type of consumption and injury outcomes. Without an examination of the temporal occurrence of injury relative to Alc+Caff use, no firm conclusion regarding causality can be drawn. Further, as with many areas of epidemiological research, designing a controlled study that could isolate cause and effect is an almost implausible feat. Therefore, many researchers and theorists have proposed a dialogue approach to causal inference that can be traced back to the seminal work of Bradford Hill (1965) (Kundi, 2006). This approach assumes that epidemiological evidence can be evaluated along certain criteria, which if met, could suffice for a finding of potential causation. As described by Kundi (2006), the four criteria include:

1.Temporal relation: Does A (agent) precede D (disease)?

2. Association: is the probability of D higher with the presence of A relative to the absence of A?
3. Environmental Equivalence: is the set of conditions for the studied population sufficiently similar except for the exposure to A?
4. Population Equivalence: are the features of the population being studied equivalent except for the exposure to A?

These arguments can also be strengthened by whether there is evidence for biological plausibility for the relationship, which has already been supported in both laboratory and human studies (Ferre & O'Brien, 2011; Lopez-Cruz et al., 2013). Without the presence of valid counterarguments refuting the above points, Kundi (2006) states that no further evidence favoring a causal relationship is necessary, aside from better epidemiological evidence. Therefore, using these criteria the goal of the present study is to determine whether there is sufficient evidence to support a causal relationship between Alc+Caff use and risk of injury.

In addition to the lack of controlled studies, the existing evidence around Alc+Caff use and injury has several weaknesses. The majority of studies are cross-sectional, using only case-control designs, and do not control for the level of alcohol use or other potentially important variables such as risk-taking propensity. With regards to the case-control design, previous research suggests that methodological variations assessing alcohol and injury have resulted in a wide variety of risk estimates (McClure, 1991; Ye et al., 2010). For example, risk-estimates for alcohol-related injuries can vary according to population being studied, as well as factors related to the context of alcohol consumption, making it difficult to compare findings across studies or to determine the extent to which the outcomes are related to actual effects versus variance associated with different methodologies. Therefore, more research is needed to explore other methodological designs (e.g. case-crossover) to examine whether injury risk estimates vary for

Alc+Caff use. In addition, since alcohol has been found to have a dose-response relationship with injury (Cherpitel, 2007; Rehm et al., 2009), without controlling for level of alcohol use, other substance use, or risk-taking propensity it is impossible to tease apart the unique effect of Alc+Caff use on risk of injury. Lastly, there is large variation across studies in the measurement of alcohol and caffeine use, making it difficult to compare results across studies. A standard drink measure for both beverages (i.e., 13.6 grams of alcohol and 50mg of caffeine) would be helpful in clarifying the dose-response relationship between Alc+Caff use and injury. The purpose of the current study is intended to fill these gaps in the literature.

The current study is an emergency department study in which independent and combined reported use of alcohol and energy drinks in the 6 hours leading up to an injury are measured. This provides the opportunity for the temporal relationship between Alc+Caff use and injury to be examined, which will allow for inferences regarding causation to be drawn (Kundi, 2006). The study will also use case-control and case-crossover designs to assess whether methodological variations exist in the relationship between Alc+Caff use and injury. In addition, level of alcohol use, other substance use, and other potential confounding variables (i.e. context of injury, demographics) will be controlled for in order to delineate the unique effect of Alc+Caff use and risk of injury. Finally, the current study includes standard drink measures of alcohol, energy drinks, and other caffeinated beverages to allow for an examination of a dose-response relationship between Alc+Caff use and injury. This will also allow us to tease apart the independent and combined effects of these substances.

Risk-taking propensity and gender differences

In addition, risk-taking propensity and gender differences will be examined as both of these variables have been identified as potential key moderating variables in the research on

alcohol use and risk of injury (Brache & Stockwell, 2011; Mcleod, Stockwell, Stevens, & Phillips, 1999; O'Brien et al., 2013; Stockwell et al., 2002). Impulsivity or risk-taking has been found to be associated with a higher risk of alcohol-related consequences (Brache & Stockwell 2011); therefore it is likely that this particular personality trait may also be associated with a higher likelihood of experiencing negative outcomes following Alc+Caff consumption. Individuals scoring higher in sensation-seeking might show a preference for the 'awake drunk' state of Alc+Caff use and therefore, may be more likely to engage in this type of use (O'Brien et al., 2013). Research also indicates that individuals who score higher in impulsivity may be more likely to consume more alcohol or engage in more binge drinking and may be more likely to engage in risky drinking behaviors; therefore, having greater opportunity to experience harms related to risky drinking behaviors (Brache & Stockwell, 2011; O'Brien et al., 2013). However, in observational studies at least, the relationship between Alc+Caff and injury risks seems to remain even after controlling for risk-taking propensity (Brache & Stockwell, 2011); therefore, the role that risk-taking propensity plays in the relationship between Alc+Caff use and injury risk remains unclear. As impulsivity or risk-taking may play an important role in the relationship between alcohol and injury, it stands out as a key factor that should also be considered when examining Alc+Caff use and risk of injury. Therefore, the current study aims to determine whether the risk relationship between Alc+Caff use and injury varies according to self-reported individual differences in risk-taking tendency. Given the unknown nature of risk-taking propensity in the relationship between Alc+Caff use and injury, mediating and moderating pathways will be examined. More specifically, we will test whether risk-taking propensity moderates the relationship between Alc+Caff use and injury (i.e. do individuals higher in risk-taking propensity have a higher risk of injury relative to those lower in risk-taking propensity

following similar levels of Alc+Caff use?). We will also examine whether Alc+Caff use mediates the relationship between risk-taking propensity and injury risk (i.e. are those higher in risk-taking propensity more likely to engage in Alc+Caff use, thereby resulting in a higher risk of injury?)

With regards to gender differences in the relationship between alcohol use and injury risk, it has been argued that women may be at higher risk of injury following alcohol use because they tend to reach higher BACs than men following the consumption of equal amounts of alcohol, even after controlling for body weight (Mumenthaler, Taylor, O'Hara, & Yesavage, 1999). However, previous research examining gender differences in the dose-response relationship between alcohol and injury provides conflicting results. There is research suggesting that females may be at higher risk for injury following alcohol consumption, although this gender difference may only exist at higher levels of alcohol consumption (McLeod et al., 1999; Stockwell, 2002; Cherpitel, 2015; Cherpitel, 2019). In contrast, a review of risks and harms associated with alcohol concluded that there was no empirical support for different drinking guidelines for men and women in regards to the quantity of alcohol consumed on one occasion (Ashley et al., 1994). Furthermore, some emergency department studies using case-crossover and case-control analyses report sex differences (Cherpitel, Ye, Monteiro, 2019; Cherpitel et al., 2014; Stockwell et al., 2002; Watt et al., 2004). The lack of consensus around differential alcohol-related risk between men and women also extends to policies, with countries across the world disagreeing on whether low-risk drinking guidelines should be different for men and women (Dawson, 2009). While findings regarding gender differences in the risk-relationship between alcohol use and injury are conflicting, understanding whether gender differences exist in the relationship between Alc+Caff use and injury has significant implications for intervention

and prevention practices. For example, there is currently disagreement around differential low-risk drinking guidelines and the results of this study could offer further clarification on this matter. Furthermore, knowledge of the role of gender differences in the relationship between Alc+Caff use and injury may help to provide more understanding of the potential mechanisms underlying the conflicting findings in the alcohol-related injury research. Therefore, the current study will examine gender differences in the relationship between Alc+Caff use and injury.

Case-control and case-crossover methodologies

Lastly, the present study will be utilizing both case-crossover and case-control methodologies. In case-crossover designs, injured individuals serve as their own controls controlling for stable risk factors such as their patterns of substance use and other behaviors in the past (Borges et al., 2004; Vinson et al., 1995); whereas in case-control designs non-injured ED patients are used as quasi-controls (Cherpitel, 2007; Ye, Cherpitel, & Bond, 2010). Emergency department studies using either method have reported alcohol as a significant risk factor for injury (Cherpitel 1993; Cherpitel 2007); however, case-crossover designs tend to yield higher risk estimates than case-control designs (Gmel & Daeppen, 2007; Ye, Cherpitel, & Bond, 2010). There are strengths and weaknesses to both designs. The case-control design will allow us to compare injured with non-injured patients in order to examine between person differences (e.g., gender, age) with regard to injury risk and Alc+Caff use. However, using quasi-controls could be problematic as non-injured patients are also more likely to be drinking heavily or abstaining compared to the general population (Cherpitel, 1993). In the case-crossover design there is the benefit of a reduction in confounding variables because of the within-person factors, such as age, sex, and, risk-taking propensity. This analysis also allows for a matched-pair approach; which involves comparing the probability of Alc+Caff use in the six-hour period prior

to the injury event with the exact same time period 24 hours earlier and/or 7 days earlier. Furthermore, the matched-pair approach will allow for the adjustment of other potential sources of bias, such as day of the week. In particular, including pairs of observations that have the same level of alcohol consumption in the analysis has been found to reduce the relative risk estimates compared to a case-crossover analysis in which these pairs are excluded (Ye et al., 2010). Given the strengths and weaknesses of both methods, it seems advantageous to use both methodologies to examine the relationship between Alc+Caff use and injury risk. This will allow us to compare the risk relationship between Alc+Caff use and injury across methodologies, which could provide information on the stability of the relationship across different methodologies as well as further information on the methodologies themselves.

Objectives and Content Overview

The aim of the current study is to examine the independent and shared contributions of alcohol and caffeine use on the risk of injuries leading to ED treatment. The flowchart in Appendix A outlines all possible relationships being considered within the study. The current study will be, to our knowledge, the first controlled ED study examining the risk relationship between Alc+Caff use and injury. In addition, the present study will explore the potential roles of risk-taking propensity and gender differences in this relationship. Lastly, the study will utilize both a case-crossover and case-control analyses to compare findings across methodologies. Future research is needed to expand our current knowledge and respond to the limitations existing within the literature. Increased knowledge and understanding of the relationship between Alc+Caff use and injury could be crucial in informing both the public and public health policy. The importance and urgency for further restrictions on caffeinated alcoholic beverages is partly related to the extent of evidence that they increase the risk of injury or harm. While some

policies have already been put into place to limit the sale and availability of these beverages, further understanding of Alc+Caff related risks could facilitate the development of intervention and prevention practices. For example, the results could inform low-risk drinking guidelines, as well as policies on the caffeine or alcohol content of these beverages, as well as the sale or marketing of these beverages. The results could also be used to inform the general public, or health care professionals that may be working with individuals engaging in this practice. Identifying these consumers could then lead to focus on reducing this type of use and its associated harms through targeting interventions in this population.

More specifically, this program of research seeks to answer the following research questions:

1. What does the current literature demonstrate about the relationship between the combined use of caffeinated alcoholic beverages and risk of injury?
2. Is the use of alcohol mixed with caffeine associated with an increased risk of injury over and above the effects of dose of alcohol?
3. Do the risk estimates for alcohol mixed with caffeine and injury differ between case-crossover and case-control designs?
4. Does the dose-response relationship between alcohol and caffeine use and injury vary according to self-reported risk-taking tendency?
5. Does the use of alcohol mixed with caffeine mediate the relationship between risk-taking propensity and injury risk?
6. Is the relationship between alcohol, caffeine use, and injury significantly different for males and females?

The above listed questions will be addressed in three consecutive studies. The first study aims to answer the first question; it will be a systematic review of the literature examining the relationship between alcohol mixed with energy drinks and injury. The remaining five questions will be addressed within two separate papers. In the following section a description of the search criteria and methods for the systematic review, a description of the Emergency Department Study, and the planned analyses for all research questions will be provided.

Study 2 & 3: Emergency Department Study

The remaining two studies will involve secondary data analysis of an ED study that was conducted by the Canadian Institute of Substance Use Research (CISUR) between 2013 and 2015. Materials from the study, including participation consent form, reference table for categorizing injury versus illness, standard drink cue card, and the complete interview questionnaire are included at the end of this paper in Appendix B. The purpose of these two studies is to address research questions 2-6. More specifically, study 2 will address the following research questions:

2. Is the use of alcohol mixed with energy drinks associated with an increased risk of injury over and above alcohol on its own?
3. Do the risk estimates for alcohol mixed with energy drinks and injury differ between case-crossover and case-control designs?
4. Does the dose-response relationship between alcohol and energy drink use and injury vary according to self-reported risk-taking tendency?
5. Does the use of alcohol mixed with caffeine mediate the relationship between risk-taking propensity and injury risk?

Study 3 will address the final research question:

6. Is the relationship between alcohol, energy drink use, and injury significantly different for males and females?

Chapter 2

General Methodology

Overview of the Emergency Department Study

Data were collected from representative samples of ED patients at St. Paul's Hospital and Vancouver General Hospital in Vancouver, and Royal Jubilee Hospital in Victoria. St. Paul's Hospital is a 500-bed acute care, academic and research hospital and level 2 trauma center, located in downtown Vancouver, and serves as the major treatment resource for Vancouver's Downtown Eastside, an identified "hotspot" for homeless, poverty, violence, substance addiction and sex work. Vancouver General Hospital (VGH) is a 955-bed specialist level-1 trauma center providing specialized and tertiary medical services to over 80,000 residents annually in Vancouver. VGH is the largest hospital in British Columbia and accepts patients referred from other parts of the province requiring highly specialized services. VGH is also a teaching hospital in affiliation with the University of British Columbia. Royal Jubilee Hospital (RJH) in Victoria is a 425-bed acute care facility located about 3km outside of the city center. RJH offers critical-care, surgery, diagnostics, emergency facilities and other patient programs with a particular focus on cardiac medicine. RJH serves the downtown population as well as the surrounding areas.

Procedure

In each ED, patient samples aged 18 and over were drawn from computerized registration available on the ED computer, entered in consecutive order of patient arrival at the ED, for both those that arrived on their own and those that arrived by ambulance. An approximately equal number of injured and non-injured control subjects were interviewed on each shift. With a known ratio at these sites of between one in three and one in five admitted to

the ED for an injury, the sample was achieved at quieter times by seeking to interview every presenting injured attendee and every second or third ED attendee with an illness (Chan et al, 2010). At busier times the sampling ratio was adjusted; e.g., every second or third injured patient and every fourth or sixth non-injured patient. At the data analysis stage the data were weighted to account for the differences in sampling ratios across data collection periods.

Sampled patients were approached as soon as possible after registering for care with a request for informed consent to provide a breath sample and to be interviewed. Interviews, lasting about 25 minutes, were completed either in a private area in or near the waiting department or in the treatment department. In the case of those who were severely impaired, every attempt was made to interview the patient at a later time. Those patients who were too seriously ill or injured to be approached or interviewed in the ED were followed into the hospital and interviewed after they have been admitted and their condition stabilized. Patients were offered a $10.00 gift card for completing the interview. This methodology was used in prior ED studies in both the U.S. and Canada, and has proven acceptable to both patients and ED staff, and successful in obtaining high completion rates.

Participants

There were a total of 2804 participants, with 1613 being non-injured patients and 1191 injured. Participants ranged between the ages of 18-98 with a mean age of 44.96 (SD=20.08). There was an equal distribution of males (52.3%) and females (47.7%) and participants were primarily white (72.25%). The majority of participants were either married or single and never married and 71.4% had completed some form of post-secondary education or training. Participants who came to the ED for an injury were more likely to be male, younger in age, and higher in risk-taking propensity.

Measures

Patient interview and injury variables: Patients were interviewed regarding the cause of injury (including violence) or medical problem which brought them to the ED, alcohol use, energy drink use, other caffeine use, and other substance use within six hours prior to the event, and within the same six-hour period the previous day and the previous week (for case-crossover and control-crossover analyses); the amount of alcohol, energy drinks, or caffeine consumed; time elapsed between use and the event, feeling drunk at the time, believing the event would not have happened if he or she had not been drinking alcohol and/or using stimulants (including caffeinated drinks) or other drugs, usual use of alcohol, energy drinks and caffeine, and other substances (licit and illicit), and demographic characteristics.

Additionally, data were obtained on the place where the patient was and the specific activity the patient was engaged in at the time of injury (or first awareness of the medical condition bringing the patient to the ED), as well as for the same time the day before and the week before the injury event. Such measures have been utilized in previous studies (e.g. Stockwell et al, 2002) and in the BC preliminary studies to date. The place of injury was categorized as to the respondent's home, workplace (school/trade area/office), recreation or sporting areas, premises licensed for the sale of alcohol, an industrial area, and a street or "other". Activity at time of injury (or medical problem) was classified as to passive activities (reference group), sports, household chores or domestic activities, travel, working to earn money, social activities and "other" activities.

Alcohol and Energy Drink use: The Alco-Sensor III breathalyzer, used in earlier studies, was used to estimate blood alcohol level, and provides estimates which have a Pearson's correlation coefficient as high as 0.96 for oral exhalation among cooperative patients when

compared to chemical analysis of blood (Gibb, et al., 1984). Previous analyses (e.g. Stockwell et al, 2002) have found that self-reported alcohol consumption has a higher incidence than positive breath tests, with few reporting not drinking when registering positive for BAC (less than .05% in some studies) (Cherpitel et al., 1992). The main outcome of interest will be self-reported alcohol and energy drink use. Our interest in obtaining breathalyzer readings to estimate BAC stems from prior research which has successfully mapped breathalyzer readings to the actual number of drinks consumed prior to injury, up to a threshold level of six drinks, and was, therefore, a useful alternative for some patients who are not able to report the number of drinks consumed prior to the event bringing them to the ED (Bond et al., 2010).

Since energy drinks contain variable amounts of caffeine, as well as other ingredients, data were obtained on the exact beverage line, brand, and amount of each energy drink consumed, as well as coffee, tea, and caffeinated sodas, during the six hours prior to injury or first awareness of the medical condition, and during the two control periods, to more accurately quantify caffeine consumption.

Risk-taking/impulsivity: A scale designed to measure risk-taking, impulsivity, and sensation seeking was used (α=.78). The scale was constructed by Cherpitel (1993) and has been used in several ED studies. Both sub-scales were constructed from items that were combined and factor analyzed using principal axis factor analysis. There were 5 five questions designed to measure risk-taking and impulsivity, and an additional 5 questions for sensation seeking. For all items, participants were asked whether each statement described them on a 4-point scale ranging from “not at all” (scored 1) to “quite a lot” (scored 4) (see Cherpitel, 1993 for further description of items).

Analytical plan

As stated above, study 2 addresses the following research questions:

2. Is the use of alcohol mixed with energy drinks associated with an increased risk of injury over and above alcohol on its own?
3. Do the risk estimates for alcohol mixed with energy drinks and injury differ between case-crossover and case-control designs?
4. Does the dose-response relationship between alcohol and energy drink use and injury vary according to self-reported risk-taking tendency?
5. Does the use of alcohol mixed with caffeine mediate the relationship between risk-taking propensity and injury risk?

Study 3 addresses the final research question:

6. Is the relationship between alcohol, energy drink use, and injury significantly different for males and females?

These research questions were examined using both the case-crossover and case-control methods. Using both case-crossover and case-control methods offers the opportunity to contrast the results. Previous research has indicated that these different methods of analyses can produce varying risk estimates and there are benefits and limitations to both (McClure, 1991; Ye et al., 2010). The case-crossover analysis allows for the reduction in confounding variables due to stable within person risk factors (e.g. risk-taking propensity, sociodemographic characteristics); however, it does not allow for the control of transient within person factors or environmental and contextual factors. The case-control method allows for the control of environmental and contextual factors that could impact the Alc+Caff and injury risk relationship, as well as

sociodemographic characteristics. The use of both methods facilitates a better understanding of the nature of the relationship between Alc+Caff use, risk-taking propensity, gender, and injury.

The case-crossover analyses were performed using conditional logistic regression. The case period was the 6-hour period prior to the injury and the control times were the same 6-hour period one day and one week before. Patient data was re-structured with two periods clustered under each individual, and the case period coded as injury and the control period coded as non-injury. Finally, to adjust for potential biases and the loss of efficiency when concordant pairs are eliminated from the analysis, a sensitivity analysis was performed through minor artificial adjustments of exposure levels, either for the exposure or control conditions (McClure, 1991). In order to examine gender differences (Question #6) the regression models were fitted separately for men and women to estimate the relevant odds ratios (ORs) as risk estimates.

To perform the case-control analyses logistic regression were performed to produce risk estimates for injured and non-injured presentations. Again, models were fitted separately for men and women when examining gender differences. Potential confounding factors were adjusted as covariates entered in the logistic regressions. To determine which covariates were to be included in the model the univariate and bivariate relationship between the outcome variable and each potential covariate was examined. Any covariates associated with the outcome variable at the 0.2 level or higher were included in the analyses (Hosmer, Lemeshow, Sturdivant, 2013). The difference in the dose-response relationship between alcohol consumption and injury risk between males and females was investigated by comparing the sex-specific estimates with $\chi 2$ test of homogeneity assessing whether the effects differ across gender (Rothman and Greenland, 1998).

Research questions 4 and 5 were also being examined using the case-control approach. Previous research has identified risk-taking propensity as a potential key factor in the relationship between Alc+Caff use and injury risk; however, whether it can best be characterized as a mediating or moderating relationship remains unclear. Therefore, both a mediating and moderating relationship will be tested using logistic regression. First, to test for a full or partial mediation relationship risk-taking propensity, alcohol use, caffeine use, and Alc+Caff use were entered as independent variables in the regression predicting injured versus non-injured presentations. Then, an ordinary least squares path analysis (Hayes, 2018) was used to test whether Alc+Caff use mediated the relationship between risk-taking propensity and injury. The estimation of the joint effect, or moderation, of Alc+Caff use and risk-taking propensity was conducted by creating an interaction term and including it in a model with alcohol, caffeine, risk-taking propensity, and all other covariates. Testing of the joint effect is performed either by the Wald test or the likelihood ratio test. If the interaction term were significant this would indicate a moderation effect. If a moderation effect is supported, participants will be categorized as either high or low in risk-taking propensity and then logistic regression analyses will be run separately for each group to allow for closer examination of the relationship between Alc+Caff use and injury in each group. Potential confounding factors, identified in the same manner as previously described, were adjusted as covariates entered in the logistic regressions.

Chapter 3

Study 1: Alcohol Mixed with Energy Drinks and Risk for Injury: A Systematic Review

Abstract

Objective: The present study is a systematic review of the literature examining the relationship between alcohol mixed with energy drinks (AmED) and injury. The study provides a summary and critical analysis of the current literature.

Methods: The review was conducted using PRISMA guidelines for systematic reviews. Studies included in the review were those that quantified the relationship between AmED use and injury risk relative to alcohol only. Records were considered along the following theme areas: (1) controlled for drinking behaviors, (2) controlled for impulsivity or risk-taking propensity, (3) examined sex differences, and (4) self-reported injury outcomes for (a) AmED versus alcohol consumers and (b) AmED versus alcohol sessions.

Results: The results support the association between AmED and increased risk of injury; however, substantial variability in harm outcomes and methodology makes it difficult to determine the extent of this risk.

Conclusion: There is significant need for further examination of the role of AmED use in the risk for injury. A better understanding of the relationship between AmED use and injury and potential underlying mechanisms are critical for informing effective preventive intervention strategies. The review can be used to inform the public and health practitioners on the risks associated with AmED use. Further, translating this knowledge to policy makers could inform regulations on the availability of AmED, with the goal of reducing injury related outcomes.

Introduction

There has been a trend in recent years towards increased use of alcohol mixed with energy drinks (AmED) across North America (Howland et al., 2011). Alcohol mixed with energy drinks refers to the combining of energy drinks with alcohol, either by hand, or in pre-mixed beverages sold in convenience and liquor stores. There is evidence of increased risk of both intentional and unintentional injury following AmED use (O'Brien et al., 2008). Injury refers to physical harm or damage to a body, caused by either unintentional intent (e.g. falling, tripping, MVA), or intentional intent (e.g. violence, suicide). It has been estimated that the number of emergency department visits involving energy drinks nearly doubled between 2007 and 2011, with 13-16% of these admissions related to AmED use (Center for Behavioral Health Statistics and Quality, 2013). Following several fatal incidents reported in the media involving alcoholic energy drinks, there have been calls from Health Canada and others for more research in this area (Health Canada, 2011; Schmidt, 2011).

The increase in risk of injury related to AmED use is thought to be due to both increased alcohol consumption and a diminished sense of perceived intoxication (Howland et al., 2011). Some researchers have theorized that the stimulating effects of energy drinks may work to attenuate the depressant effects of alcohol, thereby masking the physiological and psychological sedative experiences (Ferreira et al, 2006; Marczinski et al., 2006, & Howard, 2011). This masking of the sedative effects may result in the consumer underestimating their level of intoxication, which has been theorized to lead to more hazardous drinking practices, increased risk-taking, and poorer risk assessment (Brache & Stockwell, 2011; Ferreira et al., 2006). Such behavioral changes caused by AmED consumption are all associated with a higher likelihood of the consumer incurring an injury (Room et al, 2005; WHO, 2009). However, there have been mixed findings regarding the ability for energy drinks to attenuate the negative effects of alcohol, with impairment of some psychomotor functions but not others (Marczinski & Fillmore, 2003). In addition, some research suggests AmED use may produce subjective effects, such as a reduction in subjects' perception of intoxication, without reducing BAL level or related

psychomotor deficits (Ferreira et al., 2006). Therefore, some negative effects of alcohol intoxication may be attenuated when mixed with caffeinated drinks, but overall impairment still exists.

To the best of our knowledge, the present paper will be the first systematic review of published research on AmED use and risk of injury. With many countries currently determining the level of need and suitability of policy responses to energy drinks and AmED use, it is crucial that we begin to integrate and further our understanding of the current literature. While our primary objective of this paper is to review evidence for whether AmED use compared with alcohol use alone is associated with increased injury risk, we also investigate specific variables that have been indicated as risk factors for alcohol-related injuries. In particular, risk-taking tendency and binge drinking have been associated with a higher risk of experiencing alcohol-related consequences (Brache & Stockwell, 2011; Igra & Irwin, 1996), therefore these variables may also be associated with a higher likelihood of experiencing negative outcomes following AmED consumption. Individuals scoring higher in sensation seeking might show preference for the 'awake drunk' state of AmED use and therefore, may be more likely to engage in AmED use (O'Brien et al., 2013). Research also indicates that individuals who tend to consume more alcohol or engage in more binge drinking may be more likely to engage in risky drinking behaviors and have greater opportunity to experience harms related to risky drinking behaviors (Brache & Stockwell, 2011; O'Brien et al., 2013). Therefore, controlling for such factors becomes important when trying to isolate the effects of AmED use on AmED-related injury. As such, the current paper will examine whether the current literature on AmED use and injury have identified any associations that may parallel the findings of alcohol-related injury research. Lastly, the paper will examine whether there are any sex differences underlying this association, as some studies suggest sex differences exist in the risk relationship between alcohol use and injury (Nordstrom et al., 2001; Mcleod et al., 1999).

Method

Search Strategy

An online Appendix details the study selection and data extraction process (Appendix 1) and the research protocol is registered on PROSPERO (Roemer et al., 2016). Studies were identified by author AR via EBSCO and Pubmed (last search 15 February 2016). Each energy drink related search term ('energy drink*', 'Red Bull') was combined with all alcohol search terms ('alcohol*', 'drinking*') in conjunction with: 'injury*', 'harm*', 'adverse effect*', 'adverse outcome*', 'risk*', 'accident*'. An additional search term of 'caffeinated* alcohol' was also included in the search. All duplicates were removed and author A.R. completed initial eligibility screening based on publication criteria. Content assessment based on title and abstract was performed by A.R. The assessment was not blind, with full-text review when necessary. A secondary reviewer examined selected articles and randomly reviewed excluded articles for accuracy and consistency in search strategy.

Publication Criteria

Studies were restricted to those that quantified the risk relationship between combining alcohol and energy drinks with the risk of an injury related outcome of some kind. Animal studies, case studies, qualitative studies, reviews, methodology papers, and commentaries were excluded. Peer-reviewed journal papers published in English between January 1981 and January 2016 with the search terms in the title or abstract were included.

Content Criteria

As the primary objective of the review was to examine the association between AmED use and injury relative to alcohol alone, papers were included if they reported comparisons of AmED versus alcohol consumers, or AmED versus alcohol consumption with regard to the incidence of an intentional or unintentional harm or injury outcome. AmED use refers to combining energy drinks with alcohol, either by hand, or in pre-mixed beverages. Alcohol

combined with energy drinks by hand was defined as either combining both beverages into a single beverage to consume simultaneously; or, consuming both beverages consecutively within the same drinking session.

Papers were only included if they specifically measured the occurrence of being either intentionally or unintentionally hurt or injured. Studies that examined other, or broader alcohol-related outcomes (e.g., sleep and academic difficulties) or risk-taking behaviors only (e.g., driving under the influence) were excluded.

Data Extraction and analysis

A data extraction sheet was used to extract information on: study design, sample characteristics, primary measures, method of administration, covariates, and outcomes. A second researcher reviewed the data extraction for quality assurance. The reviewers were not blind to the publication details. While no studies were removed based on quality assessment, study quality was considered in the synthesis of the results. Specifically, included papers were coded for whether they: (1) controlled for drinking behaviors, (2) controlled for personality traits of impulsivity or risk-taking propensity, (3) examined sex differences, and (4) used self-reported injury outcomes both for (a) AmED versus alcohol consumers and (b) AmED versus alcohol sessions. While we considered running a meta-analysis, as this is often the next step following a systematic review, it was decided that with such a small sample size and the large degree of heterogeneity in measures and outcomes this would not be meaningful.

Results

Sample for synthesis

Three hundred and twenty three papers were retrieved after duplicates were removed (Fig. 1). Thirteen studies were included in the final sample following exclusion (Table 1). The majority of studies were from the US (N = 8), two were Canadian, and there was one study each from Australia, New Zealand and Taiwan. Most studies sampled college or university students

(N = 6), three used general population samples [8, 9, 12], two high school students [1, 5], one manual workers [4], and one active military personnel [7]. All were cross-sectional studies of which three used within subject designs [2, 8, 9] and the remainder a between-subjects design.

Definition of Injury/Harm, Alcohol, and AmED use

All thirteen studies reported risk estimates for AmED use and an injury or harm outcome. While all but two papers measured the presence of harm or injury as a dichotomous outcome, there was variability in the definition of the injury or harm outcome: six studies defined the outcome as the occurrence of being hurt or injured [2, 4, 5, 8, 9, 10]; three measured the occurrence of being hurt or injured requiring medical treatment [3, 12, 13]; one measured the frequency of motor vehicle accidents [1]; one defined the outcome as a work-related injury or disease [4]; one specified the outcome as traumatic brain injury [6]; another study specifically measured suicide and self-harm behaviors [7], and another measured the frequency of sexual victimization [11].

Additionally, there were varying methodologies used to assess both alcohol and AmED use. The time frame for reporting past AmED use ranged from past 30 days to past 12 months, while the time frame for self-reported incidence of injury or harm ranged from past 30 days to lifetime. Many of the studies maintained consistency between the recall period of AmED use and incidence of injury or harm; however six of the studies had different time frames for measuring these variables [4, 5, 7, 11, 12, 13]. In addition, eight of the studies asked only about injury or harm that had occurred while consuming or following the consumption of alcohol. Of the remaining studies there was no specification that the injury or harm outcome being measured had to be alcohol related. More specifically, one study asked about injury only during AmED sessions [5], one about injury or disease because of work [4], one focused on the occurrence of traumatic brain injuries [6], one asked about past year suicidality [7], and one examined lifetime report of sexual victimization [11]. With regards to measuring AmED use, seven papers measured the frequency of use [1, 2, 3, 5, 6, 7, 12], three studies measured quantity and

frequency of use [8, 9, 10], one measured quantity of use only [11], and two defined AmED users as those self-reporting AmED consumption at least once in a specified period of time [4, 13]. Furthermore, 10 studies defined AmED use as simultaneous use [1, 2, 3, 4, 5, 6, 7, 10, 11, 13], while three studies measured simultaneous and subsequent use [8, 9, 12]. Lastly, only two studies [8, 9] utilized a standard drink method to measure the amount alcohol and energy drinks consumed. In both studies a standard drink of alcohol was considered approximately 10g and a standard energy drink was defined as one 250ml can containing approximately 80mg of caffeine.

AmED use and risk of injury

Out of all thirteen studies, ten of the studies indicated support for an association between increased risk for injury and AmED use, while three studies found no support for such a relationship [2, 9, 10]. No consistent differences in the type of injury or harm outcome measured, methods, or sample characteristics were observed between the ten and the three. However, two of three negative studies used quantity-frequency measures of alcohol and AmED use, and were within subject comparisons [9, 10]. Peacock and colleagues (2012) found that while participants reported more alcohol and energy drink consumption during AmED sessions relative to alcohol only sessions and typical energy drink use, the risk of injury or harm was lower during AmED sessions compared to alcohol sessions. Similarly, Woosley and colleagues (2010) found that AmED users typically consumed less alcohol during AmED sessions compared to alcohol sessions; however, no significant differences were found between AmED and alcohol only sessions in the risk of injury. The similar methodologies of these two studies are of note, as within-subjects research asks a different question than between-subjects research. In particular, the former examines whether the same individual is at higher risk of injury after AmED use relative to alcohol, which allows for tentative inference of causation. In contrast, between-subjects research examines whether individuals who consume AmED are more risky than those who consume only alcohol, which does not allow for any inference of causation.

The contrast between the findings from these two studies and the reported trend of increased risk of harm or injury following AmED use may be explained by such differences in methodology. However, Peacock and colleagues (2015) argued that since the relative frequency of AmED use is less than alcohol only use there are fewer opportunities for risk behaviors and injuries to occur. Therefore, to accurately compare the risks associated with both patterns of drinking, the differences in the frequency of these occasions needs to be considered. Using a matched-frequency design Peacock and colleagues (2015) found partial support for increased risk following AmED consumption. The results indicated lower odds of engaging in risk behaviors in AmED sessions relative to alcohol sessions. However, greater average energy drink consumption during AmED sessions relative to average energy drink consumption was associated with an increased likelihood of being physically hurt or injured compared to alcohol only sessions. The authors concluded that higher levels of energy drink consumption might be associated with a higher risk of injury even after controlling for alcohol intake and risk-taking.

The third study (Berger et al., 2013) reporting no support for increased risk of injury with AmED use was distinct in that the analyses compared three types of drinkers: nonhazardous drinkers, hazardous drinkers, and hazardous drinkers who engaged in AmED use. The authors argued that hazardous drinking is a significant risk factor for experiencing alcohol-related harm; therefore, comparing alcohol-related harms across these three categories of drinkers could help determine the extent to which AmED use is associated with injury or harm while controlling for this pattern of alcohol use. Berger and colleagues (2013), found nonhazardous drinkers were significantly less likely to report being injured or hurt, while no differences were reported between hazardous drinkers and hazardous drinkers who engaged in AmED use. These findings suggest that individuals who are more likely to engage in risky drinking behaviors are at a higher risk of alcohol-related harm regardless of AmED use.

Risk-taking tendency and other individual characteristics

Three of the studies pointed to the importance of considering risk-taking tendency [5] or sensation seeking [12], as well as risk-taking behaviors during alcohol only sessions [8], when examining the association between AmED and injury. The results the study by O'Brien and colleagues (2013) indicated that AmED users scored higher in sensation seeking. After controlling for this variable AmED use was still related with a higher risk of injury; however, this association was stronger among individuals with higher scores in sensation seeking. Similarly, Brache and Stockwell (2011) reported that AmED use was associated with higher risk-taking tendency, but the relationship between AmED use and injury remained significant after controlling for this variable. Lastly, Peacock and colleagues (2015) found that amount of variance accounted for in the relationship between AmED and injury increased by about 45% following the inclusion of risk-taking behavior during alcohol sessions. Taken together, the results suggest that while risk-taking is an important factor in predicting AmED-related injury, AmED use appears to contribute to the risk of injury over and above such dispositional characteristics.

Drinking Behaviors and Other Covariates

The majority of studies controlled for binge drinking [1], alcohol consumption [5, 7, 8, 9, 13], or both [3, 4]. A pattern emerged across several studies indicating that AmED users tend to report higher levels of alcohol consumption and binge drinking than non-AmED users. In addition, the results suggested that more alcohol was typically consumed during AmED sessions relative to either alcohol only sessions or average alcohol consumption. All but one of the eight studies that controlled for alcohol use or binge drinking still found a higher risk of injury following AmED use [9]. In summary, the results suggest that higher levels of alcohol consumption during AmED use as well as AmED itself may both contribute independently to the higher likelihood of injury or harm.

There were two other control variables included in three of the publications that were notable. Two of the studies controlled for other substance/drug use [1, 11] and one study considered other caffeine use [12]. As drug use has been found to be a significant predictor for experiencing alcohol-related harms (O'Brien et al., 2008), and stimulant use could have similar effects to caffeine when mixed with alcohol, controlling for drug use seems crucial. Both studies controlling for this variable still found an association between AmED use and injury or harm. With regards to caffeine use, Kiponee and colleagues (2014) argued that alcohol is often mixed with caffeinated soft drinks and the consumption of these beverages may have similar effects as energy drinks. Therefore, in order to isolate any effects of AmED use it is critical to control for the potential effects of other caffeinated beverages. In their study, they compared AmED use with 'traditional' forms of mixing alcohol and caffeinated beverages (i.e., soda). The results of their study indicated AmED use was associated with a higher risk of injury compared to traditional forms of caffeinated alcoholic beverages and non-caffeinated alcoholic beverage use (Kiponee et al., 2014).

Lastly, only one study [11] examined sex differences in the relationship between AmED use and risk of injury or harm. Snipes and colleagues (2014) found that AmED consumption was associated with a higher likelihood of sexual victimization only among men, whereas alcohol use on its own was associated with a higher risk of sexual victimization only among women. No other examination of sex differences in the relationship between AmED use and risk of injury were found in the included publications. However, one study reported that men were overall at a higher risk for injury [1] and two studies reported that men were more likely consume AmED [11, 13].

Figure 1.Flowchart for Systematic Review

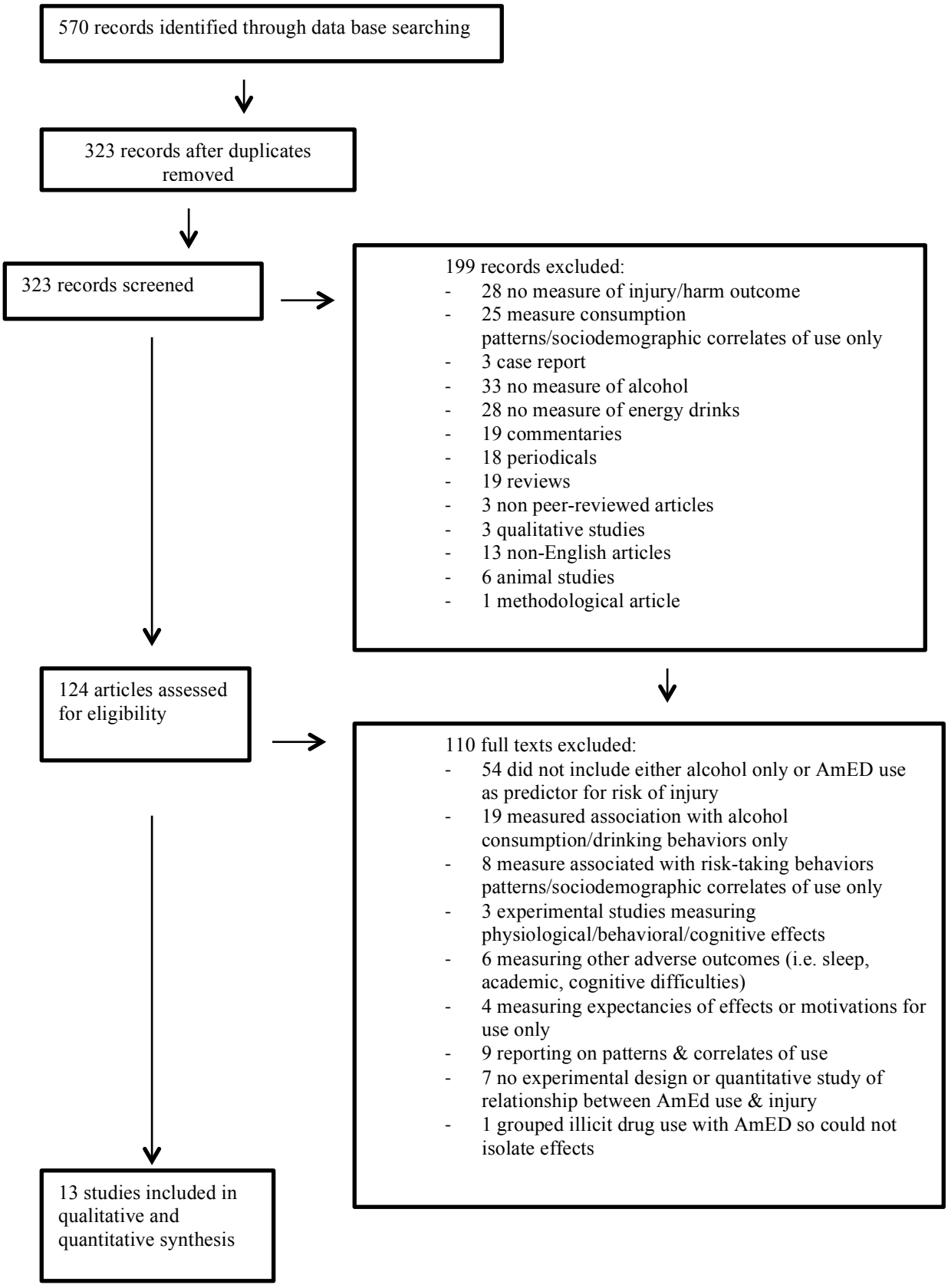


Table 1

Summary of Systematic Review Findings

Study	**Study Design**	**Sample n & Characteristics**	**Definition of AmED use**	**Definition of Harm Outcome**	**Covariates**	**Results (risk estimate)**
1. Martz et al., 2015	Cross-Sectional Descriptive	Grade 12 U.S. students, randomized sample (*n*=3169 males). Total N=6498; AmED users = 1600	Simultaneous use in past 12 months (frequency of use - # occasions)	Frequency of MVA accidents in past 12 months that occurred after drinking alcohol	Sociodemographic groups, social & academic factors, other substance use, binge drinking	Males > AmED use. AmED use associated with > of alcohol-related unsafe driving. AmED use in past 12 mo. associated with > risk of MVA accidents after drinking (OR 4.32 (95% CI 1.27-4.66))
2. Berger et al., 2013	Cross-sectional descriptive (web-based and interview)	U.S. University students ages 18-25 (mean=21.5, SD=1.7)), 61.6% female, 81.8% white. Total N=606, AmED users = 322; Alc = 284 (divided into hazardous users n= 74 & nonhazardous users n=210)	Past year AmED use (premixed and self-mixed simultaneous use) Frequency of use	Past-year report of being hurt or injured because of alcohol (dichotomous)	None reported	Nonhazardous drinkers sig < likely to drive car under influence, be hurt/injured, or have unprotected sex. No sig differences found between hazardous drinkers who drink AmED & non-AmED hazardous drinkers in injury (OR = 1.92 (95% CI 0.90-4.10). Males > likely to be injured overall. No sex differences in AmED use.
3. O'Brien et al., 2008	Cross-Sectional descriptive (web-based)	U.S. Undergraduate college students mean age 20.4 (SD=2.8), 78% white. Total N = 4237, non-drinkers = 1351, non-AmED drinkers = 2189, AmED drinkers = 697.	Simultaneous use in past 30 days (frequency of use)	Being hurt or injured, or requiring medical treatment in past 30 days as result of their drinking (yes/no response)	Drinking behaviors (alcohol quantity, binge drinking), gender, age, race, fraternity/sorority status, athlete status, within campus clustering	AmED drinkers drank more during typical drinking session, reported more drinking days & more episodes of weekly drunkenness. AmED users > likely to report being taken advantage of sexually, take advantage of other sexually, ride with driver under influence, be hurt/injured (OR being hurt/injured = 2.25 (95% CI = 1.70-2.96)), & require medical tx. (OR = 2.17 (95% CI = 1.24-3.80)) No sex differences in AmED use
4. Cheng et al., 2015	Cross-sectional descriptive (in-person survey)	Manual workers in Taiwan 25-65 (mean = 42.4 (SD=9.3)). Male = 1143. All regular drinkers (drink > 1 per week). Total n =	Simultaneous use. AmED use more than 1 per week =	Report of injury or disease because of their work in past year (yes/no response)	Presence of problem drinking (CAGE scores) and	AmED users > risk of work-related injury or disease in past year relative to alcohol users only (OR 1.48 (95% CI = 1.14-1.93)). No sex differences in use or injury.

		1192, problem drinkers = 633, AmED drinkers = 411	AmED drinker.		alcohol use frequency	
Study	**Study Design**	**Sample n & Characteristics**	**Definition of AmED use**	**Definition of Harm Outcome**	**Covariates**	**Results**
5. Brache et al., 2011	Cross-sectional descriptive (web-based survey)	Western Canadian university students between ages 17-51 (mean = 24.03, SD = 6.7), 55.9% female. Total N=465, reported drinking at least once in past 30 days = 410, AmED users = 105	Frequency of simultaneous use of pre and manually mixed drinks in past 30 days	Lifetime experience of injury/being hurt with AmED use (dichotomous)	Risk-taking tendency, age, sex, drinking behavior	AmED users > likely to be younger, live on campus, score higher in risk-taking. No gender effect. AmED users > likely to drink larger amounts of alcohol & engage in higher risk drinking practices. More frequent use of AmED in past 30 days associated with being hurt/injured (OR 1.38 (95% CI 1.02-1.88)). No sex diff.
6. Ilie, G, et al., 2015	Cross-sectional school based survey, descriptive	Ontario students (grades 7-12); age 11-20, 54.9% female N=10,272 (only n = 4794 asked about AmED use) AmED lifetime users = 3309	Simultaneous use in past 12 months (frequency measure)	TBI in past 12months & lifetime (yes/no). Past 12 mo occurrence was asked about cause of injury.	Academic performance, sex	Past year & lifetime TBI associated with alcohol & ED use. Recent (but not former) TBI incurred while doing something other than sports was associated with use of 5+ AmED drinks in past 7 days (OR = 6.36 (95% CI 1.48-27.42)). Sex diff not examined
7. Mash et al., 2014	Cross-sectional, descriptive	Active duty U.S. military soldiers, 45% ages 17-25, 85% male, 65% white. Weighted sample n = 4,999, 26% reported AmED use	Frequency of simultaneous use in past 30 days	Suicidality in past year (seriously considered or attempted) (yes/no response)	Avg daily ethn consumption, ED use, age, gender, race, education, marital status, enlistment status	Daily AmED use > likely suicidality after controlling for all variables (OR = 1.99 (95% CI 1.18-3.35)). Less than daily use was not significantly associated with suicidality in adjusted model. Sex diff not examined
8. Peacock et al., 2015	Cross-sectional (matched frequency), descriptive	3 samples (2 Australia and 1 new Zealand) of general population 16 or older (mean age = 22.3, SD = 3.4), 66% female. Total N = 273 matched frequency of AmED users	Quantity & frequency of monthly AmED use. Standard drink= 10 g alcohol & standard ED = 250ml of approx. 80mg caffeine	Physically hurt or injured during AmED & alcohol sessions in past 6 months for 2 studies & 12 months for 1 study (dichotomous)	Matched frequency (to control for relative frequency of alcohol and AmED use), avg ED and alcohol intake in AmED sessions, risk-taking beh during alcohol	Lower odds of risk-taking behaviour after AmED vs. alcohol only (OR = .72 (95% CI .57-.92)). Risk-taking in alcohol only sessions strongest association with risk-taking in AmED sessions. Greater ED intake post AmED consumption associated with > likelihood of harm/injury. Sex diff not examined

					sessions	
Study	**Study Design**	**Sample n & Characteristics**	**Definition of AmED use**	**Definition of Harm Outcome**	**Covariates**	**Results**
9. Peacock et al., 2012	Cross-sectional (web-based survey), descriptive	Australian sample from general population age 18-35 (mean=23.1, SD =3.8), 61% female. Total N=963, analysis done only on AmED users n = 403	Subsequent and simultaneous use in past 6 months (frequency and quantity)	Been physically hurt or injured in past 6 months during both alcohol and AmED sessions (dichotomous)	None reported (within subject design)	In AmED sessions > alcohol & ED consumed; risk of being hurt/injured < during AmED sessions compared to alcohol only (OR = .46 (95% CI .36-.58)). AmED users report < sedation effects, > stimulatory mood states, & < disinhibition. Sex diff not examined
10. Woolsey et al., 2010	Cross-sectional descriptive (in-person survey)	U.S. Intercollegiate student athletes (257 male & 144 female), Mean age = 19.8. Total N = 401, AmED users = 150, alcohol users = 315	Quantity-frequency measure over past year	Be injured in past year while using alcohol and AmED	-	AmED users consumed > alcohol & had riskier drinking habits versus alcohol users; in AmED sessions AmED users reported < alcohol use versus alcohol only sessions, but consumed > ED when using alcohol. AmED users reported more risk taking & negative consequences. No difference in report of injury (Paired sample t-test *d*=.08 (t=-1.12 p=.266)). Sex diff not examined
11. Snipes et al., 2014	Cross-sectional descriptive (web-based)	U.S. University students in intro psych course (253 men & 545 women). Mean age women=19.1 (SD=2.63) & men =19.64 (SD=3.1). Total N=798 14.2% of men and 10.1% of women reported AmED use	Number of AmED drinks in past month	Sexual victimization – lifetime report (scale 0-4 times)	Drug use, ethnicity, relationship status, year in school, sexuality	Final model, higher use of AmED associated with > likelihood of sexual victimization for men but not women (Men OR=1.17 (95% CI 1.01-1.37) women OR 1.06 (.92-1.21)). Correlations show relationship between AmED use & physically forced victimization among women. Men reported > AmED use
12. Kiponee et al., 2013	Cross-sectional descriptive (web-based)	General pop in U.S. age 13-20 from nationally based study. Total N =1031; AmED users= 19.6%. Any caffeinated bev with alc use = 52.4% & traditional CAB = 45.6%	Frequency of simultaneous & subsequent use in past 30 days (# of days)	Alcohol related injury & injury requiring doctor visit in past 12 months (dichotomous)	Age, sex, race, income, seat belt use.	All CAB users reported > alcohol use & > binge drinking. This was highest among AmED users. Same pattern found for adverse outcomes. Alc related injury (OR=5.6 (95% CI=3.6-8.7)); injury requiring doctor (OR=1.9, .8-4.4). No sex diff in AmED use
13. O'Brien et al., 2013	Cross-sectional web based survey,	U.S College students, 62% female, mean age = 20.5 (SD=2.9). Total N=4907,	Yes/no of simultaneous use in past 30	Alcohol related injury requiring medical tx in past	Typical amount of alcohol	AmED users higher in sensation seeking and more likely to report injury/harm (OR=1.71 (95% CI

	descriptive	AmED users = 786; 3390 reported alcohol use once or more in past 30 days	days	12 months (dichotomous)	consumed and sensation seeking	=1.23-2.39)); however this was even higher among higher scores of sensation-seeking. Males > likely to consume AmED

Discussion

Overall, the results from the systematic review suggest support for a relationship between increased risk of injury and AmED use; however, several limitations in the current literature were noted. First and foremost, all of the studies were cross-sectional and no consideration was given to the temporal occurrence of injury relative to AmED use. As such, no firm conclusion regarding causality between AmED use injury and can be drawn. In addition, some studies did not differentiate between injuries occurring in alcohol only sessions relative to AmED sessions, making a comparison of the risk of injury between alcohol and AmED use impossible. While there is strong evidence to support the association between AmED use and risk of injury, future research assessing the temporal relationship between AmED use and injury is needed to determine the causal pathways between AmED consumption and injury. For example, emergency department studies provide opportunity to obtain information on the timing and context of injuries and any substance use that occurred prior to the injury. Crossover acute dosing and real-time assessment studies may also be useful to further understand the pharmacological effects of AmED and allow for assessment of risk-taking behaviors in situ. Lastly, the majority of studies were case-control designs and previous research suggests that methodological variations assessing alcohol and injury have resulted in a wide variety of risk estimates (McClure, 1991; Ye et al., 2010). Therefore, future research should explore other methodological designs (e.g. case-crossover) to examine whether injury risk estimates vary for AmED use.

Another limitation relates to the widely varying definitions and measures of the injury/harm outcome, alcohol use, and the recall time frames used. The practice of using of frequency only measures limits the ability to confidently determine relationships between use and outcomes, as the quantity of alcohol consumed is important in understanding alcohol-related harms (Rehm, 1998). Furthermore, without the use of a standard drink measure the amount of

ethanol consumed is unknown; again, making it difficult to draw conclusions about the dose-response relationship between alcohol use and outcomes.

Similarly, no standard drink measures have been developed for energy drinks of caffeinated beverages and only two studies quantified the effect of caffeine dose. Energy drinks can vary significantly in their contents, which makes having a standard drink measure or objective measure of caffeine essential in this research. Furthermore, no study considered the ratio of alcoholic beverage to energy drink consumption during AmED sessions (i.e., one energy drink per alcoholic drink versus one energy drink for every three alcoholic drink). Lastly, only one study included other caffeinated beverages into their analysis (Kiponee et al., 2014). The practice of mixing alcohol with caffeinated sodas is common and yet, little research has compared the use of AmED to these other caffeinated beverages. As such, the lack of standardized measuring for AmED use and caffeine consumption makes comparisons across individuals and studies difficult; and, it identifies a significant gap in the literature with regards to the risk of injury related to AmED use compared to other caffeine consumption. Nonetheless, the research points to increased risk of harm and injury following AmED use and future research addressing these limitations could further elucidate this relationship.

Other drug use was also a variable that was largely ignored in the current literature. Previous research suggests there is a synergistic effect between stimulant use (i.e. cocaine) and alcohol use, such that the combined use of these substances results in a much higher risk of injury relative to the use of the substances on their own (Brache & Stockwell, 2011; O'Brien et al., 2008). Research also indicates that individuals higher in risk-taking tendency are more likely to use stimulant drugs (Chambers et al., 2013), a finding that parallels the relationship between risk-taking tendency and AmED use (Brache & Stockwell, 2011). Thus, individuals consuming AmED may be more likely to use other substances; therefore, differentiating the impact of either of these substances on the likelihood of injuries would be difficult without proper measurement. Controlling for other substance use, particularly stimulant use, is another critical factor in delineating the relationship between AmED use and the risk for injury. In summary, future

research utilizing standardized drink measures and controlling for other caffeine consumption and substance use is needed to fill this current gap in the literature.

In addition to being a predictor for AmED and other drug use, impulsivity or risk-taking tendency was identified within the literature as a potentially important explanatory factor in the relationship between AmED use and injury. While the results remain mixed in terms of whether impulsivity or risk-taking may moderate the relationship between AmED use and injury risk, there is enough evidence to warrant further exploration. Future research is needed to further explore the role of risk-taking tendency in both the likelihood of AmED use and the relationship between AmED use and injury.

Finally, one of the secondary goals of the present study was to examine whether any sex differences exist in the relationship between AmED use and injury. Only one study specifically reported on this difference [11], with the results suggesting some support for sex differences. However it is difficult to draw such a conclusion with the limited research. Given that previous research provides some support for sex differences in the dose-response relationship between alcohol use and injury (Mcleod et al., 1999; Stockwell et al., 2002), future research is needed to determine whether this association also exists between AmED use and injury.

The present paper is, to our knowledge, the first systematic review of published research on AmED use and risk of injury. The research provides some support for the association between AmED use and increased risk for injury, but the substantial variability in harm outcomes and methodology makes it difficult to determine the extent of this risk. Future research is needed to expand on the current knowledge and respond to the limitations existing within the literature. Increased knowledge and understanding on the relationship between AmED use and injury could be crucial in informing both the public and public health policy. The importance and urgency for further restrictions on alcoholic energy drinks is partly related to the extent of evidence that they increase the risk of injury or harm. While some policies have already been put into place to limit the sale and availability of these beverages, further understanding of AmED related risks could facilitate the development of intervention and prevention practices.

Chapter 4

Study 2: Alcohol Mixed with Caffeine, Risk-taking Propensity, and the Risk of Injury

Abstract

Aims: This controlled, Emergency Department study sought to examine the relationship between the combined use of alcohol and caffeine (Alc+Caff) and risk for injury. The study also explored the potential role of risk-taking propensity in this relationship.

Design: Utilizing case-control and case-crossover analyses, the study examined situ session specific Alc+Caff use and injury risk, while controlling for sociodemographic variables, dose of alcohol and caffeine, other substance use, risk-taking propensity, and context.

Setting and Participants: The sample included individuals (*N=2804)* aged 18-years or older who presented to an Emergency Department at 3 separate hospitals in British Columbia.

Measurements: Data were collected on demographics, reason for admission to the ED, and context of event leading to ED admission, alcohol (self-report) and caffeine use for the case period and 2 other control periods, other substance use, and risk-taking propensity.

Findings: Results revealed that alcohol combined with of caffeine resulted in an increased risk of injury over and above alcohol on its own in the case control (OR=1.54, 95%CI=1.04-1.23, $p<.01$) and both case-crossover analyses). This effect remained even after controlling for multiple factors, including other substance use and location at time of event. Risk-taking propensity was also found to independently predict injury, but did not eliminate or moderate the link between Alc+Caff and injury. Instead, Alc+Caff partially mediated the link between risk-taking propensity and injury.

Conclusions: The combined consumption of alcohol and caffeinated beverages is associated with an increased risk of injury. Given this, future research is needed to further understand the mechanisms underlying the relationship between Alc+Caff use and injury. The findings support public health policies that aim to better regulate these beverages and reduce the negative impact of this type of consumption.

Key Words: alcohol, caffeine, injury risk, case-control, case-crossover

Introduction

The consumption of alcohol mixed with caffeine has become a common practice among young adults worldwide (O'Brien et al., 2013). There are growing concerns about the potential risks associated with this type of consumption, especially given recent reports of fatalities associated with the combined use of alcohol and energy drinks, which contain high doses of caffeine (Smith, 2014; Terry, 2014). Furthermore, it has been estimated the number of emergency department visits involving energy drinks nearly doubled in the United States between 2007 and 2011, with 13-16% of these admissions related to alcohol mixed with energy drinks (Center for Behavioral Health Statistics and Quality, 2013). While there has been increased attention around the use of alcoholic energy drinks, the principal stimulant ingredient in energy drinks is caffeine; therefore, understanding the risks associated with alcohol combined with any source caffeine is important for public health policy. Additionally, some restrictions have already been put into place limiting the caffeine content in energy drinks to that of a cup of coffee (70-140mg of caffeine); therefore, understanding the risks associated with alcohol combined with any source caffeine is important for public health policy.

Previous research supports the existence of a correlation between alcohol mixed with caffeine use, (Alc+Caff) and an increased risk for injury (Brache & Stockwell, 2011; O'Brien et al., 2008; Thombs et al., 2010). It has been proposed that the combined use of alcohol and caffeine may create an "awake drunk state", in which the psychostimulant effects of the caffeine mask the sedative effects of alcohol (Ferreira et al., 2006; Howland & Damaris, 2013; Marczinski & Filmore, 2006). The increase in risk of injury is thought to be due to both increased alcohol consumption and a diminished sense of perceived intoxication (Howland & Damaris, 2013). In other words, this state may result in the consumer underestimating their level of intoxication, which may lead to more hazardous drinking practices, increased risk-taking, and poorer risk assessment (Brache & Stockwell, 2011; Ferreira et al., 2006). Furthermore, the

combined use of alcohol and caffeinated beverages may also result in increased alcohol consumption (Mcketin, Coen, & Kaye, 2015; Peacock et al., 2012).

Increased alcohol consumption and the behavioral changes caused by Alc+Caff use are all associated with a higher likelihood of the consumer incurring an injury (Room et al., 2005; WHO, 2009). However, there have also been mixed findings regarding the ability for energy drinks to attenuate the negative effects of alcohol, with impairment of some psychomotor functions but not others (Ferreira et al., 2013). Therefore, some negative effects of alcohol intoxication may be attenuated when mixed with caffeinated drinks, but overall impairment still exists. Nonetheless, there is a lack of agreement in the current literature regarding the mechanisms by which Alc+Caff use leads to an increased risk of injury (Mcketin, Coen, & Kaye, 2015; Peacock et al., 2012; Roemer & Stockwell, 2017). Despite the increasing popularity of Alc+Caff use and the growing concerns with the associated risk factors, no controlled study has been conducted which may contribute evidence towards a possible casual link between this type of consumption and injury risk. A recent systematic review (Roemer, 2017) identified several studies supporting an association between Alc+Caff use and risk of injury, as well as several limitations in the current literature, including: the majority of studies are cross-sectional, use case-control designs, and do not control for the level of alcohol use or other potentially important variables such as risk-taking propensity (Roemer & Stockwell, 2017).

In particular, risk-taking may be associated with a higher likelihood of experiencing negative outcomes following Alc+Caff consumption. Individuals scoring higher in sensation seeking might show a preference for the 'awake drunk' state of Alc+Caff use and therefore, may be more likely to engage in this type of use (O'Brien et al., 2013). Research also indicates that individuals who score higher in impulsivity may be more likely to consume more alcohol or engage in more binge drinking and may be more likely to engage in risky drinking behaviors; therefore, having greater opportunity to experience harms related to risky drinking behaviors (Brache & Stockwell, 2011; O'Brien et al., 2013). However, the role that risk-taking propensity plays in the relationship between Alc+Caff use and injury risk remains unclear. Given the

potential risks associated with Alc+Caff use, as well as the public health burden of injuries, in situ session specific research is urgently needed to understand the temporal and casual link between Alc+Caff use and injury risk.

The current study

The present study is, to our knowledge, the first controlled Emergency Department Study examining the risk relationship between Alc+Caff use and injury. The study will also explore the potential role of risk-taking propensity in this relationship and utilize both a case-crossover and case-control analyses to compare findings across alternative study designs. We hypothesize that risk of injury will be correlated with the extent of alcohol and caffeine consumption in the 6-hour period prior to the event that led to hospital admission. We also hypothesize that Alc+Caff use will predict an increased risk of injury even after controlling for both levels of alcohol and caffeine use, as well as risk-taking propensity. Lastly, we seek to engage to exploratory analysis to determine whether risk-taking propensity moderates the relationship between Alc+Caff use and injury; or, Alc+Caff use mediates the relationship between risk-taking and injury. The increased knowledge and understanding on the relationship between Alc+Caff use and injury could be crucial in informing both the public and public health policy. The importance and urgency for further restrictions on alcoholic energy drinks is partly related to the extant evidence indicating the increased risk of injury or harm. While some policies have already been put into place to limit the sale and availability of these beverages (e.g., Canada capped caffeine content at 180mg per container; warning labels required on beverage containers; banning sale of certain alcoholic energy drinks (i.e. Four Loko), further understanding of Alc+Caff related risks could facilitate the development of intervention and prevention practices.

Methods

The University of Victoria and Vancouver Island Health Authority review boards both approved the study proposal.

Sampling

Data was collected between 2013 and 2015 from representative samples of ED patients (aged 18 and older) at three hospitals located on the West Coast of British Columbia.

Procedure

In each ED, patient samples aged 18 and over were drawn from computerized registration on the ED computer, entered in consecutive order of patient arrival. An approximately equal number of injured and non-injured control subjects were interviewed. The sample was achieved at quieter times by seeking to interview every presenting injured attendee and every second or third ED attendee with an illness[x]. At busier times the sampling ratio was adjusted.

Sampled patients were approached as soon as possible for informed consent to provide a breath sample and to be interviewed. Interviews (approximately 25 minutes), were completed in a private or semi-private area. In the case of those who were severely impaired, every attempt was made to interview the patient at a later time. Patients who were too seriously ill or injured to be approached/interviewed in the ED were followed into the hospital and interviewed after they had been admitted and their condition stabilized. Patients were offered a $10.00 gift card for their participation. This methodology has been used in prior ED studies in both the U.S. and Canada (Cherpitel, Pares, Rodes, & Rosovsky, 1992; Cherpitel et al., 2014; Stockwell et al., 2002) and has proven acceptable to both patients and ED staff, and successful in obtaining high completion rates.

Participants

There were a total of 2804 participants, with 1613 non-injured patients and 1191 injured. The total response rate was 69.16%. Participants ranged between the ages of 18-98 with a mean age of 44.96 (*SD*=20.08). There was an equal distribution of males (52.3%) and females (47.7%) and participants primarily identified as Caucasian (72.25%). The majority of

participants were either married/common-law (39.1%) or single and never married (44.2%) and had completed some form of post-secondary education or training.

A small proportion of the sample (2.5%) reported using energy drinks in the 6-hour period. The small *N* for this group would likely result in difficulties related to power; therefore, it was decided that all caffeinated beverages be combined into a single group. Given that caffeine is the psychoactive substance in energy drinks, and the psychostimulant effects of the caffeine are the focus of the paper, combining all caffeinated beverages allowed us to examine the dose-response relationship with caffeine and alcohol use in combination with caffeine (henceforth Alc+Caff) using a larger number of participants.

Given the response rate of 69.16%, analysis was done to compare those with missing data to the rest of the sample. No significant differences were found except participants who refused or were unable to participate were slightly older (M=48.24, SD=21.57) than the rest of the sample (M=44.96, SD=20.08). For the missing data, the mean was used to replace missing values for continuous variables and missed values for categorical variables were classified into the most frequent group.

Measures

Patient interview and injury variables: Patients were interviewed regarding the cause of injury (including violence) or medical problem (i.e., illness, medical condition or non-injury related medical condition) which brought them to the ED, alcohol use, energy drink use, other caffeine use, and other substance use within six hours prior to the event, and within the same six-hour period the previous day and the previous week, and demographic characteristics (sex, age, marital status, income level, and education level).

Additionally, data was obtained on the place where the patient was and the specific activity the patient was engaged in at the time of injury/illness event, as well as for the same time the day before and the week before the injury or medical event. Such measures have been utilized in previous studiesand in the BC preliminary studies to date.

Alcohol and Energy Drink use: Following suit of previous ED studies(Bond et al., 2010; Cherpitel et al., 2014) self-reported alcohol use was measured by asking participants how many standard drinks they consumed in the 6-hour period prior to the injury/illness event, the same 6-hour period the day before and week before, and alcohol use in the previous 12 months. To facilitate in the accuracy of self-reported alcohol use individuals were provided with a description and visual aid of what constitutes a standard drink.

Since energy drinks contain variable amounts of caffeine, as well as other ingredients, data was obtained, using an open-ended question, on the exact beverage line, brand, and amount of each energy drink consumed, as well as coffee, tea, and caffeinated sodas, during the six hours prior to injury/illness event, and during the two control periods, to more accurately quantify caffeine consumption. Following the completion of the interview, the researcher calculated the total amount of alcohol (in gm) and caffeine (in mg) consumed using caffeine content from a food composition database (United States Department of Agriculture, 2011). At the stage of data analysis alcohol was converted into number of standard drinks (13.45 grams/standard drink) and the unit of change of caffeine was converted to 50mg of caffeine (approximately a small cup of coffee).

Risk-taking/impulsivity: A scale designed to measure risk-taking, impulsivity, and sensation seeking was used (α=.78). The scale was constructed by Cherpitel (1993)and has been used in several ED studies. Both scales were constructed from items that were combined and factor analyzed using principal axis factor analysis. There were 5 five questions designed to measure risk-taking and impulsivity, and an additional 5 questions for sensation seeking. For all items, participants were asked whether each statement described them on a 4-point scale ranging from "not at all" (scored 1) to "quite a lot" (scored 4). All ten items were summed and the mean is calculated and used as the scale score, resulting in a range of scores from 1-4.

Statistical Analysis

Case-control study design and case-crossover study design were used to investigate the relative risk (RR) of injury due to alcohol and /or caffeine use. All statistical analyses conducted using SAS 9.3. The case-control study was analyzed by testing whether or not there was a significant difference between the proportion of subjects who drank alcohol and/or caffeine drink within six hours of injury or illness among patients attending the emergency departments. We conducted logistic regression analysis to estimate the odds ratio (OR) as estimate of relative risk (RR) of injury for alcohol and/or caffeine use within six hours of injury. Any covariates associated with the outcome variable at the 0.2 level or higher were included in the analyses (Hosmer et al., 2013). The analysis adjusted for potential confounding effects of covariates including age, marital status, educational attainment, location at time of injury/illness, and substance use within the past six hours.

In order to determine a mediation effect of risk-taking propensity on Alc+Caff use and injury we performed a simple mediation analysis using ordinary least squares path analysis as outlined by Hayes, 2018. First, we performed 3 simple regression analyses to confirm independent significant relationships between Alc+Caff use, risk-taking propensity, and injury followed by a multiple regression analyses with all variables included. Next, using the path analysis we tested for the indirect and direct effects of risk-taking propensity on injury through Alc+Caff use. To test for a moderation effect an interaction term of risk-taking propensity by Alc+Caff use is calculated and included in the model. A threshold of .05 was used to determine statistical significance.

The case-crossover study was also conducted by testing whether or not there was a significant difference of drinking alcohol and / or caffeine drink between within six hours of injury and 1-week prior among patients with injury attending the emergency departments. Conditional logistic regression was used to calculate hazard ratios with a control period of 1-week prior to the injury event was used, as this would allow us to control for day of the week.

Results

Descriptive statistics for all sociodemographic variables and substance use variables are summarized in Table 2. The alcohol use and caffeine use variables were all positively skewed. While the non-normality of variables would be problematic in most GLM analyses, logistic regression is a fairly robust analysis that avoids the issue of the violation of normality (Tabachnick & Fidell, 2013). A total of 490 participants reported Alc+Caff use in the 6-hour period prior to their injury/medical event. Lastly, the risk-taking scale was normally distributed with a mean score of 1.00 (*SD*=.73).

For the case-control analysis we first ran 3 simple regression analyses between Alc+Caff use (mediator), risk-taking propensity, and injury. All relationships were significant below the .01 level, suggesting that mediation is possible. Next, we entered the variables of alcohol use, caffeine use, risk-taking propensity, and Alc+Caff, in a stepwise fashion (Table 3). The adjusted model was significant, $X^2 = 1524.77$, $p < .01$, with both alcohol and caffeine showing independent effects. Alc+Caff use was also significant, indicating an increased risk of injury for Alc+Caff use over and above alcohol or caffeine use independently. When risk-taking was entered into the analysis there was a significant independent effect; however, the addition of the Alc+Caff variable into the model did not change the significance of risk-taking propensity, suggesting partial mediation. Additionally, all covariates except marital status were significant. The results showed that males, those who were younger, had lower levels of education, were at a licensed venue/event, and had consumed stimulants or other drugs were at a higher risk of injury. The addition of the covariates did not significantly change the independent effects of alcohol use, caffeine use, Alc+Caff use, or risk-taking propensity. Figure 2 illustrates the effect of Alc+Caff use on risk of injury relative to alcohol on its own.

The model for the path analysis can be seen in Figure 3. Individuals who were higher in risk-taking propensity were more likely to engage in Alc+Caff use (a=0.178) and individuals engaging in Alc+Caff use were at a higher risk for injury (b =0.558). A bootstrap confidence

interval for the indirect effect (*ab*=0.099) based on 5,000 bootstrap samples was entirely above zero (0.070 to 0.129). There was also evidence that risk-taking propensity predicted injury independent of its effect on Alc+Caff use (c'= 0.380, $p < .01$), all of which supports a partial mediation of the effect of risk-taking propensity on injury through Alc+Caff use.

Table 2

Sociodemographic, presenting condition and substance use characteristics of Emergency Department attendees included in study sample (n=2804)

	Men		**Women**	
Age *M(SD)*	44.13 (19.32)		45.79 (20.77)	
Ethnicity *N*				
Caucasian	1058		967	
Other	406		373	
Education *N*				
< Completed High school	216		116	
Completed High school	273		232	
College	529		519	
Completed University or Higher	444		468	
Marital Status *N*				
Married/Common-law	559		538	
Widowed/Separated/Divorced	175		285	
Single/Never Married	728		512	
Risk-taking score *M(SD)*	1.16(.76)		.84(.67)	
Injury *N*	713		478	
Illness/non-injury *N*	751		862	
Location at time of injury/illness				
Private Dwelling/Home	738		873	
Licensed Premises	120		73	
Public Space	220		123	
Work	180		118	
Transport	51		44	
Other	115		104	
Substance Use 6hr prior *N*				
Stimulants	39		17	
Depressants	48		51	
Other Drug use	618		612	
Alcohol Use (unit=standard drink)	*N*	*M(SD)*	*N*	*M(SD)*
Six-hour prior	281	7.12(6.51)	207	5.12(4.93)
One day prior	206	5.95(7.51)	151	3.48(4.00)
One week prior	238	6.46(7.67)	144	4.36(5.36)
Caffeine use (unit=50mg)				
Energy Drink	46	158.48(141.36)	22	119.77(45.76)

Soda	134	45.27(35.47)	91	50.29(49.15)
Coffee/tea	511	165.56(136.38)	467	128.82(87.28)
All Caffeine 6hr prior	633	154.75(138.87)	545	123.61(88.75)
Caffeine 1 day prior	615	171.66(178.74)	558	135.45(106.84)
Caffeine 1 week prior	631	164.81(158.06)	561	138.00(100.38)
Alc+Caff Use		**Mean Alcohol, Caffeine (SD)**		**Mean Alcohol, Caffeine (SD)**
	271	7.05(5.51), 7.41(9.75)	219	6.25(4.92), 11.27(12.31)

Table 3

The odds ratio of injury (OR) and 95% confidence interval (CI) for alcohol and caffeine use within 6 hours of injury or illness in case-control analysis of patients with injury or other illness attending the emergency departments in British Columbia

	N of Patients		Unadjusted			Partially Adjusted †			Fully Adjusted †		
Alcohol/caffeine use	Injury	Others	OR	95%CI		OR	95%CI		OR	95%CI	
No alcohol/caffeine	400	874	1			1			1		
Alcohol only	231	118	1.19**	1.16	1.24	1.14**	1.10	1.18	1.10**	1.06	1.14
Caffeine only	468	572	1.12**	1.08	1.17	1.07**	1.02	1.11	1.05**	1.03	1.08
Risk-taking						1.13**	1.04	1.23	1.10**	1.04	1.21
Alcohol +caffeine	278	212							1.54**	1.04	1.23

Note: † Adjusted for sex, marital status, age, educational attainment, location and other substance use.
* $p<.05$, ** $p<.01$

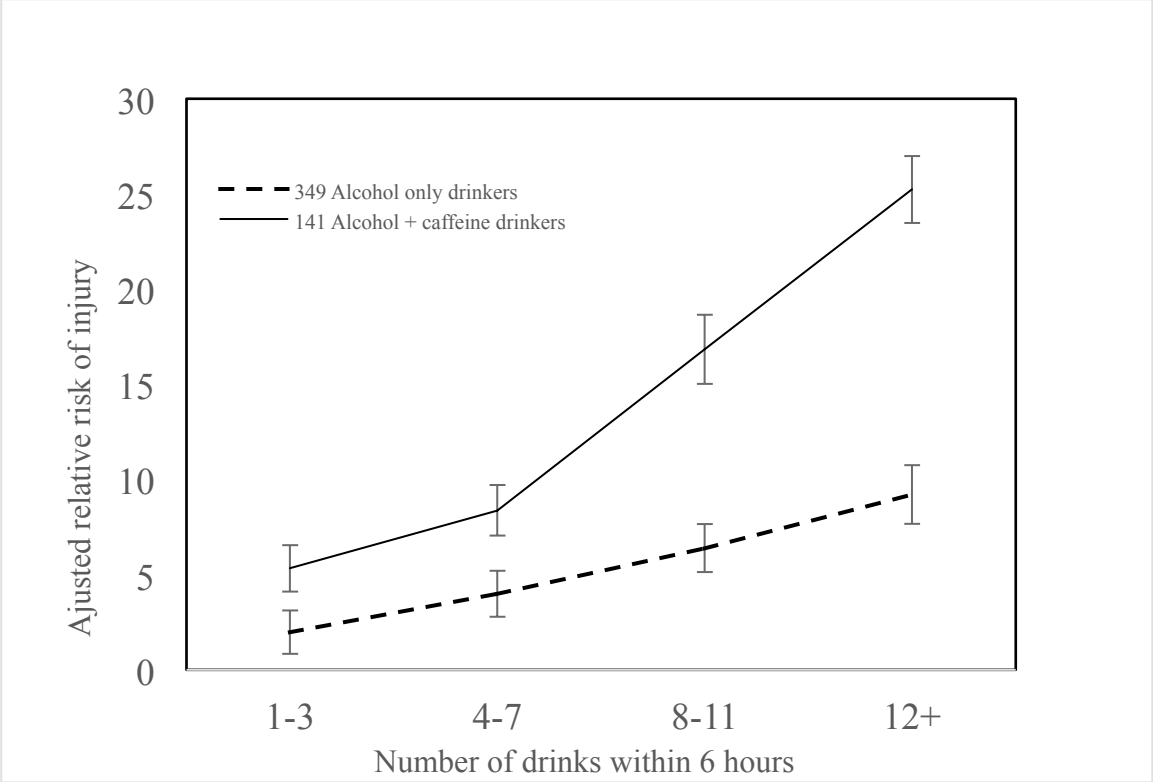


Figure 2. Increase in risk of injury with alcohol consumption in 6 hours before ED admission, for alcohol only and alcohol plus caffeine drinkers (N=2,804 ER attendees)

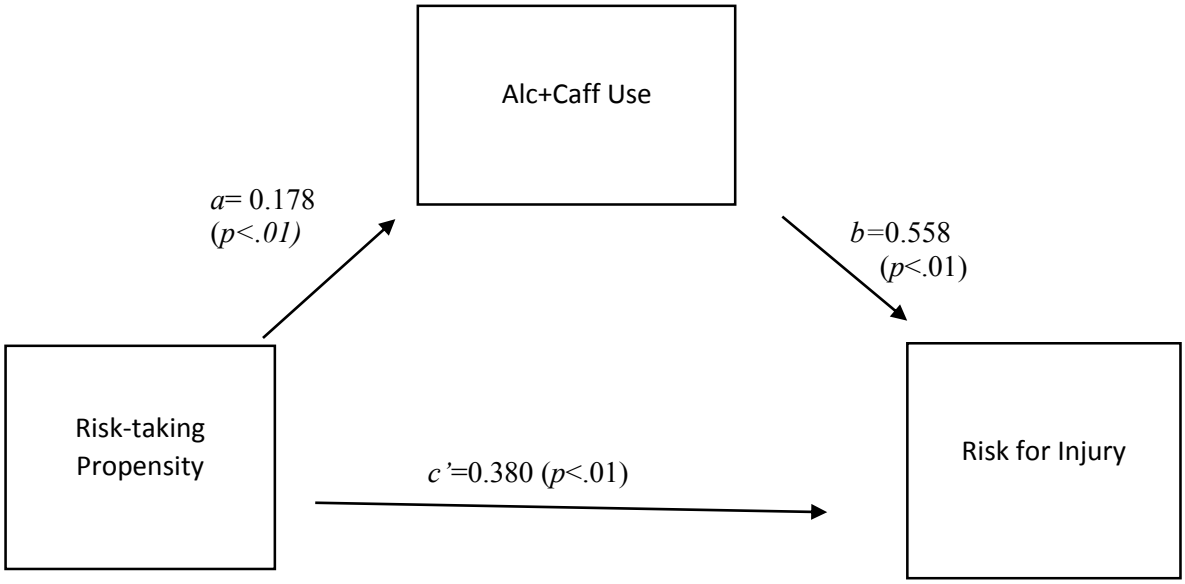


Figure 3. Simple mediation model for Alc+Caff use and risk-taking propensity on injury risk

As risk-taking was being examined for possible moderation effects we re-ran the case-control analysis to include interactions for Alc+Caff use by Risk-taking. Both the overall unadjusted, $X^2 = 200.63$, $p<.01$, and adjusted, $X^2 = 748.33$, $p<.01$, were significant; however, none of the interaction terms came out as significant at a .05 or .10 level, indicating risk-taking propensity does not appear to moderate the effect between Alc+Caff use and injury.

Next, we ran the case-crossover analyses in which participants were used as their own controls. Analyses were run separately for the 2 control periods of 1-day prior (Table 4) and 1-week prior (Table 5). In the adjusted models the covariates of location at time of injury/illness and other substance use were included. Both adjusted models for 1-day prior, $X^2 = 351.30$, $p<.01$, and 1-week prior, $X^2 = 225.34$, $p<.01$, were significant. Alcohol use remained a significant predictor; however, caffeine use on its own did not.

Table 4.

The hazard ratio (HR) and 95% confidence interval (CI) of injury for alcohol and caffeine use within 6 hours of injury and one day prior in case-crossover analysis of patients with injury attending the emergency departments in British Columbia

Alcohol/caffeine use	N of patients injured		Unadjusted model			Partially adjusted model †			Adjusted model †		
	6H prior	24H prior	HR	95% CI		HR	95% CI		HR	95% CI	
No alcohol/caffeine	400	380	1.00				1.00				
Alcohol only	231	192	1.10**	1.06	1.15	1.08**	1.03	1.14	1.03*	1.01	1.08
Caffeine only	418	370	0.93**	0.89	0.97	0.92**	0.86	0.98	0.98**	0.86	0.98
Alcohol + caffeine	278	119							1.48**	1.10	1.98
Note: Adjusted for location and other substance use. ‡ X² test P-value.											

Table 5.

The hazard ratio (HR) and 95% confidence interval (CI) of injury for alcohol and caffeine use within 6 hours of injury and one-week prior in case-crossover analysis of patients with injury attending the emergency departments in British Columbia

Alcohol/caffeine use	N of patients injured		Unadjusted model			Partially adjusted model †			Adjusted model †		
	6H prior	1W prior	HR	95% CI		HR	95% CI		HR	95% CI	
No alcohol/caffeine	400	513	1.00			1.00			1.00		
Alcohol only	231	137	1.20**	1.14	1.27	1.15**	1.07	1.23	1.08*	1.01	1.16
Caffeine only	418	458	1.01	0.96	1.07	1.00	0.92	1.08	1.00	0.93	1.08
Alcohol + caffeine	278	146							1.63*	1.05	2.53
Note: Adjusted for location and other substance use. ‡ X² test P-value.											

Discussion

There has been an increasing concern associated with the consumption of alcohol and caffeinated beverages, and the potential increase for risk of alcohol-related injuries. To our knowledge, this is the first study examining in situ, session specific Alc+Caff use and outcomes, allowing us to speak to the temporal relationship between this type of consumption and risk of injury.

A primary aim of the study was to determine whether Alc+Caff use was associated with an increased risk of injury over and above the risk posed by alcohol use. The results of the study indicate Alc+Caff use does in fact predict a risk of injury, even after controlling for doses of both alcohol and caffeine, age, sex, marital status, education level, location at time of injury/illness event, and other substance use. The higher risk of injury associated with Alc+Caff use is particularly notable when speaking to alcohol and energy drink use and offers support for the recent restrictions placed on these beverages. Energy drinks tend to contain higher levels of caffeine than traditional caffeinated beverages that alcohol is mixed with (i.e., soda or Irish coffee). When alcohol is mixed with caffeine, particularly at higher doses, it is thought that an increased risk of injury is due to increased alcohol consumption and spending longer periods of time drinking alcohol (O'Brien et al., 2008; Patrick, Evans, & Maggs, 2014; Thombs et al., 2010). The results of the study offer at least partial support for these theories; however, even after controlling for doses of both alcohol and caffeine the association between Alc+Caff and injury risk was significant. This suggests there is a synergistic effect associated with this type of consumption that cannot be explained by alcohol consumption alone. Some research also argues that the environment or context may explain the association between Alc+Caff use and injury, as this type of consumption most commonly occurs in party and licensed venues (Droste et al., 2016 Droste et al., 2016). While the present study did find an increased risk associated with these contexts, the relationship between Alc+Caff use and injury risk remained even after controlling for the context of consumption.

An additional noteworthy and novel finding was that caffeine consumption independently predicted injury. There is some research to suggest that higher doses of caffeine and/or the withdrawal from caffeine can result in higher levels of negative affect, anger, risk-taking, or anxiety (Smith, 2002; Wikoff et al., 2017). This lends further support for the synergistic effect of alcohol mixed with caffeine, and also calls for future research on the role of caffeine in alcohol-related injuries.

It has also been posited that the link between Alc+Caff use and injury risk could be explained by risk-taking tendency (O' Brien et al., 2013; Patrick et al., 2014). The present study tested for both a mediating and moderating relationship between risk-taking, Alc+Caff use and injury, with results indicating a partial mediation effect. Risk-taking propensity was independently associated with a higher risk of injury and predicted Alc+Caff use. Alc+Caff use also predicted injury; however the independent effect of risk-taking propensity remained significant even with Alc+Caff use in the model. The moderating effect of risk-taking propensity was not supported, indicated that it does interact with Alc+Caff use to produce a higher risk of injury. Individuals higher in risk-taking propensity may prefer the "awake drunk" produced by Alc+Caff use and therefore may be more likely to engage in this type of consumption (O'Brien et al., 2013). Furthermore, the psychostimulant effects of caffeine may make it more likely for individuals higher in risk-taking propensity to engage in riskier behaviors(Brache & Stockwell, 2011; O'Brien et al., 2013), thereby increasing their risk of incurring injury. Nonetheless, the relationship between Alc+Caff use and injury cannot entirely be explained by this factor. These findings are not entirely without precedent, as other research has found that the association between the use of alcohol and energy drinks remains even after controlling for risk-taking propensity (Brache & Stockwell, 2011). However, future research may be needed to further explore the impact of risk-taking tendency on patterns of hazardous drinking behaviors and potential interactions with other risk factors. For example, the present study found that relative to females, males were at a higher risk of injury and previous research has indicated that there is a sex difference in the relationship between impulsivity and substance use (Baker & Yardley, 2002; Fu et al., 2007; Grano et al., 2004). Given this, it is possible that the relationship between risk-taking, Alc+Caff use, and injury risk may vary by sex. Future research could help to examine these relationships and further delineate the role of Alc+Caff use on risk of injury.

Another purpose of the study was to compare the results between a case-crossover and case-control methodology, as there are strengths and weaknesses to both designs. The case control design allows for the examination of between person differences; however, using quasi-

controls may not suffice as good controls because non-injured patients are more likely to be drinking heavily or abstaining compared to injured patients (Cherpitel, 1993). The case-crossover design has the benefit of a reduction in potentially confounding variables due to within-person factors. This analysis also uses a matched-pair approach; which allows for the adjustment of other potential sources of bias. In particular, including pairs of observations that have the same level of alcohol consumption in the analysis has been found to reduce the relative risk estimates compared to a case-crossover analysis in which these pairs are excluded (Cherpitel et al., 2014). The higher risk of injury associated with Alc+Caff use was found in both the case-crossover and case-control analysis, which lends further support for this finding. However, caffeine use as an independent predictor was only significant in the case-control analyses. It is possible that this difference in results could be explained by the differences in the two methodologies. For example, there may be a difference in the level of caffeine consumption between individuals who came into the ED for an injury compared to an illness (i.e. those coming for an illness consume less caffeine due to a medical condition). If this were true, then in the case-control analysis caffeine consumption would come out as a significant predictor; whereas in the case-crossover this effect would no longer be present. Additionally, recall bias for alcohol consumption in case-crossover designs has been reported, such that individuals have a difficulties recalling more distant past alcohol consumption (Gmel & Daeppen, 2007; Ye et al., 2013). This recall bias tends to result in slightly higher risk-estimates relative to case-control designs; however, it is possible that the patterns of recall for caffeine consumption may differ from that of alcohol. Future research could help in further examining the differences between case-control and case-crossover designs. Nonetheless, the consistent finding of a higher risk of injury associated with Alc+Caff use is noteworthy, particularly when considering the recent increasing concerns with the dangers of alcohol and energy drinks.

We note a number of limitations with our study. First, participants were aged over 18; however approximately 20% of Canadian high school students report regularly engaging in this type of consumption (Azagba, Langille, & Asbridge, 2013). Further, mixing alcohol with energy

drinks may be particularly hazardous among this age group. For example, one study reported that individuals aged 15-23 were 4 times more likely to binge drink when mixing alcohol with energy drinks compared to those only consuming alcohol (Emond, Gilbert-Diamond, Tanski, & Sargent, 2014). While there is still limited information regarding the different patterns of Alc+Caff across different age groups, it is clear that youth are engaging in this risky drinking practice and therefore, future in situ, session specific research is needed for this younger population.

Another potential limitation focuses on the measurement of self-reported alcohol and caffeine use. The lack of biological measurement of caffeine intake and BAC limits the sensitivity of the dose-response relationship. Furthermore, the 6-hour time period in which any alcohol and caffeine consumed in this 6-hour period was considered co-consumption still allows for uncontrolled variability in the effects of consumption on the user. In particular, the half-life of caffeine is approximately 4.5 hours, although this is subject to significant individual variability based on multiple factors (i.e. use of oral contraceptives, smoking, liver function, alcohol use) (Ferre & O'Brien, 2011). Furthermore, , some research suggests there are differing effects of alcohol on cognitive functioning on the descending versus ascending limb of the BAC curve (Phil**,** Paylan, Gentes-Hawn, Hoaken, 2006). However, a measure of BAC would have to be taken at the time of the interview, which does not provide an accurate indication of BAC at the time of the event. Future research examining the patterns of consumption in the few hours leading up to an alcohol-related injury using wearables to monitor objective intoxication levels could help to demarcate the causal relationship between these variables and better quantify alcohol and caffeine use. Additionally, clarifying the timing of consumption and controlling for other factors such as nicotine use and estrogen levels (endogenous and exogenous) could help to increase sensitivity of the findings. Nonetheless, a strength of the current study is the use of a standardized measure for alcohol and caffeine use. Using a standard drink and mg of caffeine allows for the examination of a dose-response relationship and easier replication of study findings.

Finally, while the current study had a large overall sample size, once the sample was divided according to Alc+Caff use and injury/illness outcome, the group sizes were too small to do any further comparisons (i.e. compare outcomes across different types of injuries). Alcohol tends to have a higher association with violence-related injuries relative to other injuries (Cherpitel, 1995) therefore, understanding the potential role of Alc+Caff use in violence-related injuries may be pertinent to injury prevention.

In summary, the findings from the present study provide support for a relationship between Alc+Caff use and injury risk. Alcohol mixed with caffeine predicted a higher risk of injury even after controlling for context and sociodemographic factors, indicating a synergistic effect of Alc+Caff use on the risk of injury. A higher risk of injury associated with Alc+Caff was found in both the case-control and case-crossover method, suggesting the robustness of this effect. The current study also presents new information on the relationship between Alc+Caff use, risk-taking tendency, and injury risk. Risk-taking independently predicted injury, and was also found to partially mediate the relationship between Alc+Caff use and injury.

These findings have implications for policy and prevention strategies. Many countries are currently working to determine the level of need and suitability of policy responses to alcohol and energy drink use and the present findings offer insight into the potential risks associated with this use. The United States placed restrictions on the inclusion of stimulants in malt-based beverages, making premixed caffeinated alcoholic beverages almost non-existent in the past few years (FDA, 2010). Similarly, municipalities across Canada have restricted the sale of alcohol mixed with energy drinks. Health Canada also recently implemented policies around the marketing and sale of these drinks to help mitigate the potential risks associated with the consumption of these beverages. Our findings support these current policies restricting the sale of these beverages and we offer some further suggestions regarding regulation. For example, restricting the caffeine and sugar content in these beverages, as well as limiting the number of standard drinks to 1.5 per container could help to reduce the harm associated with this type of

consumption. Additionally, placing clear labeling of sugar, caffeine, ethanol, and other stimulant content on containers as well as warning labels of various health risks could help to better inform consumers. Of important note, these policies are focused on pre-mixed caffeinated alcoholic beverages; however, alcohol can be hand-mixed or simultaneously consumed with various caffeinated beverages (i.e. Irish coffee continues to be sold with little restriction). Therefore, further attention needs to be paid on how we can further help to reduce the risk associated with this type of use. In particular, informing the general public on these risks could help to reduce the risk of alcohol-related injuries, as well as regulating and reducing the availability of all types of alcohol mixed with caffeinated beverages.

Chapter 5

Study 3: Consumption of Alcohol Mixed with Caffeine and Risk of Injury: Gender Differences and Implications for Drinking Guidelines

Abstract

Introduction and Aims: There is increasing evidence suggesting the consumption of caffeinated alcoholic beverages is associated with risks over and above alcohol use on its own; however, research in this area remains limited. We examined whether gender differences existed in the relationship between the combined use of alcohol and caffeine (Alc+Caff) and risk for injury.

Designs and Methods: This Emergency Department (ED) study utilized case-control and case-crossover analyses to examine in situ session specific Alc+Caff use and injury risk for males and females, while controlling for sociodemographic variables, dose of alcohol and caffeine, other substance use, risk-taking propensity, and context. The sample comprised 2804 individuals aged 18-years or older who presented to three hospital EDs in British Columbia.

Results: A relationship between Alc+Caff use and increased risk of injury was confirmed. Further, gender differences were found in the risk-relationship between Alc+Caff use and injury. Women were found to have a higher risk injury propensity following Alc+Caff use in both the case-control (OR=3.10, 95%CI=1.78-5.84) and case-crossover analyses (OR=3.21, 95%CI=1.69-6.12), relative to men (OR=1.69, 95% CI= 1.30-2.30; OR=1.38, 95% CI=1.08-1.86). These results remained even after controlling for demographic factors, risk-taking, context, and other drug use.

Discussion and Conclusions: Women may be at a higher risk of injury following the consumption of alcohol mixed with caffeine. The findings offer support for differential low-risk drinking guidelines for men and women and the restriction and regulation of the sale and availability of caffeinated alcoholic beverages.

Key Words: Alcohol, Caffeine, Injury, Gender differences, Drinking Guidelines

Introduction

Over the last decade there has been increasing concern over the risks associated with the consumption of caffeinated alcoholic beverages, especially given recent reports of fatalities linked to this type of use (Terry, 2014; Smith, 2018). There is suggestive evidence that the combined use of alcohol and caffeine (Alc+Caff) may be associated with riskier drinking practices, higher alcohol consumption, and increased risk of injury and hospitalizations (Brache & Stockwell, 2011; Peacock, Bruno, Martin, 2012; Roemer et al., 2017; Thombs et al, 2010). Despite the increasing concerns with this type of use, there is a lack of controlled studies examining the link between Alc+Caff use and injury.

Gender differences have been reported in the relationship between alcohol use and injury (Cherpitel et al., 2014; McLeod et al., 1999; Stockwell et al., 2002) as well as in the consumption patterns of caffeinated alcoholic beverages (Friis, Lyng, Lasgaard, & Larsen, 2014). Women may be at a higher risk of injury following alcohol use, as they tend to reach a higher BAC compared to men following the consumption of equal amounts of alcohol (Mumenthaler, Taylor, O'Hara, & Yesavage, 1999). However, some research suggests that this gender difference may only exist at higher levels of alcohol consumption (Cherpitel, Ye, & Monteiro, 2019; McLeod et al., 1999; Stockwell, 2002). Other research indicates the gender differences may be a factor associated with the type of methodology used. Emergency department (ED) studies using case-crossover methods are less likely to significant gender differences, whereas ED studies using case-control methods consistently report gender differences (Cherpitel et al., 2014; Stockwell, 2002; Watt et al., 2004). These conflicting findings have translated into disagreements around whether low-risk drinking guidelines should be different for men and women (Dawson, 2009). Therefore, it becomes important to resolving these various findings in order to inform consistent prevention and policy practices.

Although firm conclusions regarding gender differences in the risk-relationship between alcohol and injury may be conflicting, determining whether these differences exist in the relationship between Alc+Caff use could have implications for policy, intervention, and prevention practices. For example, gender differences in the risk of injury associated with Alc+Caff use could inform low-risk drinking guidelines. Lastly, exploring the differences between case-control and case-crossover methodologies may help to provide more understanding of the potential mechanisms underlying the conflicting findings in the alcohol-related injury research.

The current study

The present study is, to our knowledge, the first controlled ED Study examining the risk relationship between gender, Alc+Caff use, and injury. In this paper we will build on a previous analysis of this study, which indicated an additive effect of Alc+Caff use on the risk for injury (Roemer et al., under review) by exploring potential gender differences in this relationship. Given the strengths and limitations of different study designs, both case-crossover and case-control analyses will be used to compare findings across study designs. Based on previous research of alcohol use and injury risk, we hypothesize that women will show a higher risk of injury relative to men following the consumption of alcohol mixed with caffeine even after controlling for dose of alcohol and caffeine consumed.

Methods

The University of Victoria and Vancouver Island Health Authority review boards both approved the study proposal.

Study Design

Both case-control study and case-crossover study designs were used to investigate the relative risk (RR) of injury due to alcohol and /or caffeine use. The case control design allows for the examination of between person differences; however, using quasi-controls may not suffice as

good controls because non-injured patients are more likely to be abstaining compared to injured patients due to their medical condition (Cherpitel, 1993). The case-crossover design has the benefit of a reduction in potentially confounding variables due to within-person factors (e.g. age, education, marital status). This latter analysis also uses a matched-pair approach; which allows for the adjustment of other potential sources of bias (Baker & Yardley, 2002). The case-control study involved testing whether or not there was a significant difference between the proportions of subjects who drank alcohol and/or caffeine drink within six hours of either presenting with an injury or an illness to the emergency departments. Logistic regression was used to calculate odds ratios for both men and women, as well as to test an interaction effect between Alc+Caff use and gender. The case-crossover analysis was conducted by testing discordant pairs of each injured individual to see whether or not they were significantly more likely to have drunk alcohol and / or caffeine either within six hours of their injury compared to exactly one week prior to their ED presentation. Conditional logistic regression was used to calculate hazard ratios for both men and women (Tabachnick & Fidell, 2013).

Sampling

Data were collected between 2013 and 2015 from representative samples of ED patients (aged 18 and older) at three hospitals located on the West Coast of British Columbia.

Procedure

In each ED, samples of patents aged 18 and over were drawn from computerized registration available on the ED computer, entered in consecutive order of arrival at the ED. An approximately equal number of injured and non-injured control subjects were interviewed on each shift. The sample was achieved at quieter times by seeking to interview every presenting

injured attendee and every second or third ED attendee with an illness (Chan et al, 2010). At busier times the sampling ratio was adjusted; e.g., every second or third injured patient and every fourth or sixth non-injured patient. Data was then weighted to account for this differential sampling ratio.

Sampled patients were approached as soon as possible after registering for care with a request for informed consent. Interviews, lasting about 25 minutes, were completed either in a private area near the waiting department or in the treatment department. In the case of those who were severely impaired, every attempt was made to interview the patient at a later time. Those patients who were too seriously ill or injured to be approached or interviewed in the ED were followed into the hospital and interviewed after their condition stabilized. Patients were offered a $10.00 gift card for completing the interview. This methodology has been used in our prior ED studies in both the U.S. and Canada, and has proven acceptable to both patients and ED staff, and successful in obtaining high completion rates (Stockwell et al., 2002; Cherpitel et al., 2014).

Participants

There were a total of 2804 participants, with 1613 non-injured patients and 1191 injured. The total response rate was 69.16%. Participants ranged between the ages of 18-98 with a mean age of 44.96 (*SD*=20.08). There was an equal distribution of males (52.3%) and females (47.7%) and participants primarily identified as Caucasian (72.25%). The majority of participants were either married/common-law (39.1%) or single and never married (44.2%) and had completed some form of post-secondary education or training.

A small proportion of the sample (2.5%) reported using energy drinks in the 6-hour period. The small *N* for this group would likely result in difficulties related to power; therefore, it was decided that all caffeinated beverages be combined into a single group. Given that caffeine

is the psychoactive substance in energy drinks, and the psychostimulant effects of the caffeine are the focus of the paper, combining all caffeinated beverages allowed us to examine the dose-response relationship with caffeine and alcohol use in combination with caffeine (henceforth Alc+Caff) using a larger number of participants. Further, recent research comparing energy drinks and other caffeinated beverages has found little difference in the harm outcomes between these two types libations (Johnson et al., 2018).

Given the response rate of 69.16%, analysis was done to compare those with missing data to the rest of the sample. No significant differences were found except participants who refused or were unable to participate were slightly older (M=48.24, SD=21.57) than the rest of the sample (M=44.96, SD=20.08). For the missing data, the mean was used to replace missing values for continuous variables and missed values for categorical variables were classified into the most frequent group.

Measures

Patient interview and injury variables: Patients were interviewed regarding the cause of injury or medical problem; alcohol use; energy drink use; other caffeine use; combined alcohol and caffeine use, and other substance use, variously within the six hours prior to the event, and the same six-hour period exactly one-week prior; and risk-taking propensity and demographic characteristics (gender, age, marital status, income level, and education level).

Additionally, data were obtained on the place where the patient was and the specific activity the patient was engaged in at the time of injury (or first awareness of the medical condition), as well as for the same time the week before. Such measures have been utilized in previous studies (e.g. Stockwell et al, 2002; Cherpitel et al., 2014; Korcha et al., 2018) and in the BC preliminary studies to date.

Alcohol and Energy Drink use: Following suit of previous ED studies (Bond et al, 2010; Cherpitel et al., 2014) self-reported alcohol use was measured by asking participants how many standard drinks they consumed in the 6-hour period prior to the injury/illness event, and the same 6-hour period the week before. To facilitate the accuracy of self-reported alcohol use individuals were provided with a description and visual aid of what constitutes a standard drink.

Since energy drinks contain variable amounts of caffeine, as well as other ingredients, data was obtained, using an open-ended question, on the exact beverage line, brand, and amount of each energy drink consumed, as well as coffee, tea, and caffeinated sodas, during the six hours prior to injury/illness event, and the control period, to more accurately quantify caffeine consumption. Following the completion of the interview, the researcher calculated the total amount of alcohol (in gm) and caffeine (in mg) consumed using caffeine content from a food composition database (United States Department of Agriculture, 2011). At the stage of data analysis alcohol was converted into number of standard drinks (13.45 grams/standard drink) and the unit of change of caffeine was converted to 50mg of caffeine (approximately a small cup of coffee).

Statistical Analysis

All statistical analyses were conducted using SAS 9.3. We first completed t-test and Chi-square analyses to examine the differences in demographic and behavior measures of the sample by gender. Next, we conducted logistic regression analyses in the case-control study to estimate the odds ratio (OR) as estimate of relative risk (RR) of injury for alcohol and/or caffeine use within six hours of injury; the analysis adjusted for potential confounding effects of covariates including age, marital status, education attainment, risk-taking propensity, location at time of injury/illness, and substance use within six hours. A hospital variable was also included into the model to determine whether hospital site confounded with the risk estimates. The coefficient changes were <15%, therefore the effect of the hospital can be ignored (Rothman et al, 2008).

Results

Descriptive statistics for all sociodemographic and substance use variables by gender are illustrated in Table 6. The alcohol use and caffeine use variables were both positively skewed. While the non-normality of variables would be problematic in most GLM analyses, logistic regression is a fairly robust analysis that avoids the issue of the violation of normality (Tabachnick & Fidell, 2013). For the alcohol mixed with caffeine variable a total of 490 participants reported Alc+Caff use in the 6-hour period prior to their injury/medical event.

The case-control analyses formally testing for a gender difference in injury risk levels following Alc+Caff use were significant. In the unadjusted model, alcohol use, caffeine use, and Alc+Caff use was independently associated with a higher risk of injury. Additionally, males were at an overall higher risk of injury. The overall adjusted model was significant, $X^2 = 1805.12$ $p<.01$, as was the interaction term of Alc+Caff by Gender, $X^2 = 9.49$ $p<.05$. In other words, the risk of injury associated with Alc+Caff use is different among males and females after controlling for the dose of alcohol and caffeine. In addition, the results showed that those who

are younger in age, had lower levels of education, are higher in risk-taking propensity, were at a licensed venue/event, and had consumed stimulants or other non-depressant drugs were at a higher risk of injury. In order to gain a better understanding of the gender difference, the case-control analysis was rerun for males and females separately. Table 7 illustrates the adjusted case-control analyses according to males and females. Alcohol mixed with caffeine was a significant predictor for both men and women at the 1% level. For men, the OR for risk of injury associated with Alc+Caff use was 1.69, whereas for women it was 3.10. In other words, the risk of injury associated with Alc+Caff use was much higher among women. Women were also at a higher risk of injury following alcohol use on its own. Interestingly, caffeine on its own was a risk factor only for men and a protective factor for women.

The case-crossover analysis (Table 8) results were similar. The covariates of location at time of injury/illness and other drug use were included, with being at a licensed venue/event and consuming stimulants or other drugs associated with a higher risk of injury. Both adjusted models for males, $X^2 = 151.02$, $p<.01$, and females $X^2 = 73.17$, $p<.01$, were significant and the patterns of results were similar to the unadjusted and partially adjusted model. Alcohol use was an independent predictor of injury for both males and females; however, caffeine use was a significant predictor of injury for males and a protective factor among females. Alcohol combined with caffeine was significant for both males and females; however, the risk was again higher among females. For females the relative risk of injury was 3.21, compared to 1.38 for males. In other words, both males and females are at a higher risk of injury when consuming alcohol mixed with higher doses of caffeine, but this effect is much stronger among females. Figures 4 and 5 illustrate the varying effects of Alc+Caff use relative to alcohol use on its own on the risk of injury for both men and women.

Table 6

Sociodemographic, presenting condition and substance use characteristics of Emergency Department attendees included in study sample (n=2804)

	Men		**Women**	
Age *M(SD)*	44.13 (19.32)		45.79 (20.77)	
Ethnicity *N*				
Caucasian	1058		967	
Other	406		373	
Education *N*				
< Completed High school	216		116	
Completed High school	273		232	
College	529		519	
Completed University or Higher	444		468	
Marital Status *N*				
Married/Common-law	559		538	
Widowed/Separated/Divorced	175		285	
Single/Never Married	728		512	
Risk-taking score *M(SD)*	1.16(.76)		.84(.67)	
Injury *N*	713		478	
Illness/non-injury *N*	751		862	
Location at time of injury/illness				
Private Dwelling/Home	738		873	
Licensed Premises	120		73	
Public Space	220		123	
Work	180		118	
Transport	51		44	
Other	115		104	
Substance Use 6hr prior *N*				
Stimulants	39		17	
Depressants	48		51	
Other Drug use	618		612	
Alcohol Use (unit=standard drink)	*N*	*M(SD)*	*N*	*M(SD)*
Six-hour prior	281	7.12(6.51)	207	5.12(4.93)
One day prior	206	5.95(7.51)	151	3.48(4.00)
One week prior	238	6.46(7.67)	144	4.36(5.36)
Caffeine use (unit=50mg)				
Energy Drink	46	158.48(141.36)	22	119.77(45.76)
Soda	134	45.27(35.47)	91	50.29(49.15)
Coffee/tea	511	165.56(136.38)	467	128.82(87.28)
All Caffeine 6hr prior	633	154.75(138.87)	545	123.61(88.75)
Caffeine 1 day prior	615	171.66(178.74)	558	135.45(106.84)
Caffeine 1 week prior	631	164.81(158.06)	561	138.00(100.38)
Alc+Caff Use		**Mean Alcohol, Caffeine (SD)**		**Mean Alcohol, Caffeine (SD)**

	271	7.05(5.51), 7.41(9.75)	219	6.25(4.92), 11.27(12.31)

Table 7

The odds ratio of injury (OR) and 95% confidence interval (CI) for alcohol and caffeine use within 6 hours of injury or illness in case-control analysis of patients with injury or other illness attending the emergency departments in British Columbia

	Unadjusted		Partially Adjusted †		Fully Adjusted †	
Alcohol/caffeine use by sex	OR (95% CI)	95%CI	OR	95%CI	OR	95%CI
Men						
Alcohol only	1.20**	1.16-1.23	1.18**	1.14-1.23	1.11**	1.06-1.17
Caffeine only	1.07**	1.05-1.10	1.08*	1.05-1.11	1.08**	1.05-1.11
Alcohol + caffeine					1.69**	1.30-2.20
Women						
Alcohol only	1.36**	1.30-1.69	1.31**	1.10-1.72	1.16**	1.04-1.23
Caffeine only	0.95**	0.78-0.92	0.93**	0.76-0.98	0.98**	0.92-0.99
Alcohol + caffeine					3.10**	1.78-5.84

Note: † Adjusted for age, risk-taking propensity, education, marital status, location, and other substance use.
* $p<.05$, ** $p<.01$

Table 8

The hazard ratio (HR) and 95% confidence interval (CI) of injury for alcohol and caffeine use within 6 hours of injury and one-week prior in case-crossover analysis of patients with injury attending the emergency departments in British Columbia

	Unadjusted		Partially Adjusted †		Fully Adjusted †	
Alcohol/caffeine use by sex	HR	95%CI	HR	95%CI	HR	95%CI
Men						
Alcohol only	1.16**	1.08-1.24	1.12**	1.06-1.19	1.06*	1.01-1.10
Caffeine only	1.14**	1.04-1.26	1.11*	1.02-1.22	1.00	0.93-1.08
Alcohol + caffeine					1.38*	1.02-1.86
Women						
Alcohol only	1.46**	1.24-1.72	1.41**	1.12-1.78	1.32**	1.28-1.40
Caffeine only	0.83**	0.75-0.92	0.83**	0.71-0.97	1.00.**	1.00-1.01
Alcohol + caffeine					3.21**	1.69-6.12

Note: † Adjusted for location and other substance use.
* $p<.05$, ** $p<.01$

Figure 4. Increase in risk of injury for case-control analysis of men with alcohol consumption in 6 hours before ER admission, for alcohol only and alcohol plus caffeine drinkers

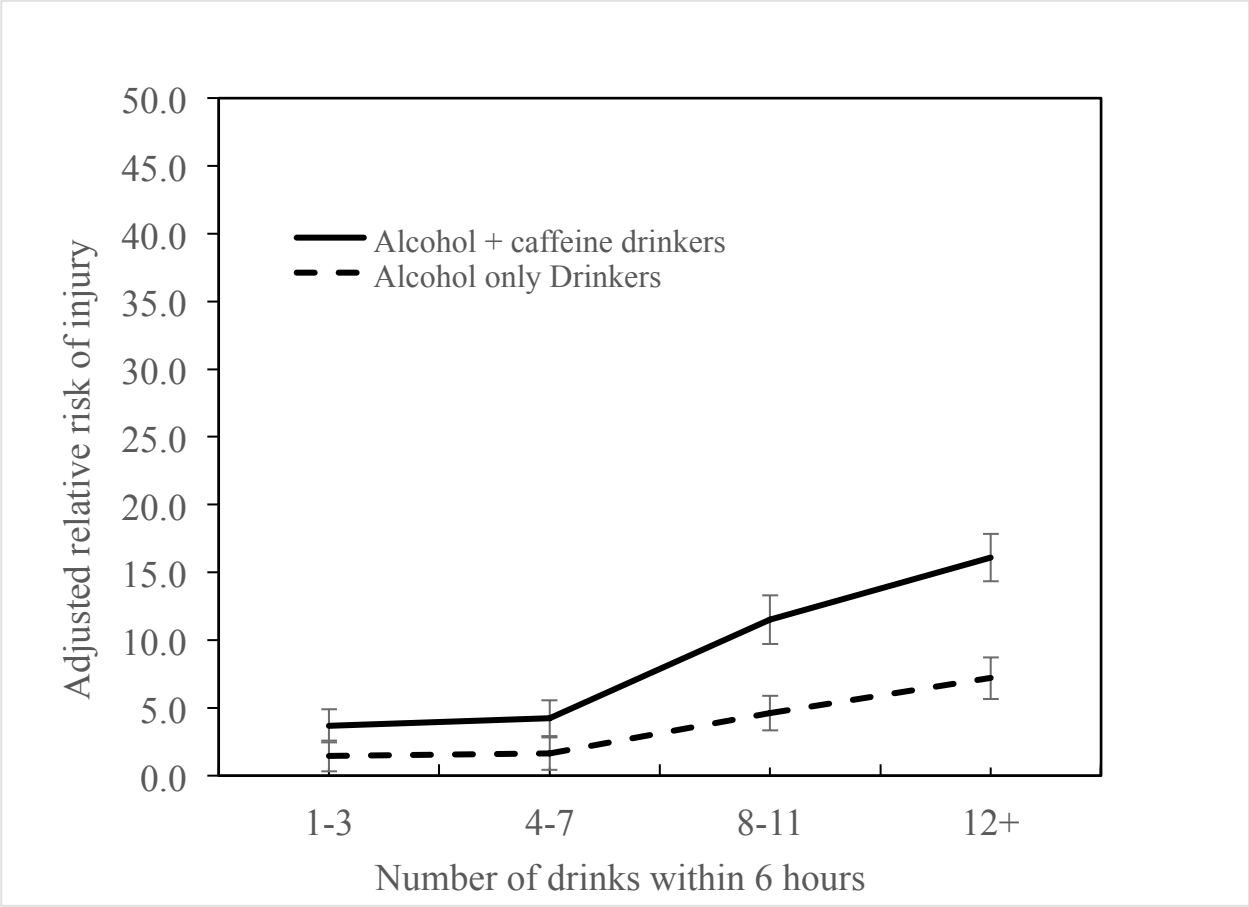
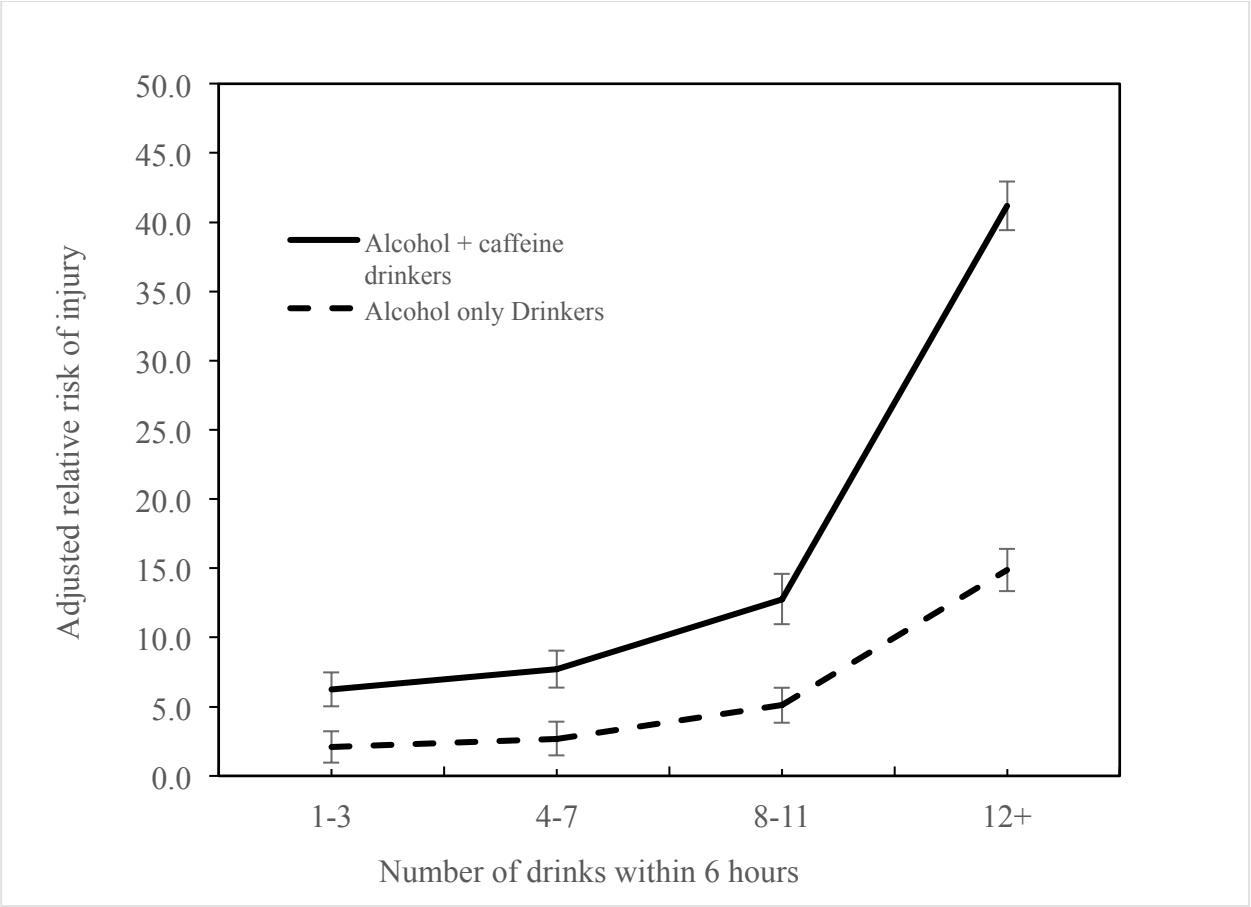


Figure 5. Increase in risk of injury for case-control analysis of women with alcohol consumption in 6 hours before ER admission, for alcohol only and alcohol plus caffeine drinkers



Discussion

The results supported our hypothesis that following Alc+Caff use, the risk for injury was much greater among females relative to males, even after controlling for dose of alcohol and caffeine. The findings also offer evidence for gender differences in alcohol risk independently from caffeine use. This difference appeared to become much more prominent following the consumption of 7 or more standard drinks, suggesting that when caffeine is consumed with high levels of alcohol the risk is particularly notable. These findings are not without precedent, as

previous research on alcohol and the risk of injury has found a higher risk for females even after controlling for setting, activity, and other drug use variables (Cherpitel et al., 2019; Stockwell et al., 2002; Watts et al, 2004). The results also indicated that while alcohol use on its own was associated with a higher risk of injury, this association was again stronger among woman. Furthermore, the gender differences in the risk relationship between alcohol use, Alc+Caff use, and injury were found in both the case-crossover and case-control analyses, which speaks to the robustness of this effect. An unexpected finding was the gender difference with the independent effect of caffeine. In particular, caffeine on its own acted as a protective effect for women, but when mixed with alcohol the combined use is associated with a higher risk than alcohol on its own. In contrast, caffeine remains a risk factor among males regardless of whether or not it is mixed with alcohol. The mechanism underlying this is unclear, and warrants further research examining the gender differences on the behavioral effects associated with caffeine consumption both with and without the use of alcohol.

The higher risk of injury associated with alcohol and caffeine is particularly notable when considering the combined use of alcohol and energy drinks, as energy drinks tend to contain high amounts of caffeine. The combined use of alcohol and energy drinks is thought to lead to an increased risk of injury via increased alcohol consumption, increased time spent drinking, and engaging in riskier drinking practices (Ferreira et al, 2006; Marczinski et al., 2006; Howard, 2011; Room et al., 2005). Given that, even after controlling for body weight, women may become more impaired than men after drinking equivalent amounts of alcohol (Mumenthaler et al., 1999; Stockwell et al., 2002), it would follow that women would be at a higher risk of injury following the consumption of caffeinated alcoholic beverages. That being said, the current study

was able to control for dose of alcohol and risk-taking propensity, suggesting there is a synergistic effect of Alc+Caff use that warrants further exploration.

Currently, only some countries have differential low-risk guidelines in place and there is disagreement as to whether these differential guidelines should exist (Dawson, 2009). A higher injury risk propensity for women than men as a function of both alcohol and Alc+Caff use supports differential low-risk drinking guidelines for men and women and suggests these guidelines may need to expand to include risk statements on the combined use of alcohol and caffeine. Again, when the dose-response relationship is observed, we can see that the risk for injury increases exponentially among women following the consumption of 7 or more standard drinks both with and without caffeine.

The present study helps to further delineate the relationship between alcohol and Alc+Caff use and risk of injury; however, we do note a number of limitations. First, participants under the age of 18 were excluded and yet, the practice of Alc+Caff use is common among adolescence (Azagba, Langille, & Ashbridge, 2013). Further in situ, session specific research examining the risk outcomes of Alc+Caff use among youth is needed. Second, the 6-hour time period used to measure Alc+Caff use still allows for uncontrolled variability in the rate of and effects of consumption on the user. Additionally, the assumption that any alcohol and caffeine consumed in this 6-hour period was considered co-consumption does not factor in extraneous variables impacting the metabolism of these substances. In particular, the half-life of caffeine is approximately 4.5 hours, although this is subject to significant individual variability based on multiple factors (i.e. use of oral contraceptives, nicotine, liver function), and alcohol tends to prolong this (Ferre & O'Brien, 2011). Future research examining the different patterns of Alc+Caff use, while controlling for additional factors (i.e., nicotine, estrogen levels) in the hours leading up to an injury could help to further delineate the casual and temporal nature of this

relationship. More objective measures to determine BAC and caffeine levels in the body may also be informative in determining a dose-response relationship. Lastly, there were limitations in the analyses that could be run due to concerns with power from small group sizes. For example, we were unable to compare outcomes for violent versus non-violent injuries. While men may be at a higher risk of experiencing a violence-related injury overall (Macdonald, Wells, Giesbrecht, & Cherpitel, 1999), women may be at a higher risk of a violence-related injury following alcohol use (Wells, Thompson, Cherpitel, Macdonald, Marais, & Borges, 2007); however, the research on this remains limited. Additionally, the ED setting of the study excludes individuals who choose not to seek medical assistance for an injury, or are unable to due to an abusive partner. Further research focusing on gender differences in the risk-relationship between Alc+Caff use and violent versus non-violent injuries is needed to help inform public health policy and effective prevention strategies. Nonetheless, the present study was able to respond to several gaps existing in the current literature on caffeinated alcoholic beverages. In addition to examining the temporal relationship between Alc+Caff use and injury, the present study controlled for a multitude of potential covariates, controlled for dose of alcohol and caffeine, and utilized two methodologies to compare outcomes.

In summary, the present study provides further support for an additive effect of Alc+Caff use on injury risk. Even more, the study highlights important gender differences both for alcohol and caffeine independently, as well as for the two substances combined. The results indicate the propensity for incurring an injury following Alc+Caff use is greater for women than men. This effect was found in both a case-crossover and case-control method, denoting the robustness of this effect. These results offer support for the already existing differential low-risk drinking guidelines for men and women. In addition, the results have implications for further policy and

prevention strategies. Many countries are currently working to form suitable policy responses to alcoholic energy drink use, and the present study offers helpful insight into the potential risks associated with this type of use. More targeted prevention and intervention strategies for men and women may be more effective than a universal one; for example, including Alc+Caff use in differential low-risk guidelines for men and women. Lastly, informing the general public on the risks associated with Alc+Caff use could help to reduce the risk of alcohol-related injuries, as could regulating and reducing the availability of these types of beverages. For example, restricting the caffeine content in energy drinks, as well as limiting the number of standard drinks to 1.5 per container could help to reduce the harm associated with this type of consumption. Additionally, placing clear labeling of sugar, caffeine, ethanol, and other stimulant content on containers as well as warning labels of various health risks could help to better inform consumers.

Chapter 6

Conclusion

General Conclusions

Both injury and the consumption of alcohol mixed with caffeinated beverages have been identified as public health concerns (Health Canada, 2018; PHAC, 2016). Additionally, previous research has identified an association between these issues. More specifically, research supports a clear causal link between alcohol use and an increased risk of injury (Cherpitel, 2007; Rehm et al., 2004; Rehm et al., 2009), and recent fatalities linked to the combined use of alcohol and caffeine suggests that this type of use may be even more harmful (Howland et al., 2011; Terry, 2014; Smith, 2018). Previous research indicates that Alc+Caff use is associated with increased alcohol consumption, riskier drinking behaviors, increased arousal, and poorer risk-assessment, all of which are associated with a higher risk of injury (Brache & Stockwell, 2011; Ferreira et al., 2006; Room et al, 2005; WHO, 2009). Health Canada (2018) recognizes the combined use of alcohol and caffeine is dangerous and yet, it is still considered a common practice among young adults.

Currently, there is a dearth of controlled research studies examining the association between this type of use and injury outcomes, as well as other potential important underlying mechanisms within this relationship. Further knowledge on the risks associated with alcohol and caffeine use is needed to inform public health policy and harm reduction strategies. The overall purpose of the studies presented in this dissertation was to advance our understanding of the risk relationship between Alc+Caff use and injury. Part of this process involved identifying and critically evaluating the existing literature on the relationship between injury and the combined use of alcohol and energy drinks through a systematic review. This was then followed by two

studies that were intended to fill in some of the gaps of the existing literature. The studies were ED studies that used case-control and case-crossover analysis to examine the risk relationship between Alc+Caff use and injury, while controlling for the dose of alcohol and caffeine, demographic variables, risk-taking propensity, context, and other substance use. The studies also examined gender differences in this relationship and explored the possibility of a mediating and moderating relationship between risk-taking propensity, Alc+Caff use, and injury. This remaining chapter will conclude the research by summarizing the key findings and outlining and discussing the various implications of these findings. Additionally, the contributions this research had made to the alcohol and injury risk literature will be outlined, as well as recommendations for future research.

Key findings and contributions

The aim of study 2 and study 3 was to examine the risk-relationship between Alc+Caff use and injury, while also exploring the potential role of gender and risk-taking propensity within this relationship. Studies 2 and 3 were also intended to be a response to the limitations of the current literature identified in Study 1. This systematic review (Study 1) was published in *Journal of Studies on Alcohol and Drugs,* and was one of the first systematic reviews to examine the literature on the relationship between injury and the use of alcoholic energy drinks. The study received media attention, which helped to disseminate the study findings to the general public and inform the public on the potential dangers of the combined consumption of alcohol and energy drinks. It was the intention of this research to inform the public and policymakers and I hope that my research will have an impact on public health policy and the alcohol research field.

In Study 1, it was concluded that the research supports a positive association between the combined use of alcohol and energy drinks; however, several limitations of the current research were also identified. One of the major limitations identified in the previous literature was a lack

of standardized measurement for dose of alcohol and other substances consumed. Furthermore, many studies had not controlled for other potentially significant confounding factors, such as: risk-taking propensity, other substance use, and context of injury. Lastly, there was a dearth of case-crossover analysis, and a heavy reliance on case-control and cross-sectional findings. In case-control studies, the use of quasi-controls may not suffice as good controls because non-injured patients are also more likely to be drinking heavily or abstaining compared to the general population (Cherpitel, 1993). Additionally, there is more difficulty in controlling for the confounding variables associated with within-person factors, such as age, sex, and, risk-taking propensity. In contrast, a case-crossover approach can reduce confounding variables using the matched-pair approach. The matched-pair approach will also allow for the adjustment of other potential sources of bias. In particular, including pairs of observations that have the same level of alcohol consumption in the analysis has been found to reduce the relative risk estimates compared to a case-crossover analysis in which these pairs are excluded (Ye et al., 2010). One of the unfortunate realities of these limitations is that there is very limited research supporting a causal link between alcohol and energy drink use and injury outcomes.

Studies 2 and 3 are, to our knowledge, the first controlled ED study examining the temporal association between Alc+Caff use and injury. Data collection was completed over the course of a year and a half, allowing us to collect a large sample from three separate Emergency Departments. Data were collected across all seven days of the week and at all hours of the day, with the aim of providing a representative sample of all ED patients served by the respective ED and thereby increasing the likelihood of the generalizability of our findings. Examining whether Alc+Caff use in the 6-hour period prior to an injury allows us to make inferences about the causal relationship between these two variables, expanding our knowledge a step further than the existing correlational research. For both Study 2 and 3, alcohol use was measured using standard drinks and caffeine was measured in mg, which were

collected with the assistance of visual aids and open-ended questioning to increase reliability of self-reporting. This method of measuring allowed for the control of the dose of both alcohol and caffeine, and facilitates the replicability of methods and findings. Additionally, case-crossover and case-control analyses were done in order to compare findings across the different methods; the strengths and weakness of both methods have been previously discussed. The use of both methods adds to our knowledge on Alc+Caff use and injury, but also contributes to the greater knowledge base surrounding these methods and the risk-estimate differences produced by each method.

Finally, risk-taking propensity, demographic variables (education, sex, age, ethnicity, and marital status), location at time of injury, and other substance use were all included in the adjusted models. Many of these variables have been previously identified as significant factors in the risk-relationship between alcohol and injury and as such, it was important to incorporate them into the models in order to examine the risk-relationship between Alc+Caff use and injury. Including these covariates in the analyses allowed a teasing apart of the unique association between Alc+Caff use and injury, but also offered insight into some of the mechanisms underlying these relationships. Controlling for these other factors also allowed for the demonstration of the independent effect of Alc+Caff use on injury risk that cannot be accounted for by increased alcohol consumption, risk-taking propensity, or being in a high-risk context. This is particular noteworthy, as it suggests there is a unique effect of Alc+Caff use that cannot be explained by previously posited theories and calls for further research in this area.

In Study 2 it was found that the combined use of alcohol and caffeine was associated with a risk of injury over and above alcohol on its own. This finding remained even after controlling for age, sex, marital status, level of educational attainment, risk-taking propensity, location at time of injury/illness event, and other substance use. The finding was also consistent across case-crossover and case-control analysis, offering support for the robustness of this effect. Risk-taking propensity was also examined as a potential moderator of the relationship between Alc+Caff use and risk of injury. The findings indicated no moderating effect. Additionally, Alc+Caff use was

examined as a potential mediator between the relationship of risk-taking propensity and injury. The findings offered support for a partial mediation. Risk-taking propensity appears to be a significant factor in predicting injury and may be of one the mechanisms underlying the relationship between Alc+Caff use and risk of injury; however, it is not the only explanatory factor and more research will be needed to understand the role of risk-taking propensity in predicting injury associated with Alc+Caff use. Nonetheless, our results showed that the relationship between Alc+Caff use remained even after controlling for risk-taking propensity, indicating this factor cannot wholly account for the effect of Alc+Caff use on injury risk. Even so, considering how risk-taking propensity interacts with other important factors is an important area for further study. Previous research exploring sex differences in the association between impulsivity and alcohol use are mixed, with some research supporting a stronger association between impulsivity and substance use among females (Fu et al., 2007; Grano, Virtanen, Vahtera, Elovainio, & Kivimaki, 2004), while others have found a stronger association among males (Baker & Yardley, 2002). Given this, there may also be sex differences in the risk-estimates associated with risk-taking propensity, Alc+Caff use and injury.

In Study 3 we examined the role of gender in the risk-relationship between Alc+Caff use and injury. The findings indicated that while Alc+Caff use predicted a risk of injury for both men and women, this association was much stronger among women. In other words, women have a higher risk-propensity for injury following the consumption of alcohol mixed with caffeine. The same was found for alcohol use, with women showing a high risk of injury following alcohol use even after controlling for demographics, other substance use, and context. This finding was also consistent across the case-crossover and case-control analyses and remained after all covariates were included in the model. The findings from this study offered support for differential low-risk guidelines for men and women, for both alcohol and caffeine use.

Study 2 was submitted to the journal *Alcoholism: Clinical and Experimental Research*, a distinguished and most highly cited journal in the field of alcoholism. Its multi-disciplinary and international readership base, as well as its high and focus on translating research into clinical

practices motivated the choice of this journal. Study 3 was submitted to the journal *Drug and Alcohol Review*, which was chosen for its high impact on the field of drug and alcohol-related problems, its multi-disciplinary and worldwide readership base, and its focus on translating alcohol research into clinical practice and policy. I hope to follow suit from Study 1, and disseminate the findings from both studies to both an academic and lay audience. Other academics and researchers could continue to build upon this study and I believe it is important for the general public to be informed of the potential risks associated with the combined used of alcohol and caffeine. Study 2 and 3 were able to respond to many of the limitations identified in Study 1 and offer significant contributions to the field of alcohol and other substance use. First and foremost, these studies provide findings from a well-controlled ED study that extends our knowledge from the existing correlational research. The findings support the previous research, which has identified an association between Alc+Caff use and an increased risk of injury, and offers support for this being a causal relationship. More objective measures of alcohol and caffeine use were utilized in order to control for dose as well as to facilitate comparison across and replicability of findings. We were also able to control for other important factors, which tells us there is an independent effect of Alc+Caff use on injury risk that cannot be accounted for by increased alcohol consumption, risk-taking propensity, or being in a high-risk context. This last note is of particular importance, as it suggests that there is a unique effect of Alc+Caff use that needs to be explored further. Further discussion of future directions and implications of these findings will be discussed following the summary of Study 3.

Similar to Study 2, the hope is that the findings from Study 3 can inform policy and clinical practice on Alc+Caff use in order to prevent or reduce some of the associated harms. For example, focusing on more public education on the risks and harms associated with this type of use and reducing the ease or availability of accessing these beverages would be an important step. Additionally, informing health care workers about this type of use so that they can screen, target, and offer support to identify and support higher risk individuals may also be an effective intervention practice. Further areas for policy implications are discussed in the section below.

Implications and Areas for future research

When I first began this research, the goal was to examine the risk of injury associated with the combined use of alcohol and energy drinks. However, following data collection it became apparent that only a very small percentage (approximately 1%) of the sample population had reported this type of consumption. This finding was comforting, as it suggested that perhaps this is a less popular practice than previous thought. On the other hand, this study was not a prevalence survey of the general population and cannot account for the many people who may choose to not seek medical attention following an alcohol-related injury. Further, according to a more recent review, the prevalence of alcohol mixed with energy drink use continues to be somewhat variable across studies, with estimates ranging 8.1% to 64.7% among U.S. students and young adults (Verste et al., 2018). It is of important note that our sample consisted of individuals over the age of 18 and recent research suggests that this practice may be more common among individuals aged 13-18 (Reid, Hammond, McCrory, Scott, Leatherdale, 2015). Reid and colleagues (2018) reported that among grade 9-12 Canadian high school students, 17.3% of the sample reported using energy drinks mixed with alcohol, a practice that was associated with more frequent binge drinking. Further research using controlled studies to examine the relationship between the combined use of alcohol and energy drinks among adolescents is needed.

Given the small percentage of individuals reporting the combined use of alcohol and energy drinks, it was decided to include anyone reporting the combined use of alcohol and caffeine into the analysis. The primary concern around energy drinks was the high caffeine content, which was found to have independent adverse side effects even without considering when these beverages were mixed with alcohol. An additional concern was the high sugar content of these beverages, which when combined with alcohol, was thought to be associated with an increase in rate of consumption and increase in quantity of consumption of caffeinated alcoholic beverages (Toronto Public Health, 2017). The increasing concern around the negative effects associated with the consumption of energy drinks and the combined use with alcohol

resulted in several countries placing regulations on the sale of energy drinks. For example, the United States FDA sent warning letters to manufacturers of premixed alcoholic energy drinks (e.g. Four Loko) that halted the production and sale of these beverages. Similarly, Canada placed a restriction on the amount of caffeine allowed in these beverages in order to limit caffeine content to 400mg per Litre (Toronto Public Health, 2017). Currently, most energy drinks contain between 80-180mg of caffeine per container (Verster, Aufricht, & Alford, 2012), which is equivalent to approximately 1-3 cups of coffee. In both Canada and the U.S.A., premade beverages of alcohol and energy drinks are almost non-existent. However, within our sample it was clear that many people are continuing to engage in the practice of combining alcohol and caffeine (17.25%). Alcohol is commonly mixed with sodas and coffee/espresso, both of which could result in the equivalent amount of caffeine being consumed from some energy drinks. Additionally, sodas and specialty coffees or espresso shooters also contain high amounts of sugar, again making this type of use appear no different from alcohol mixed with energy drinks. In fact, a recent study found that compared to alcohol mixed with energy drinks, a higher frequency of alcohol use was found among those reporting use of alcohol mixed with other caffeinated beverages. Additionally, no difference was found in negative alcohol-related consequences between the use of alcohol mixed with energy drinks and alcohol mixed with other caffeinated beverages (Johnson et al., 2018). The pharmacological interaction of caffeine and alcohol also support that idea that outcomes may be similar regardless of the source of caffeine. It seems to follow that future research should focus on the combined consumption of alcohol mixed with any caffeinated beverage, and that policies may need to continue to be refined to incorporate any new knowledge found on this practice.

In addition, further research on the effects of mixing caffeine with alcohol is needed, as the research on this remains somewhat conflicted. While the biological mechanisms on the interaction of these substances (Ferre & O'Brien, 2011) and the 'awake drunk' state phenomenon are largely supported (Ferreira et al, 2006; Howard, 2011; Marczinski et al., 2006; McKetin, Coen, & Kaye, 2015); the effect on perceived impairment, perceived intoxication, and

impairment relative to alcohol on its own remains uncertain. A review by McKetin and colleagues (2015) reported that those consuming alcohol with energy drinks drank more alcohol, reported more frequent binge drinking, had higher BACs, and reported more negative alcohol-related consequences relative to those only consuming alcohol. The use of alcohol mixed with energy drinks was also found to increase stimulation and alertness, offset fatigue from alcohol consumption, and facilitate drinking; however, it did not change perceived intoxication or impairment relative to alcohol on its own. Furthermore, energy drinks or caffeine did not reverse alcohol-related impairment, although it may ameliorate some alcohol-induced impairment on some aspects of complex tasks involving executive functioning, complex motor coordination, and learning. Finally, the authors reported that studies with industry ties presented contrary evidence and suggested that industry involvement in this area of research should be monitored.

Other studies have also reported mixed findings regarding the ability of caffeine to attenuate the negative effects of alcohol (Marczinski & Fillmore, 2003), indicating that further research is needed in this area. More objective measures to estimate BAC and caffeine levels in the body could help to clarify a dose-response relationship. Of particular importance may be the consideration that alcohol inhibits the metabolism of caffeine, resulting in a prolonged half-life (Ferre & O'Brien, 2011). Additionally, there is a high co-occurrence of nicotine use with both alcohol and caffeine use and nicotine is known to speed up the metabolism of caffeine (Ferre & O'Brien, 2011; Istvan & Matarazzo, 1984). The current study was unable to control for all possible confounding factors, such as factors affecting the metabolism of alcohol and caffeine. Therefore, more research examining the role of the factors (nicotine, estrogen levels, medications) could help to lend further support for a causal relationship between Alc+Caff use and injury outcomes. Furthermore, using a more standardized measure of caffeine and alcohol consumption could help, as this would allow for the evaluation of dose-response relationships. Even the measure of a standard drink varies across countries (Kalinowski & Humphreys, 2016), while the measure of alcohol mixed with caffeine in many studies is commonly a question of yes or no. Further research with a sensitivity to this variability in

definitions of standard drinks and measuring of alcohol and caffeine use could be useful in clarifying the current conflicting findings, as well as furthering our knowledge on the negative outcomes associated with this type of use. More specifically, ensuring that measurements of alcohol and caffeine use could be converted into universal units (i.e., mg or ml) would allow for an easier comparison of findings across studies as well as replicability of studies.

Further research is also needed to help tease apart the causal relationship between Alc+Caff use and risk of injury. Study 1 identified strong support in the literature for an association between alcohol mixed with energy drinks and injury. Study 2 and 3 were able to build upon this and offer support for a temporal relationship, such that a higher risk of injury is associated with Alc+Caff use in the 6-hours preceding the injury. Additionally, Study 2 and 3 were able to show an independent effect of Alc+Caff use over and above alcohol use on its own. The results also indicated that the relationship between Alc+Caff use and injury could not be solely accounted for by location at time of injury event or other substance use. When we consider the criteria for causal inferences to be made in epidemiological research, the findings from the present research seem to meet these criteria. Considering our findings and the strong evidence for biological plausibility with respect to the criteria for a verdict of causation in epidemiological research (temporal relation, association, environmental and population equivalence), we can reasonably argue that Alc+Caff use occurred prior to the injury event and that there is an increased risk of injury following this type of use. We can also argue that we controlled for many other potential confounding environmental conditions and population features. All possible relationships outlined in the flowchart (Appendix A) were explored and controlled for, with an effect of Alc+Caff use on injury remaining. Using this pragmatic dialogue approach, the lack of valid counterarguments refuting a verdict of causation leads us to assert that we can assume a casual relation between Alc+Caff use and injury.

Our findings also support Alc+Caff use as a partial mediator in the relationship between risk-taking propensity and injury. It may be that individuals higher in risk-taking propensity are more likely to practice Alc+Caff consumption; and, the disinhibiting effects of

alcohol and the psychostimulant effects of caffeine result in individuals engaging in riskier behaviors, which would also be linked to a higher risk of injury. Further exploration on how Alc+Caff use explicitly leads to injuries is needed. More controlled studies using more objective measures (i.e. devices measuring BAC changes and caffeine levels in the body) and/or ways to account for pace and quantity of consumption could be helpful in this exploit.

One particular focus of future research should be on examining the potential role of aggressiveness in the risk-relationship between Alc+Caff use and injury. The relationship between alcohol and increased aggression is well established (Bushman & Copper, 1990) and more recent research supports an association between Alc+Caff use and increased aggression (Sheehan, Linden-Carmichael, Lau-Barraco, 2016; Woolsey et al., 2010). Similar to risk-taking propensity, individuals may feel less inhibited and more alert or stimulated following Alc+Caff use, which could result in an increased likelihood to engage in aggressive behavior. Sheehan and colleagues (2016) also noted that an individual's ability to self-regulate might be a crucial factor, as their study found self-regulation moderated the relationship between Alc+Caff use and indirect acts of aggression (i.e. malicious humor and relational aggression). Examining the role of aggression could help to further our understanding on how Alc+Caff use leads to a higher risk of injury. On a similar note, future research should also examine the differences between violence versus non-violence related injuries. There could be differences in the risk estimates of injury for different predictors, particularly when considering factors such as aggression. Again, more controlled studies focusing on the casual relationship between Alc+Caff use and various types of injuries are needed to further our knowledge and understanding within this field.

The findings from this research have implications for both clinical practice and public health policy. Alcohol use is one of the leading predictors of injuries leading the emergency department visits and injuries constitute approximately 26% of all alcohol-attributable deaths (WHO, 2014). Alcohol policies have been found to be directly related to alcohol-related injuries, with stronger policies being found to effectively reduce the likelihood of injury and vehicular injury death (Korcha et al., 2018). Therefore, developing more effective alcohol control policies

are essential in reducing the levels of alcohol-related harm, with or without the consideration of caffeine. There are already low-risk drinking guidelines in place, though countries vary on the specifics of these guidelines. The results of study 3 support differential low-risk drinking guidelines for men and women, as women are at a higher risk of injury following alcohol use. Additionally, the gender differences in the risk following Alc+Caff use suggest a need for the present guidelines to incorporate caffeine as a further means of harm reduction. The increasing concern associated with the use of energy drinks and alcohol mixed with energy drinks led many countries to put new policies in place to restrict or regulate the marketing and sale of these beverages; however, it is important to continue to determine the level of need and suitability of policy responses to Alc+Caff use. As previously mentioned, the United States has banned the sale of certain brands of alcoholic energy drinks that contained high amounts of caffeine. Canada, the European Union, Australia, and New Zealand have also placed restrictions on the concentration of caffeine allowed in these beverages and require some warning labels to be visible on the beverage containers. Canada also has a regulation that only allows beverages to contain natural caffeine. Policies are also being formulated around the sugar content of beverages, as this has also been identified as an important component in managing the risk associated with caffeinated alcoholic beverages (Toronto Public Health, 2017).

Using preliminary findings from study 2, some recommendations were made to the House of Commons for the Standing committee on Health, who were looking into premixed drinks with high sugar and alcohol content. The issue of energy drinks had been sparked partly by the tragic death of a 14-year-old girl in Québec consuming three cans of high-strength alcoholic energy drinks. A report from the Canadian Institute of Substance Use Research was made presenting research findings on the specific issue of risks associated with pre-mixed alcoholic drinks and the wider context of harms related to alcohol use in Canada. The report also included several recommendations for the federal government to reduce the risks specifically

related to consumption of high alcohol content, high sugar-content, single-serve drinks (Standing Committee on Health, 2018). These recommendations, all of which were accepted, included:

1. Limit the number of standard drinks (=17.05 mL ethanol) to 1.5 per container. It is insufficient to only limit container size or alcohol strength.
2. Limit sugar content to no more than 15g of added sugar per single-serve container and consider limiting the use of artificial flavorings.
3. Restrict the caffeine content of such drinks to 30mg per standard drink.
4. Require clear labeling of sugar, calories, caffeine, other stimulants and ethanol content, the latter in terms of standard drinks per container.
5. Require rotated labeling of all alcohol products with various health risks (including cancer) and the Canadian low risk drinking guidelines.
6. Prohibit branding or naming of products that make reference to product strength, excessive consumption or make light of alcohol dependence (e.g. Four Loko, FCKDUP, Rehab, Delirium etc.)
7. Update the Canadian Radio-Television and Telecommunication Commission alcohol advertising guidelines to include coverage of modern digital media.
8. Set excise taxes for all alcoholic drinks at 25 cents per standard drink, to provide manufacturers, retailers and consumers incentives for favoring low strength products.
9. Classify malt-based beverages with a sugar content of 5% or greater as spirits so as to both increase prices and restrict places of sale.
10. Set a national minimum price for alcohol per standard drink as has been introduced in Scotland from May 1, 2018. A rate of $1.65 is recommended for liquor store sales. (Standing Committee on Health, 2018)

Many of the current policies in play focus on pre-mixed alcoholic energy drinks or energy drinks, which unfortunately have little impact on the combined consumption of alcohol with other caffeinated beverages. Moreover, individuals can continue to mix their alcohol with caffeine by hand, which makes it difficult to regulate this type of use. Further regulation on the sale of caffeinated beverages and alcohol may need to be considered in order to continue reducing the risk of Alc+Caff use. In addition, using mass media campaigns and public health notices will be important in informing the general public on the harms associated with this type of use. Lastly, the findings from this research could also have implications within clinical practice. If clinicians and health professionals are informed about the risks associated with Alc+Caff use, they can alert themselves to offer education or intervention for behavioral change when interacting with clients and/or patients who report engaging in this practice.

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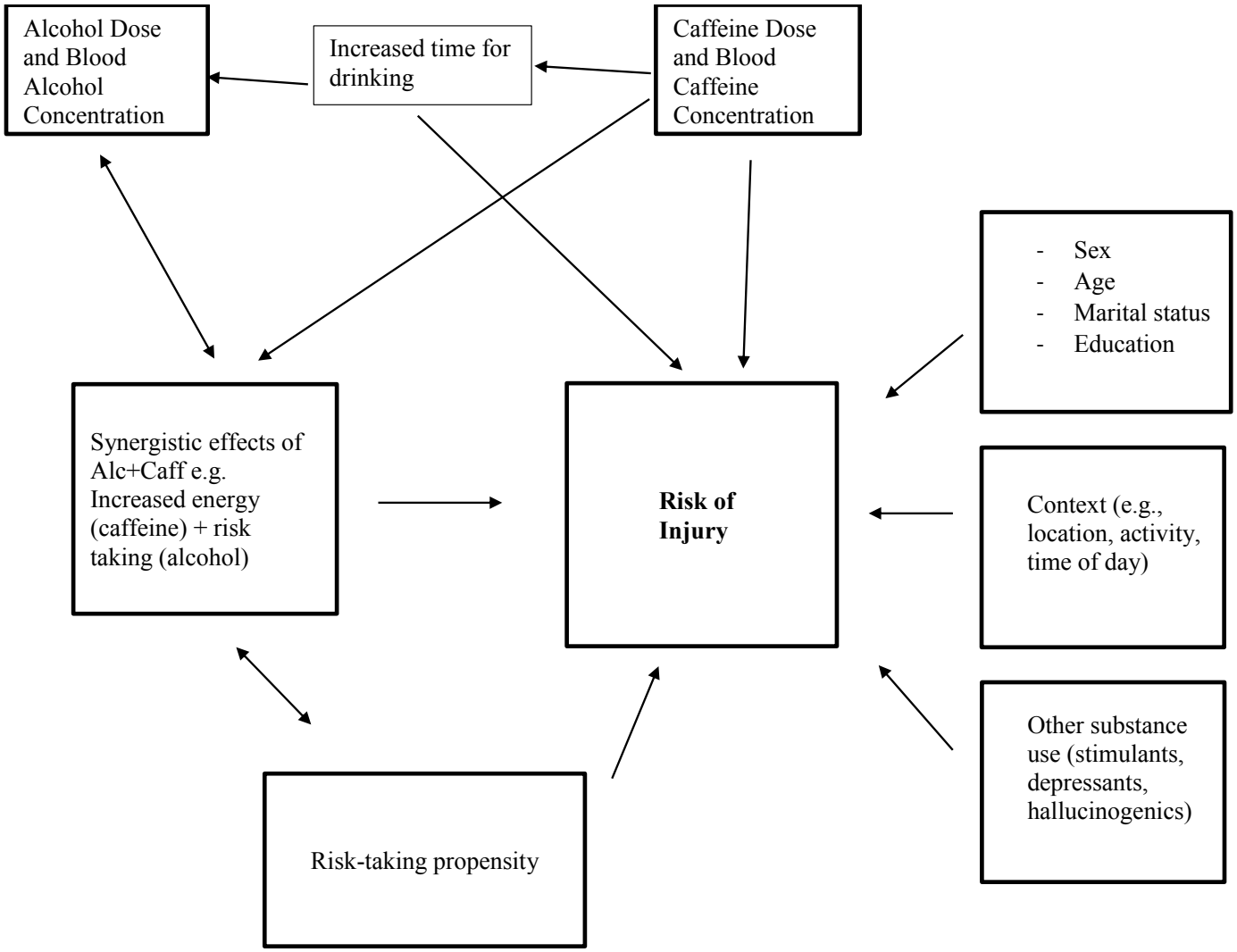
Appendix A

Hypothesized pathways to increased risk of injury resulting from the combined use of alcohol and caffeinated drinks



Appendix B

Participant Consent Form
Alcohol, stimulants and risk of injury:

You are invited to participate in a study called **Alcohol, energy drinks and other stimulants: an emergency room study assessing the effects of gender, context and substance use on injury risk.** The study is being conducted by, Dr. Tim Stockwell (Principal Investigator) and Dr. Cheryl Cherpitel (Co-Investigator). Dr. Stockwell is the Director at the Centre for Addictions Research of BC (CARBC) and Dr. Cherpitel is a Researcher at the Centre for Addictions Research of BC (CARBC). Dr. Christopher Morrow, ED Site Chief and an Emergency Physician at the Royal Jubilee Hospital, is also involved in and supportive of the project. The following information is provided to help you make an informed decision about whether or not to participate. If you have any questions, please ask the interviewer.

This research is funded by the Canadian Institutes of Health Research (CIHR).

Purpose and Objectives

This is a study looking at the harms associated with the use of alcohol and stimulants in Victoria and Vancouver. It is being conducted by researchers from the Centre for Addictions Research of BC, Royal Jubilee Hospital Emergency Department, Vancouver General Hospital Emergency Department and St Paul's Hospital Emergency Department. The purpose of this study is to learn about why people use the emergency department and about patterns of drinking and stimulant use (such as cocaine, other amphetamine-type substances, energy drinks and other caffeinated beverages). The study also looks at patterns and harms among people who come to hospital emergency departments, and how best to identify people with drinking or other drug use issues. Having an understanding of alcohol and drug use trends, and people's attitudes toward safety and prevention allows us to help influence and inform health policy, law, and service provision in Victoria, Vancouver and elsewhere in Canada.

Participant Selection

You are being invited to participate in this study because you are a patient here in the Emergency Department at the Royal Jubilee Hospital today. You also must be 18 years or older to participate in this study.

What Is Involved?

If you agree to voluntarily participate in this research, you will be interviewed about your illness or injury as well as any recent use of alcohol, coffee, soft drinks and other drugs or medications. The researchers will collect basic patient information such as your age, sex, how you arrived at the Emergency Department and the reason for your visit today. You will also be asked to provide a sample of your breath for alcohol, using a breathalyzer test. You have the right to refuse to answer any question and/or refuse to participate in the breathalyzer test and there will be no consequence for refusing. All information gathered in this study will be kept completely confidential.

Inconvenience

Participating in this study will take a total of about 25 minutes and will begin here in the Emergency Department. Agreeing to be interviewed will not delay your medical treatment. If you start the interview and the medical staff calls your name, the interview will be stopped so you can get care and you can finish the interview later. If you are admitted, we may need to check in with you 'at the bedside' once we get the OK from the medical staff so that we can finish the interview.

Risks

There are some slight but potential risks to you by participating in this research and they include possible negative emotional responses to some of the questions in the interview pertaining to your alcohol and other drug use. You may refuse, for any reason, to answer any questions that make you feel uncomfortable, and there will be no consequences for refusing to answer any questions. In the unlikely event that you become upset during the interview, interviewers will be willing to assist you in referring you to expert help.

Benefits

You will not benefit directly from participating in this study. The potential benefits of your participation in this research include contributing to a project that will ultimately benefit others in a situation similar to yours and to society as a whole. Participation in this study will contribute to gaining a better understanding of the relationship between Emergency Department visits and alcohol and other drug use, as well as the potential to better inform treatment and prevention programs.

Compensation

As a way to compensate you for any inconvenience related to your participation in this study, you will be given a $10 gift card for completing the interview. If you agree to participate in this study, this form of compensation to you must not be coercive. If you choose to withdraw before the completion of the study, you will still be offered compensation for your

participation. It is unethical to provide undue compensation or enticements to research participants.

Voluntary Participation

Your participation in this research is completely voluntary. If you do decide to participate, you may withdraw at any time without any consequences or any explanation. Your consent can be withdrawn at any time and the data collected to date can be discarded. Please note that data cannot be withdrawn once the survey has left the Emergency Department. There will be no consequences to any other health, social or other services you may receive through VIHA.

Confidentiality

Your confidentiality will be respected. No information that reveals your identity will ever be released or published. There will be no records which identify you by name or initials. Any information obtained during this study will be protected by the use of an anonymous numeric study ID code instead of your name. We will not collect any personal information (e.g., your name, date of birth, address, etc.) that would allow anyone to identify you directly. No one has access to these files except for the immediate research team. All subject data will be identified by a unique study ID number and will NOT contain any personal identifiers. Please note we have a mandatory duty to report to the appropriate authority in any circumstances where intention of harm to self or others is expressed.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in the following ways now and in the future: to participants upon request; in published articles; in presentations at scholarly meetings; in presentations/reports to health and social service providers; on our website at www.carbc.ca; and to public health policy makers. None of the results will be reported in any way which can serve to identify any individual patients. If you'd like to receive a copy of the results, please contact the study team at a future date.

Disposal of Data

Data from this study will be disposed of ten years after the last publication or scholarly presentation of the research data by shredding paper records and by electronic erasure of computer files.

Contacts

You may contact Dr. Stockwell by phone at the CARBC at (250) 472-5303 or contact Dr. Cherpitel by phone at CARBC at (250) 472-4399 if you have further questions or wish to receive study results. You may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca. You may also contact the VIHA Research Ethics Board with any questions or concerns (250-370-8620).

By completing questionnaire and the breathalyzer test and allowing us to request from you the basic patient information mentioned above, **YOUR FREE AND INFORMED CONSENT IS**

IMPLIED and indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

Please keep a copy of this letter for your reference.

www.CARBC.ca carbc_uvic carbc.uvic carbc2300.wordpress.com

INTERVIEW QUESTIONNAIRE
SECTION B: SCREENING

VGH/SPH script:

"Hi there, my name is X and I'm a researcher from the University of Victoria and we are conducting a study in the emergency department today. I would like to ask you a couple of questions to find out whether or not you are eligible to participate. Are you coming to the ER today for an injury, accident or for some other reason?"

Injury/accident: Did your injury/accident occur in the previous 6 hours? When did it occur?
Medical condition/illness: Did your condition change or worsen in the previous 6 hours prompting you to come to the ER? When did that occur?"

RJH Nurse Screener script:

"Hi there, my name is X and I'm a nurse here in the ER but today I'm working as a researcher from the University of Victoria. We are conducting a study in the emergency department today and I would like to ask you a couple of questions to find out whether or not you are eligible to participate. Are you coming to the ER today for an injury, accident or for some other reason?"

Injury/accident: Did your injury/accident occur in the previous 6 hours? When did it occur?
Medical condition/illness: Did your condition change or worsen in the previous 6 hours prompting you to come to the ER? When did that occur?"

Screening Questions

QB01	**Are you coming to the ER today for an injury/accident or for some other reason?**	
	Injury/accident (*Go to QB02*)	1
	Other (*Go to QB03*)	2

QB02	**When did your accident/injury occur?**	***ACCIDENT/INJURY**							
QB02a	Date (dd.mm.yyyy)	*d*	*d*	*m*	*m*	*y*	*y*	*y*	*y*
QB02b	Time hh:mm) (*use 24 hour clock –*					*h*	*h*	*m*	*m*

If less than 6 hours proceed to consent process
If more than 6 hours, thank and terminate interview

QB03	When did you notice your illness/medical problem was severe enough for you to come to the ER? *ILLNESS/MEDICAL PROBLEM								
QB03a	Date	(dd.mm.yyyy)	d	d	m	m	y	y	y	y
QB03b	Time hh:mm)	(*use 24 hour clock –*					h	h	m	m

If less than 6 hours proceed to consent process
If more than 6 hours, thank and terminate interview

Script if eligible:

VGH/SPH:
"Thank you, an interviewer will be coming over shortly to tell you more about the study. We are also offering at $10 gift card to Shoppers Drug Mart to thank you for your time"

RJH:
"Thank you, you are eligible to be in the study, will it be okay for an interviewer to come over and tell you more about the study? We are also offering at $10 gift card to Shoppers Drug Mart to thank you for your time"Page Break**Interviewer script:**
"Hi there, my name is X and I'm a researcher from the University of Victoria with permission from the hospital, with patient consent, to interview patients and I'd like to ask you some questions about why you've come to the ER today. It will take about 25 minutes and will help in better understanding the causes of injuries.

> ***IF NEEDED*: This is a research study being conducted here at [NAME OF HOSPITAL] about the problems that bring people to emergency rooms**

Consent form:
"Would you please read this consent form which tells you more about the study and what we're asking you to do? Or I can summarize it for you if you prefer. You may take as much time as you need to take in this information and make your decision"

After they have read or been read the consent form:

"Do you have any questions or concerns about the study? Have all of your questions and concerns been addressed? Are you willing to take part in this interview? If yes, please retain a copy of this letter for your reference."

After the respondent reads the letter of information for verbal informed consent, that copy is given to the respondent.

h	h	m	m

Time interview began: (use 24 hour clock – hh:mm)

SECTION D: BREATH ALCOHOL ANALYSIS

Now I just need to take a reading with this breathalyzer instrument. It will test your blood alcohol content. It doesn't matter if you have had any alcohol or not.

	Case ID number					

QD01b	**Time of breath analysis (use 24 hour clock – hh:mm)**	*h*	*h*	*m*	*m*	

QD02	**Interviewer's code number**			

When I tell you, take a deep breath and hold it for a moment. Blow continuously through the mouthpiece until I tell you to stop.

QD03	**Breathalyser code number**			

QD04	**Breathalyser reading**	0	**.**			

QD05	**If a breath alcohol specimen could not be taken, please state reason**	
	Patient could not be traced	1
	Patient would not cooperate or refused	2
	Patient died	3
	Breathalyser not working	4
	Other (Specify _____)	5

Page Break

SECTION E: INJURY / MEDICAL PROBLEM

CASE ID: _____

QE01. Now please tell me what happened to you—that is, what's the main reason you're here today? *RECORD VERBATIM*

RECORD THE MAIN REASON FOR THE VISIT BELOW. IF MULTIPLE PROBLEMS ASK THE MAIN REASON THAT BROUGHT THEM TO THE ER.

Now could you please tell me specifically the main reason for your visit?

MAIN REASON FOR VISIT

A. PRIMARILY ACCIDENT/INJURY/POISONING *Circle one response only*	**B. PRIMARILY A MEDICAL CONDITION OR ILLNESS** *Circle one response only*
Cut, scrape, or puncture wound .....01 Bruise .....02 Fracture/dislocation.....03 Sprain/strain .....04 Burn .....05 Near drowning .....06 Head injury .....07 Internal injury .....08 Ingestion other than alcohol or drugs (Drano/lye, poison, etc.) .....09 Bite or sting (by insect or animal) .....10 Human bite .....11 Other injury .....12 *SPECIFY:*_____	Heart condition (congestive heart failure, heart attack, chest pain).....01 Shortness of breath .....02 Other respiratory condition (cold, cough, flu, asthma).....03 Liver condition (cirrhosis, ascites, hepatitis, jaundice) .....04 Pancreatic condition .....05 Ulcers .....06 Other stomach condition (stomach pain or stomach Ache not caused by overeating) .....07 Vitamin deficiency .....08 Anemia .....09 Alcohol withdrawal or alcohol related seizures .....10 Alcohol intoxication/overdose .....11 Drug intoxication/overdose.....12 Other medical condition/illness.....13 *SPECIFY:*_____

Page Break**QE02.** ***CODE ONE CAUSE OF ACCIDENT/INJURY IN SECTION A. OR MEDICAL CONDITION/ILLNESS IN SECTION B.***

A. ***IF ACCIDENT OR INJURY, MAIN REASON:***	**B.** ***IF MEDICAL CONDITION OR ILLNESS, MAIN REASON:***
We also need to know <u>how</u> you (hurt yourself/were injured). Tell me in your own words how it happened. ***Interviewer notes:***	**We also need to know what you think (caused your illness/made you sick.) Tell me in your own words what you think made you sick.** ***Interviewer notes:***
<u>IF THEY MENTION TWO OR MORE CAUSES:</u> **If you had to choose, which would you say was the <u>main</u> reason you were injured?** ***CODE ONLY <u>ONE</u> RESPONSE BELOW.*** **<u>MAIN CAUSE:</u>** Falling ……..01 Cutting myself or being cut .....……02 Being injured by a weapon……03 Being hit by a car or other motor vehicle (when I was a pedestrian) .....04 Being in a car (or other vehicle) accident when I was the driver or a passenger .....05 Bumping into something or someone .....06 Getting burned ……..……...…….07 Getting smoke, water, or something else in my lungs ….……..……08 Drinking alcoholic beverages ....……..09 Taking drugs or medicine ....……10 Taking something else (on purpose or by accident) .....11 Physical contact (being hit or kicked by someone) .....12 Something else ……13 *SPECIFY:* _____ ***Proceed to QE03***	***<u>IF THEY MENTION TWO OR MORE CAUSES:</u>*** **If you had to choose, which would you say was the <u>main</u> cause?** ***CODE ONLY <u>ONE</u> RESPONSE BELOW.*** **<u>MAIN CAUSE:</u>** Mentioned taking alcohol ……...01 Mentioned taking drugs or medication .....02 Answered, but no mention of either ....…….03 Have no idea what caused it ……04 ***Skip to QE06***

QE03	**Was your injury/accident unintentional?** ***If NOT unintentional ask if self-inflicted, inflicted by someone else or a result of a legal intervention.*** **(*reiterate to participant at this point that they do not have to answer any questions they do not wish to)***	
[CODE MAIN REASON]	Unintentional	1
	Intentional selfinflicted	2
	Intentional by someone else	3
	Legal intervention]	4
	Other (Specify _____)	5
	Don't know	77

QE06 **Where were you when you (had your injury/accident [or] noticed your illness/medical problem)?** *(read list to patient)*

[CODE ONE OPTION ONLY]	
Own home	1
Someone else's home	2
Pub, hotel, tavern, other drinking place	3
Nightclub	4
Sports club	5
Restaurant, café which serves full meals	6
Theatre, movies	7
Work place	8
In a private vehicle	9
At a sporting event	10
At outdoor public place, e.g. beach, park	11
Other (Specify _____)	12
Refused	88
Don't know	77

QE07-1 **What were you doing at the time you (had your injury/accident/ [or] noticed your illness/medical problem)?**

[CODE ONE OPTION ONLY]	
Participating in organized sports	1
Participating in sports socially	2
Other sports (Specify_____)	3
Household chores	4
Engaging in games, cards, artistic activities, movie/theater, yard work	5
Watching TV, resting, speaking on the phone, reading, listening to music	6
Shopping	7
Driving, traveling to another location	8
Caring for others	9
Sleeping, eating, bathing	10
Working for pay	11
Attending a concert or show	12
Participating in social gathering/event	13
Other (Specify _____)	14

Page Break**SECTION F: ALCOHOL, CAFFEINATED DRINKS AND DRUG USE PRIOR TO INJURY OR ILLNESS**

Now I want to ask you some questions with regard to alcohol use in the 6 HOURS before you were injured/noticed your medical problem. This is part of the study. Please be assured that this information will be treated as strictly confidential.

F.a Alcohol Use

Time of injury:_____ **(use 24 hour clock – hh:mm)**
Start time of 6 hour period:_____ **(use 24 hour clock – hh:mm)**

QF04	**In the 6 hours before and up to you [having your injury/accident/ noticing your illness/medical problem], did you have any alcohol to drink even one drink?**	
	Yes	1
	No (*skip to Section F.b)*	2
	Refused (*skip to Section F.b)*	88
	Don't know (*skip to Section F.b)*	77

QF05	**What time did you start drinking? (*within the 6 hour period)***								
QF05a	Date	(dd.mm.yyyy)	*d*	*d*	*m*	*m*	*y*	*y*	*y*	*y*
QF05b	Time hh:mm)	(*use 24 hour clock –*					*h*	*h*	*m*	*m*

QF06	**What time did you have your last drink prior to your injury/illness?**								
QF06a	Date	(dd.mm.yyyy)	*d*	*d*	*m*	*m*	*y*	*y*	*y*	*y*
QF06b	Time hh:mm)	(*use 24 hour clock –*					*h*	*h*	*m*	*m*

QF066	**How many hours/minutes occurred between the time you had your last drink and the time the injury/illness happened?**				
	Hours/minutes	(hh:mm)	*h*	*h*	*m*	*m*

QF07	**In the 6 hours before you [were injured / noticed your medical problem], what alcohol did you have to drink?** ***This includes beer, wine, spirits and cider—show standard drink cue card***				
Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml	
Normal beer (~5%)	Y N DK R		X	17.05ml	
Strong beer (~7.5%)	Y N DK R		X	17.05ml	
Table wine (~12%)	Y N DK R		X	17.05ml	
Fortified wine (~18%)	Y N DK R		X	17.05ml	
Spirits (~40%)	Y N DK R		X	17.05ml	

Cider/cooler (~6%)	Y N DK R		X	17.05ml		
Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	
Total amount of absolute alcohol consumed*						……ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
*E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.*Page Break

QF08	**In which of the following place(s) were you drinking within the 6 hours prior to your [injury/accident/ illness/medical problem]?** *(read list to patient)*	
[CODE ALL THAT APPLY]	Own home	1
	Someone else's home	2
	Pub, hotel, tavern, other drinking place	3
	Nightclub	4
	Sports club	5
	Restaurant, café which serves full meals	6
	Theatre, movies	7
	Work place	8
	In a private vehicle	9
	At a sporting event	10
	At outdoor public place, e.g. street, beach, park	11
	Other (Specify _____)	12
	Don't know	77

QF09	**Where did you have your last drink prior to your [injury/accident / illness/ medical problem]?** *(read list to patient)*	
[CODE ONLY ONE]	Own home	1
	Someone else's home	2
	Pub, hotel, tavern, other drinking place	3
	Nightclub	4
	Sports club	5
	Restaurant, café which serves full meals	6
	Theatre, movies	7
	Work place	8
	In a private vehicle	9
	At a sporting event	10
	At outdoor public place, e.g. street, beach, park	11
	Other (Specify _____)	12
	Don't know	77

QNF15	**Were you feeling even a little drunk at the time of injury/illness?**	
	Yes	1
	No *(skip to QF14)*	2

QNF16	Were you feeling a little drunk, somewhat drunk, or very drunk?	
	A little drunk	1
	Somewhat drunk	2
	Very drunk	3

QF14	Do you think that your [injury/accident / illness/medical problem] would have happened even if you had not been drinking?	
	Yes, if I had not been drinking, it would still have happened *(skip to QF13)*	1
	No, if I had not been drinking, it would not have happened	2
	Not sure	9

Page Break

QNF17	Is this because of the effect of the alcohol itself, or because of other reasons, such as the place you were or the people you were with or because of both alcohol and other reasons? (CODE ALL THAT APPLY)	
	Alcohol	1
	Place	2
	People	3
	Other (Specify _____)	4

QF13	Did you have any alcohol to drink between the time of your [injury/accident illness/medical problem] and coming to the Emergency Department?	
	Yes	1
	No	2

F.b Energy Drink Use

Next I would like to ask you some questions about your use of energy drinks.

Interviewer notes:
Time of injury:_____
Start time of 6 hour period: _____

QFE01	In the 6 hours before and up to you [having your injury/accident/ noticing your illness/medical problem], did you have any energy drinks?	
	Yes	1
	No (*skip to Section F.c)*	2
	Refused (*skip to Section F.c)*	88
	Don't know (*skip to Section F.c)*	77

QFE02	What time did you start drinking energy drinks within the 6 hour period?								
QFE02a	Date (dd.mm.yyyy)	*d*	*d*	*m*	*m*	*y*	*y*	*y*	*y*
QFE02b	Time (*use 24 hour clock* – hh:mm)					*h*	*h*	*m*	*m*

QFE03	What time did you have your last energy drink prior to your injury/illness?								
QFE03a	Date (dd.mm.yyyy)	d	d	m	m	y	y	y	y
QFE03b	Time hh:mm) (*use 24 hour clock* –					h	h	m	m

QFE04	How many hours/minutes occurred between the time you had your last energy drink and the time the [accident/injury / illness/medical problem] happened?					
	Hours/minutes (hh:mm)	h	h	m	m	

Page Break

QFE05 **In the 6 hours before you [were injured / noticed your medical problem], what energy drinks did you have to drink? How many such drinks did you have?**
This includes regular energy drinks, energy shots and premixed alcohol and energy drinks

Type	Use?	Brand/type of energy drink	TOTAL # drinks	TOTAL # drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Regular energy drink (small 250ml/8oz)	Y N DK R				X	~80mg	
Regular energy drink (medium 341ml/12oz)	Y N DK R				X	~115mg	
Regular energy drink (large 473ml)	Y N DK R				X	~160mg	
Regular energy shot	Y N DK R				X	~140mg	
Extra strength energy shot	Y N DK R				X	~200mg	
Premixed alcohol and energy drink (medium 341ml/12oz)	Y N DK R				X	~80mg	
Premixed alcohol and energy drink (large 473ml/16oz)	Y N DK R				X	~100mg	
						Total mg of caffeine consumed*	…….mg

*calculate the total amount of caffeine when coding the questionnaire

QFE06	In which of the following place(s) were you drinking energy drinks prior to your [injury/accident/ illness/medical problem]? *(read list to patient)*	
[CODE ALL THAT APPLY]	Own home	1
	Someone else's home	2
	Pub, hotel, tavern, other drinking place	3
	Nightclub	4
	Sports club	5

Restaurant, café which serves full meals	6
Theatre, movies	7
Work place	8
In a private vehicle	9
At a sporting event	10
At outdoor public place, e.g. street, beach, park	11
Other (Specify _____)	12
Don't know	77

Page Break

QFE07	**Where did you have your last energy drink prior to your [injury/accident / illness/medical problem]?** *(read list to patient)*	
[CODE ONLY ONE]	Own home	1
	Someone else's home	2
	Pub, hotel, tavern, other drinking place	3
	Nightclub	4
	Sports club	5
	Restaurant, café which serves full meals	6
	Theatre, movies	7
	Work place	8
	In a private vehicle	9
	At a sporting event	10
	At outdoor public place, e.g. street, beach, park	11
	Other (Specify _____)	12
	Don't know	77

If NO energy drinks mixed with alcohol skip to QFE10

QFE08	**Were you feeling even a little drunk at the time of your injury/illness?**	
	Yes	1
	No *(skip to QFE10)*	2

QFE09	**Were you feeling a little drunk, somewhat drunk, or very drunk?**	
	A little drunk	1
	Somewhat drunk	2
	Very drunk	3

QFE10	**Do you think that your [injury/accident / illness/medical problem] would have happened even if you had not been drinking energy drinks?**	
	Yes, if I had not been drinking energy drinks, it would still have happened *(skip to Section F.c)*	1
	No, if I had not been drinking energy drinks, it would not have happened	2

	Not sure	9

QFE11	**Is this because of the effect of the energy drink itself, or because of other reasons, such as the combination with alcohol, the place you were or the people you were with or because of both the energy drink and other reasons? (CODE ALL THAT APPLY)**	
	Energy Drink	1
	Place	2
	People	3
	Other (Specify _____)	4

Page Break**F.c Coffee Use**

Next I would like to ask you some questions about your use of caffeinated coffee or tea.

Interviewer notes:
Time of injury: _____
Start time of 6 hour period: _____

QFE12	**In the 6 hours before and up to you [having your injury/accident/ noticing your illness/medical problem], did you have any caffeinated coffee or tea?**	
	Yes	1
	No (*skip to Section F.d)*	2
	Refused (*skip to Section F.d)*	88
	Don't know (*skip to Section F.d)*	77

QFE13	**In the 6 hours before you [were injured / noticed your medical problem], what caffeinated coffee or tea did you have to drink? How many such drinks did you have?** ***This includes regular caffeinated coffee, espresso drinks and caffeinated tea alone and mixed with alcohol***					
Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Regular coffee 354ml (341ml/12oz)	Y N DK R			X	~100mg	
Regular coffee 473ml (472ml/16oz)	Y N DK R			X	~140mg	
Regular coffee 591ml (568ml20oz)	Y N DK R			X	~200mg	
Regular coffee 709ml (681ml/24oz)	Y N DK R			X	~240mg	
Coffee Drinks (latte, cappuccino etc.) & tea						
Espresso single shot (30ml/1oz)	Y N DK R			X	~75mg	
Espresso double shot (60ml/2oz)	Y N DK R			X	~150mg	
Espresso triple shot (90ml/3oz)	Y N DK R			X	~225mg	

Caffeinated tea (341ml/12oz)	Y N DK R			X	~70mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

F.d Caffeinated Soda Use

Next I would like to ask you some questions about your use of caffeinated sodas

QFE14	**In the 6 hours before and up to you [having your injury/accident/ noticing your illness/medical problem], did you have any caffeinated sodas such as Coca-cola, Pepsi, Dr. Pepper, Mountain Dew, etc.?** *Interviewer notes:* **Do not record if participant reported having non-caffeinated sodas such as Sprite, Ginger Ale, 7 up, Caffeine Free Coke etc.**	
	Yes	1
	No (*skip to Section F.e]*	2
	Refused (*skip to Section F.e)*	88
	Don't know (*skip to Section F.e)*	77

QFE15	**In the 6 hours before you [were injured / noticed your medical problem], what caffeinated sodas did you have to drink? *This includes caffeinated sodas alone and mixed with alcohol***					
Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Soda 250ml/8oz	Y N DK R			X	~25mg	
Soda 340ml/12oz	Y N DK R			X	~35mg	
Soda 473ml/16oz	Y N DK R			X	~48mg	
Soda 500ml/17.5oz	Y N DK R			X	~51mg	
Soda 1L/35oz	Y N DK R			X	~102mg	
Soda 2L/70oz	Y N DK R			X	~204mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

F.e Drug Use

Now I want to ask you some questions with regard to drug use. This is also part of the study. Please be assured that this information will be treated as strictly confidential.

Interviewer notes:
Time of injury: _____
Start time of 6 hour period: _____

QNF18	**In the 6 hours before you [were injured / noticed your medical problem], did you take any prescription or non-prescription medications or any other drugs?**	
	Yes	1
	No *(skip to Section NH)*	2
	Refused (*skip to Section NH)*	88
	Don't know (*skip to Section NH)*	77

QNF19	**In the 6 hours prior to injury/accident [or] illness/medical problem did you take any of the following?**		
CATEGORY	Yes	No	Unsure
A. **Drugs that reduce anxiety or make you sleepy** (e.g., Sedatives, mild tranquilizers, GHB, Ketamine, Barbiturates, Librium or Valium)	**1**	**2**	**3**
B. **Drugs which make you more alert or give you energy** (e.g. Dexedrine, speed, ecstasy, powder cocaine, crystal meth, crack) **(if no skip to C)**	**1**	**2**	**3**
B.01 Dexedrine or speed	*1*	*2*	*3*
B.02 Ecstasy	*1*	*2*	*3*
B.03 Powder cocaine	*1*	*2*	*3*
B.04 Crystal meth	*1*	*2*	*3*
B.05 Crack cocaine	*1*	*2*	*3*
B.06 Other:	*1*	*2*	*3*
C. **Heroin**	**1**	**2**	**3**
D. **Other drugs used to relieve pain** (e.g., Oxycodone, codeine, morphine, Dilaudid, opium, Demerol, fentanyl)	**1**	**2**	**3**
E. **Drugs that cause visual hallucinations** (e.g., psilocybin mushrooms, LSD, mescaline, PCP, angel's dust)	**1**	**2**	**3**
F. **Methadone**	**1**	**2**	**3**
G. **Marijuana, hash, THC**	**1**	**2**	**3**
H. **Any other drugs prescribed for a physical illness?**	**1**	**2**	**3**
I. **Any other drugs?** **Specify:** _____	**1**	**2**	**3**

QNF20	**Do you think your [injury/accident / illness/medical problem] would have happened if you had not been using drugs?**	
	Yes, if I had not been using drugs, it would still have happened *(skip to Section NH)*	1
	No, if I had not been using drugs, it would not have happened	2
	Not sure	9

QNF21	**Do you think this is because of the effect of the drugs themselves, or because of**

	other reasons, such as the place you were or the people you were with or because of both drugs and other reasons? (CODE ALL THAT APPLY)	
	Drugs	1
	Place	2
	People	3
	Other (Specify _____)	4

Page Break**SECTION NEW H (NH): ALCOHOL, CAFFEINATED DRINKS AND DRUG USE THE DAY(S) BEFORE INJURY OR MEDICAL PROBLEM**

In this next section I am going to ask you about what you were doing the day before your [injury/accident /illness/medical problem]

First, I would like you to think about where you were and what you were doing the day before [injury / illness] at the same time as you [had your (injury/accident / noticed your illness/medical problem].
(Prompt if necessary, i.e. you said you [had your accident/ noticed your medical problem] at 5pm today, Saturday. Where were you at 5pm yesterday, Friday?)

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____

QNH01 **Thinking about the time you [had your accident/ noticed your medical problem], try to remember the same time the day before the [accident / medical problem]. Where were you yesterday at the same time that you [had your accident/ noticed your medical problem]?** *(read list to patient)*

[CODE ONE OPTION ONLY]

Own home	1
Someone else's home	2
Pub, hotel, tavern, other drinking place	3
Nightclub	4
Sports club	5
Restaurant, café which serves full meals	6
Theatre, movies	7
Work place	8
In a private vehicle	9
At a sporting event	10
At outdoor public place, e.g. beach, park	11
Other (Specify _____)	12
Refused	88
Don't know	77

QNH03 Thinking about that same time, what were you doing at that time?

[CODE ONE OPTION ONLY]

Participating in organized sports	1
Participating in sports socially	2
Other sports (Specify_____)	3
Household chores	4
Engaging in games, cards, artistic activities, movie/theater, yard work	5
Watching TV, resting, speaking on the phone, reading, listening to music	6
Shopping	7
Driving, traveling to another location	8
Caring for others	9
Sleeping, eating, bathing	10
Working for pay	11
Attending a concert or show	12

Participating in social gathering/event	13
Other (Specify _____)	14

NH.a Now Thinking about Your Alcohol Use the Day before the Injury/Accident or Medical Problem (Day of week :_____)

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____

QNH04	**Still thinking about that same time, did you have any alcohol to drink in the six hours leading up to that same time?**	
	Yes	1
	No *(skip to Section NH.b)*	2
	Refused *(skip to Section NH.b)*	88
	Don't know (*skip to Section NH.b)*	77

QNH05 **Still thinking about the day prior to your injury at the same time, what alcohol did you have to drink?**
This includes beer, wine, spirits and cider—show standard drink cue card

Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml	
Normal beer (~5%)	Y N DK R		X	17.05ml	
Strong beer (~7.5%)	Y N DK R		X	17.05ml	
Table wine (~12%)	Y N DK R		X	17.05ml	
Fortified wine (~18%)	Y N DK R		X	17.05ml	
Spirits (~40%)	Y N DK R		X	17.05ml	
Cider/cooler (~6%)	Y N DK R		X	17.05ml	

Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	

Total amount of absolute alcohol consumed*	…….ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

NH.b Now Thinking about Your Energy Drink Use the Day before the Injury/Accident or Medical Problem (Day of week:_____)

Interviewer notes:
Time of injury: _____

Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNHE01	**Did you have any energy drinks in the six hours leading up to that same time?**	
	Yes	1
	No (*skip to Section NH.c)*	2
	Refused *(skip to Section NH.c)*	88
	Don't know (*skip to Section NH.c)*	77

QNHE02	**Still thinking about the day prior to your injury/accident or medical problem at the same time, what energy drinks did you have? *This includes regular energy drinks, energy shots and premixed alcohol and energy drinks***						
Type	Use?	Brand/type of energy drink	TOTAL # drinks	TOTAL # drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Regular energy drink (small 250ml/8oz)	Y N DK R				X	~80mg	
Regular energy drink (medium 341ml/12oz)	Y N DK R				X	~115mg	
Regular energy drink (large 473ml)	Y N DK R				X	~160mg	
Regular energy shot	Y N DK R				X	~140mg	
Extra strength energy shot	Y N DK R				X	~200mg	
Premixed alcohol and energy drink (medium 341ml/12oz)	Y N DK R				X	~80mg	
Premixed alcohol and energy drink (large 473ml/16oz)	Y N DK R				X	~100mg	
						Total mg of caffeine consumed*	…….mg

*calculate the total amount of caffeine when coding the questionnaire

NH.c Now thinking about your Caffeinated Coffee and Tea Use the Day Before the injury/accident or medical problem (Day of week:_____)

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNHE03	Did you have any caffeinated coffee or tea in the six hours leading up to that same time?	
	Yes	1
	No *(skip to Section NH.d)*	2
	Refused *(skip to Section NH.d)*	88
	Don't know *(skip to Section NH.d)*	77

QNHE04	Still thinking about the day prior to your injury at the same time, what caffeinated coffee or black tea did you have? ***This includes regular caffeinated coffee, espresso drinks and black tea alone and mixed with alcohol***					
Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Regular coffee 354ml (341ml/12oz)	Y N DK R			X	~100mg	
Regular coffee 473ml (472ml/16oz)	Y N DK R			X	~140mg	
Regular coffee 591ml (568ml20oz)	Y N DK R			X	~200mg	
Regular coffee 709ml (681ml/24oz)	Y N DK R			X	~240mg	
Coffee Drinks (latte, cappuccino etc.) & Tea						
Espresso single shot (30ml/1oz)	Y N DK R			X	~75mg	
Espresso double shot (60ml/2oz)	Y N DK R			X	~150mg	
Espresso triple shot (90ml/3oz)	Y N DK R			X	~225mg	
Caffeinated tea (341ml/12oz)	Y N DK R			X	~70mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

NH.d Now Thinking about Your Caffeinated Soda Use the Day before Your Injury/Accident or Medical Problem (Day of week:_____)

Interviewer notes:
Time of injury: _____
Start time of 6 hour period: _____
Make sure to name day of week being referred to

QNHE05	Did you have any caffeinated sodas such as Coca-cola, Pepsi, Dr. Pepper, Mountain Dew etc in the six hours leading up to that same time?

	Yes	1
	No (*skip to Section NH.e]*	2
	Refused *(skip to Section NH.e)*	88
	Don't know (*skip to Section NH.e]*	77

QNHE06	**Still thinking about the day prior to your injury/accident at the same time, what caffeinated sodas did you have to drink? *This includes caffeinated sodas alone and mixed with alcohol***					
Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Soda 250ml/8oz	Y N DK R			X	~25mg	
Soda 340ml/12oz	Y N DK R			X	~35mg	
Soda 473ml/16oz	Y N DK R			X	~48mg	
Soda 500ml/17.5oz	Y N DK R			X	~51mg	
Soda 1L/35oz	Y N DK R			X	~102mg	
Soda 2L/70oz	Y N DK R			X	~204mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

NH.e Now Thinking about Your Drug Use the Day before the Injury/Accident or Medical Problem (Day of week:_____)

Interviewer notes:
Time of injury: _____
Start time of 6 hour period: _____
Make sure to name day of week being referred to

QNH08	**Still thinking about the day before at the same time, did you use any drugs, including medications taken by prescription or over the counter medications, in the six hours leading up to this time?**	
	Yes	1
	No *(skip to Section NH.f)*	2

Refused (*skip to Section NH.f)*	88
Don't know (*skip to Section NH.f)*	77

QNH09	**Yesterday, during the same 6 hour time frame leading up to your [accident/injury / illness medical problem] did you take or use any of the following:**		
CATEGORY	Yes	No	Unsure
A. **Drugs that reduce anxiety or make you sleepy** (e.g., Sedatives, mild tranquilizers, GHB, Ketamine, Barbiturates, Librium or Valium)	**1**	**2**	**3**
B. **Drugs which make you more alert or give you energy** (e.g. Dexedrine, speed, ecstasy, powder cocaine, crystal meth, crack) **(if no skip to C)**	**1**	**2**	**3**
B.01 Dexedrine or speed	*1*	*2*	*3*
B.02 Ecstasy	*1*	*2*	*3*
B.03 Powder cocaine	*1*	*2*	*3*
B.04 Crystal meth	*1*	*2*	*3*
B.05 Crack cocaine	*1*	*2*	*3*
B.06 Other:	*1*	*2*	*3*
C. **Heroin**	**1**	**2**	**3**
D. **Other drugs used to relieve pain** (e.g., Oxycodone, codeine, morphine, Dilaudid, opium, Demerol, fentanyl)	**1**	**2**	**3**
E. **Drugs that cause visual hallucinations** (e.g., psilocybin mushrooms, LSD, mescaline, PCP, angel's dust)	**1**	**2**	**3**
F. **Methadone**	**1**	**2**	**3**
G. **Marijuana, hash, THC**	**1**	**2**	**3**
H. **Any other drugs prescribed for a physical illness?**	**1**	**2**	**3**
I. **Any other drugs?** **Specify:** _____	**1**	**2**	**3**

NH.f Alcohol use

We are now going to return to alcohol use in the days before the Injury/Accident or Medical Problem

Thinking about Your Alcohol Use TWO Days before the Injury/Accident or Medical Problem (Day of week:_____)

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNH10	**Still thinking about that same time, did you have any alcohol to drink in the six hours leading up to that same time?**	
	Yes	1

	No *(skip to Section NH.g)*	2
	Refused *(skip to Section NH.g)*	88
	Don't know (*skip to Section NH.g)*	77

QNH11	**What alcohol did you have to drink?** ***This includes beer, wine, spirits and cider—show standard drink cue card***					
Type	Use?		TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R			X	17.05ml	
Normal beer (~5%)	Y N DK R			X	17.05ml	
Strong beer (~7.5%)	Y N DK R			X	17.05ml	
Table wine (~12%)	Y N DK R			X	17.05ml	
Fortified wine (~18%)	Y N DK R			X	17.05ml	
Spirits (~40%)	Y N DK R			X	17.05ml	
Cider/cooler (~6%)	Y N DK R			X	17.05ml	
Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	
					Total amount of absolute alcohol consumed*	…….ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

NH.g Now Think About Your Alcohol Use THREE Days Before

(Day of week:_____)
Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNH12	**Still thinking about that same time, did you have any alcohol to drink in the six hours leading up to that same time?**	
	Yes	1
	No *(skip to Section NH.h)*	2
	Refused *(skip to Section NH.h)*	88
	Don't know (*skip to Section NH.h)*	77

QNH13	**What alcohol did you have to drink?** ***This includes beer, wine, spirits and cider—show standard drink cue card***					
Type	Use?		TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R			X	17.05ml	
Normal beer (~5%)	Y N DK R			X	17.05ml	
Strong beer (~7.5%)	Y N DK R			X	17.05ml	
Table wine (~12%)	Y N DK R			X	17.05ml	
Fortified wine (~18%)	Y N DK R			X	17.05ml	
Spirits (~40%)	Y N DK R			X	17.05ml	
Cider/cooler (~6%)	Y N DK R			X	17.05ml	
Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	
Total amount of absolute alcohol consumed*						……ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

NH.h Now thinking about your Alcohol Use FOUR Days Before

(Day of week:_____)
Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNH14	**Still thinking about that same time, did you have any alcohol to drink in the six hours leading up to that same time?**	
	Yes	1
	No *(skip to Section NH.i)*	2
	Refused *(skip to Section NH.i)*	88
	Don't know (*skip to Section NH.i)*	77

QNH15	**What alcohol did you have to drink?** ***This includes beer, wine, spirits and cider—show standard drink cue card***					
Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total	
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml		
Normal beer (~5%)	Y N DK R		X	17.05ml		
Strong beer (~7.5%)	Y N DK R		X	17.05ml		
Table wine (~12%)	Y N DK R		X	17.05ml		
Fortified wine (~18%)	Y N DK R		X	17.05ml		
Spirits (~40%)	Y N DK R		X	17.05ml		
Cider/cooler (~6%)	Y N DK R		X	17.05ml		
Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	
Total amount of absolute alcohol consumed*						……ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

NH.i Now Think About Your Alcohol Use FIVE Days Before

(Day of week:_____)
Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNH16	**Still thinking about that same time, did you have any alcohol to drink in the six hours leading up to that same time?**	
	Yes	1
	No *(skip to Section NH.j)*	2
	Refused *(skip to Section NH.j)*	88
	Don't know (*skip to Section NH.j)*	77

QNH17	What alcohol did you have to drink? ***This includes beer, wine, spirits and cider—show standard drink cue card***					
Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total	
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml		
Normal beer (~5%)	Y N DK R		X	17.05ml		
Strong beer (~7.5%)	Y N DK R		X	17.05ml		
Table wine (~12%)	Y N DK R		X	17.05ml		
Fortified wine (~18%)	Y N DK R		X	17.05ml		
Spirits (~40%)	Y N DK R		X	17.05ml		
Cider/cooler (~6%)	Y N DK R		X	17.05ml		
Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	
Total amount of absolute alcohol consumed*						……ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

NH.j Now Think About Your Alcohol Use SIX Days Before

(Day of week:_____)
Interviewer notes:
Time of injury: _____
Start time of 6 hour period for previous day: _____
Make sure to name day of week being referred to

QNH18	**Still thinking about that same time, did you have any alcohol to drink in the six hours leading up to that same time?**	
	Yes	1
	No *(skip to Section H)*	2
	Refused *(skip to Section H)*	88
	Don't know (*skip to Section H)*	77

QNH19	**What alcohol did you have to drink?** ***This includes beer, wine, spirits and cider—show standard drink cue card***				
Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml	
Normal beer (~5%)	Y N DK R		X	17.05ml	
Strong beer (~7.5%)	Y N DK R		X	17.05ml	
Table wine (~12%)	Y N DK R		X	17.05ml	
Fortified wine (~18%)	Y N DK R		X	17.05ml	
Spirits (~40%)	Y N DK R		X	17.05ml	
Cider/cooler (~6%)	Y N DK R		X	17.05ml	
Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**
Total amount of absolute alcohol consumed*					……ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

SECTION H: ALCOHOL, CAFFEINATED DRINKS AND DRUG USE EXACTLY ONE WEEK BEFORE INJURY OR MEDICAL PROBLEM

In this next section I am going to ask you about what you were doing exactly one week before your [accident/injury illness/medical problem].

First, I would like you to think about where you were and what you were doing exactly one week (7 days) before your [accident/injury / illness/medical problem] at the same time that you [had your accident/injury / noticed your illness/medical problem].
(Prompt if necessary, i.e. you said you [had your accident / noticed your medical problem] at 5pm today, Saturday. Where were you at 5pm last Saturday? ***Indicate any significant holidays, events or the date to trigger memory****)*

Time of injury: _____ **(use 24 hour clock – hh:mm)**
Start time of 6 hour period for week prior: _____ **(use 24 hour clock – hh:mm)**

QH01 **Think about the time you had your accident and remember the same time a week before. Where were you a week before at the same time?**

(read list to patient)

[CODE ONE OPTION ONLY]

Own home	1
Someone else's home	2
Pub, hotel, tavern, other drinking place	3
Nightclub	4
Sports club	5
Restaurant, café which serves full meals	6
Theatre, movies	7
Work place	8
In a private vehicle	9
At a sporting event	10
At outdoor public place, e.g. beach, park	11
Other (Specify _____)	12
Refused	88
Don't know	77

QH01-2 Thinking about that same time a week ago, what were you doing?

[CODE ONE OPTION ONLY]

Participating in organized sports	1
Participating in sports socially	2
Other sports (Specify_____)	3
Household chores	4
Engaging in games, cards, artistic activities, movie/theater, yard work	5
Watching TV, resting, speaking on the phone, reading, listening to music	6
Shopping	7
Driving, traveling to another location	8
Caring for others	9
Sleeping, eating, bathing	10
Working for pay	11
Attending a concert or show	12
Participating in social gathering/event	13
Other (Specify _____)	14

H.a Alcohol Use the Week Before

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for week prior: _____

QH02	Still thinking about a week before at the same time, did you have any alcohol to drink in the six hours leading up to this time?	
	Yes	1
	No *(skip to Section H.b)*	2
	Refused *(skip to Section H.b)*	88
	Don't know (*skip to Section H.b)*	77

QH03	Still thinking about the week before at the same time, what alcohol did you have to drink? ***This includes beer, wine, spirits and cider—show standard drink cue card***

Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml	
Normal beer (~5%)	Y N DK R		X	17.05ml	
Strong beer (~7.5%)	Y N DK R		X	17.05ml	
Table wine (~12%)	Y N DK R		X	17.05ml	
Fortified wine (~18%)	Y N DK R		X	17.05ml	
Spirits (~40%)	Y N DK R		X	17.05ml	
Cider/cooler (~6%)	Y N DK R		X	17.05ml	

Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	

Total amount of absolute alcohol consumed*	…….ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml. Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

H.b Energy Drink Use the Week Before

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for week prior: _____

QHE01	**Still thinking about a week before at the same time, did you have any energy drinks in the six hours leading up to this time?**	
	Yes	1
	No *(skip to Section H.c)*	2
	Refused *(skip to Section H.c)*	88
	Don't know (*skip to Section H.c)*	77

QHE02	**Still thinking about the week before at the same time, what energy drinks did you have? *This includes regular energy drinks, energy shots and premixed alcohol and energy drinks***

Type	Use?	Brand/type of energy drink	TOTAL # drinks	TOTAL # drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Regular energy drink (small 250ml/8oz)	Y N DK R				X	~80mg	
Regular energy drink (medium 341ml/12oz)	Y N DK R				X	~115mg	
Regular energy drink (large 473ml)	Y N DK R				X	~160mg	
Regular energy shot	Y N DK R				X	~140mg	
Extra strength energy shot	Y N DK R				X	~200mg	
Premixed alcohol and energy drink (medium 341ml/12oz)	Y N DK R				X	~80mg	
Premixed alcohol and energy drink (large 473ml/16oz)	Y N DK R				X	~100mg	
						Total mg of caffeine consumed*	……..mg

*calculate the total amount of caffeine when coding the questionnaire

`

H.c Caffeinated Coffee and Tea Use the Week Before

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for week prior: _____

QHE03	**Still thinking about a week before at the same time, did you have any coffee in the six hours leading up to this time?**	
	Yes	1
	No *(skip to Section H.d)*	2
	Refused *(skip to Section H.d)*	88
	Don't know (*skip to Section H.d)*	77

QHE04	**Still thinking about the week before at the same time, what caffeinated coffee or tea did you have? *This includes regular caffeinated coffee, espresso drinks and tea alone and mixed with alcohol***					
Type	Use?	TOTAL #	TOTAL # of		Caffeine	Caffeine

		of drinks	drinks mixed with alcohol		content mg	content total
Regular coffee 354ml (341ml/12oz)	Y N DK R			X	~100mg	
Regular coffee 473ml (472ml/16oz)	Y N DK R			X	~140mg	
Regular coffee 591ml (568ml20oz)	Y N DK R			X	~200mg	
Regular coffee 709ml (681ml/24oz)	Y N DK R			X	~240mg	
Coffee Drinks (latte, cappuccino etc.) & Tea						
Espresso single shot (30ml/1oz)	Y N DK R			X	~75mg	
Espresso double shot (60ml/2oz)	Y N DK R			X	~150mg	
Espresso triple shot (90ml/3oz)	Y N DK R			X	~225mg	
Caffeinated tea (341ml/12oz)	Y N DK R			X	~70mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

H.d Caffeinated Soda Use the Week Before

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for week prior: _____

QHE05	**Still thinking about a week before at the same time, did you have any caffeinated sodas such as Coca-Cola, Pepsi, Dr. Pepper, Mountain Dew etc. in the six hours leading up to this time?**	
	Yes	1
	No *(skip to Section H.e)*	2
	Refused *(skip to Section H.e)*	88
	Don't know (*skip to Section H.e)*	77

QHE06	**Still thinking about the week prior to your injury/accident at the same time, what caffeinated sodas did you have to drink?** ***This includes caffeinated sodas alone and mixed with alcohol***					
Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed		Caffeine content	Caffeine content total

			with alcohol		mg	
Soda 250ml/8oz	Y N DK R			X	~25mg	
Soda 340ml/12oz	Y N DK R			X	~35mg	
Soda 473ml/16oz	Y N DK R			X	~48mg	
Soda 500ml/17.5oz	Y N DK R			X	~51mg	
Soda 1L/35oz	Y N DK R			X	~102mg	
Soda 2L/70oz	Y N DK R			X	~204mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

H.e Drug Use the Week Before

Interviewer notes:
Time of injury: _____
Start time of 6 hour period for week prior: _____

QH06	**Still thinking about the week before your [accident/injury / illness medical problem] at the same time, did you use any drugs, including medications taken by prescription or over the counter medications, in the six hours leading up to this time?**
Yes	1
No *(skip to Section G)*	2
Refused (*skip to Section G)*	88
Don't know (*skip to Section G)*	77

Still thinking about the week before at the same time, please tell me whether you took any of the following substances during the 6 hours leading up to this time. Keep in mind that we want you to include anything we may have talked about earlier.

QH07	**Last week, during the same time leading up to your [accident/injury / illness**

	medical problem] did you take or use any of the following:		
CATEGORY	Yes	No	Unsure
A. **Drugs that reduce anxiety or make you sleepy** (e.g., Sedatives, mild tranquilizers, GHB, Ketamine, Barbiturates, Librium or Valium)	**1**	**2**	**3**
B. **Drugs which make you more alert or give you energy** (e.g. Dexedrine, speed, ecstasy, powder cocaine, crystal meth, crack) **(if no skip to C)**	**1**	**2**	**3**
B.01 Dexedrine or speed	*1*	*2*	*3*
B.02 Ecstasy	*1*	*2*	*3*
B.03 Powder cocaine	*1*	*2*	*3*
B.04 Crystal meth	*1*	*2*	*3*
B.05 Crack cocaine	*1*	*2*	*3*
B.06 Other:	*1*	*2*	*3*
C. **Heroin**	**1**	**2**	**3**
D. **Other drugs used to relieve pain** (e.g., Oxycodone, codeine, morphine, Dilaudid, opium, Demerol, fentanyl)	**1**	**2**	**3**
E. **Drugs that cause visual hallucinations** (e.g., psilocybin mushrooms, LSD, mescaline, PCP, angel's dust)	**1**	**2**	**3**
F. **Methadone**	**1**	**2**	**3**
G. **Marijuana, hash, THC**	**1**	**2**	**3**
H. **Any other drugs prescribed for a physical illness?**	**1**	**2**	**3**
I. **Any other drugs?** **Specify:** _____	**1**	**2**	**3**

SECTION G: TYPICAL ALCOHOL, CAFFEINATED DRINKS AND DRUG USE HABITS

G.a Alcohol Use

Now I am going to ask you some questions about your typical patterns of alcohol use. Remember that all your answers are confidential.

QG01	**In the past 12 months, how often did you typically drink any kind of alcoholic beverage?** *(Prompt if necessary glass of beer, home brew, wine, readytodrink, cocktails etc.).*	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	About once a month	6
	611 times a year	7
	15 times a year	8
	No alcohol during last 12 months	9

	Don't know	77

If None, skip to Section G.b, Energy Drink Use

QG01-1	**When you drink wine, beer or hard liquor, how many drinks do you usually have at one occasion?**	…… drinks

Now I want you to think of **a typical drinking** occasion and answer the following questions for me.

QG02	**What type of alcohol do you usually have to drink? *This includes beer, wine, spirits and cider—show standard drink cue card***				
Type	Use?	TOTAL # of drinks		Absolute alcohol per drink	Absolute alcohol total
Low alcohol beer (~2.5%)	Y N DK R		X	17.05ml	
Normal beer (~5%)	Y N DK R		X	17.05ml	
Strong beer (~7.5%)	Y N DK R		X	17.05ml	
Table wine (~12%)	Y N DK R		X	17.05ml	
Fortified wine (~18%)	Y N DK R		X	17.05ml	
Spirits (~40%)	Y N DK R		X	17.05ml	
Cider/cooler (~6%)	Y N DK R		X	17.05ml	

Other	Y N DK R	**Type**	**% alc content**	X	**Amount (mL)**	

Total amount of absolute alcohol consumed*	……ml

*Calculate the total amount of absolute alcohol when coding the questionnaire
Note: For "other", write the type, percentage alcohol content, and amount in ml.
Multiply the amount consumed by the % alcohol content to get the absolute alcohol for that type.
E.g. Drinking 500mL of 95% rubbing alcohol means 0.95 x 500mL = 475mL absolute alcohol.

QG03	**In the past 12 months, how often did you drink 12 or more drinks on one occasion?** *(Prompt if necessary 12 cans of beer, 12 glasses wine, 12 shots brandy, etc.)*	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	About once a month	6
	611 times a year	7
	15 times a year	8
	Never during last year	9
	Don't know	77

QG04	**In the past 12 months, how often did you drink between 5 and 11 drinks on one**

	occasion? *(Prompt if necessary 511 cans of beer, 511 glasses of wine, 511 shots of brandy, etc.)*	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	About once a month	6
	611 times a year	7
	15 times a year	8
	Never during last year	9
	Don't know	77

QG04a	**In the past 12 months, how often did you drink between 1 and 4 drinks on one occasion?** *(Prompt if necessary – 1-4 cans of beer, 1-4 glasses wine, 1-4 shots brandy, etc.)*	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	About once a month	6
	611 times a year	7
	15 times a year	8
	Never during last year	9
	Don't know	77

QG05a	**During the past 12 months, have you had feelings of guilt or remorse after drinking?**	
	Yes	1
	No	2
	Refused	88
	Don't know	77

QG05b	**During the past 12 months, has a friend or family member ever told you about things you said or did while you were drinking that you could not remember?**	
	Yes	1
	No	2
	Refused	88
	Don't know	7 7

QG05c	**During the past 12 months, have you failed to do what was normally expected of you because of drinking?**	
	Yes	1
	No	2
	Refused	88
	Don't know	77

QG05d	During the past 12 months, do you sometimes take a drink in the morning when you first get up?	
	Yes	1
	No	2
	Refused	88
	Don't know	77

QG06	During the past 12 months, have you found that you need to drink much more than before to get the same effect or that drinking your usual amount began to have less effect on you?	
	Yes	1
	No	2
	Refused	88
	Don't know	77

Illness/Medical Patients ONLY
(If accident/injury, skip to Energy Drink Use questions - Section G.b)

QNG07	Have you decreased your drinking in the last month because of illness or a medical problem?	
	Yes	1
	No	2

G.b Energy Drink Use

Now I would like to ask you some questions about your typical patterns of energy drink use.

QNGE01	In the past 30 days, how often did you typically drink energy drinks?	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	Once a month	6
	None in the past month	7
	Don't know	77

If none, skip to Section G.c, Coffee/tea Use

QNGE02	When you drink energy drinks, how many drinks do you usually have on one occasion?	……. drinks

Now I want you to think of a **typical occasion** when you drink energy drinks and answer the following questions for me.

QNGE03	What type of energy drinks do you usually drink? ***This includes regular energy drinks, energy shots and premixed alcohol and energy drinks***						
Type	Use?	Brand/type of energy	TOTAL # drinks	TOTAL # drinks		Caffeine content	Caffeine content

		drink		mixed with alcohol		mg	total
Regular energy drink (small 250ml/8oz)	Y N DK R				X	~80mg	
Regular energy drink (medium 341ml/12oz)	Y N DK R				X	~115mg	
Regular energy drink (large 473ml)	Y N DK R				X	~160mg	
Regular energy shot	Y N DK R				X	~140mg	
Extra strength energy shot	Y N DK R				X	~200mg	
Premixed alcohol and energy drink (medium 341ml/12oz)	Y N DK R				X	~80mg	
Premixed alcohol and energy drink (large 473ml/16oz)	Y N DK R				X	~100mg	
						Total mg of caffeine consumed*	…….mg

*calculate the total amount of caffeine when coding the questionnaire

G.c Caffeinated Coffee and Tea Use

Now I am going to ask you some questions about your typical patterns of coffee use.

QNGE04	**In the past 30 days, how often did you typically drink caffeinated coffee or tea?**	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	Once a month	6
	None in the past month	7
	Don't know	77

If no, skip to Section G.d, Caffeinated Soda Use.

QNGE05	**When you drink caffeinated coffee or tea, how many drinks do you usually have on one occasion?**	…… drinks

Now I want you to think of a **typical occasion** when you drink coffee and answer the following questions for me.

QNGE06	**What caffeinated coffee or tea do you usually have to drink? *This includes regular caffeinated coffee, espresso drinks and tea alone and mixed with alcohol***

Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Regular coffee 354ml (341ml/12oz)	Y N DK R			X	~100mg	
Regular coffee 473ml (472ml/16oz)	Y N DK R			X	~140mg	
Regular coffee 591ml (568ml20oz)	Y N DK R			X	~200mg	
Regular coffee 709ml (681ml/24oz)	Y N DK R			X	~240mg	
Coffee Drinks (latte, cappuccino etc.) & Tea						
Espresso single shot (30ml/1oz)	Y N DK R			X	~75mg	
Espresso double shot (60ml/2oz)	Y N DK R			X	~150mg	
Espresso triple shot (90ml/3oz)	Y N DK R			X	~225mg	
Caffeinated tea (341ml/12oz)	Y N DK R			X	~70mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

G.d Caffeinated Soda Use

Now I am going to ask you some questions about your typical patterns of caffeinated soda use.

QNGE07	**In the past 30 days, how often did you typically drink caffeinated sodas?**	
	Every day	1
	Nearly every day	2
	3 or 4 times a week	3
	Once or twice a week	4
	2 or 3 times a month	5
	Once a month	6
	None in the past month	7
	Don't know	77

If no, skip to Section G.e, Drug Use.

QNGE08	**When you drink sodas, how many drinks do you usually have on one occasion?**	…… drinks

Now I want you to think of a **typical occasion** when you drink sodas and answer the following questions for me.

QNGE09	**What caffeinated sodas do you usually have to drink? *This includes caffeinated***

	sodas alone and mixed with alcohol					
Type	Use?	TOTAL # of drinks	TOTAL # of drinks mixed with alcohol		Caffeine content mg	Caffeine content total
Soda 250ml/8oz	Y N DK R			X	~25mg	
Soda 340ml/12oz	Y N DK R			X	~35mg	
Soda 473ml/16oz	Y N DK R			X	~48mg	
Soda 500ml/17.5oz	Y N DK R			X	~51mg	
Soda 1L/35oz	Y N DK R			X	~102mg	
Soda 2L/70oz	Y N DK R			X	~204mg	
					Total mg of caffeine consumed*	……mg

*calculate the total amount of caffeine when coding the questionnaire

G.e Drug Use

Now I am going to ask you some questions about your typical patterns of drug use. Remember that all your answers are confidential.

QNG09	**During the last 12 months did you use any of the following substances?**		
CATEGORY	Yes	No	Unsure
A. **Drugs that reduce anxiety or make you sleepy** (e.g., Sedatives, mild tranquilizers, GHB, Ketamine, Barbiturates, Librium or Valium)	**1**	**2**	**3**
B. **Drugs which make you more alert or give you energy** (e.g. Dexedrine, speed, ecstasy, powder cocaine, crystal meth, crack) **(if no skip to C)**	**1**	**2**	**3**
B.01 Dexedrine or speed	*1*	*2*	*3*
B.02 Ecstasy	*1*	*2*	*3*
B.03 Powder cocaine	*1*	*2*	*3*
B.04 Crystal meth	*1*	*2*	*3*
B.05 Crack cocaine	*1*	*2*	*3*
B.06 Other:	*1*	*2*	*3*
C. **Heroin**	**1**	**2**	**3**
D. **Other drugs used to relieve pain** (e.g., Oxycodone, codeine, morphine, Dilaudid, opium, Demerol, fentanyl)	**1**	**2**	**3**
E. **Drugs that cause visual hallucinations** (e.g., psilocybin mushrooms, LSD, mescaline, PCP, angel's dust)	**1**	**2**	**3**
F. **Methadone**	**1**	**2**	**3**
G. **Marijuana, hash, THC**	**1**	**2**	**3**
H. **Any other drugs prescribed for a physical illness?**	**1**	**2**	**3**
I. **Any other drugs?** **Specify:**	**1**	**2**	**3**

_____			

Illness/Medical Patients ONLY
(If accident/injury, skip to next Section HA - Dispositional Characteristics)

QNG10	Have you decreased your drug use in the last month because of illness or a medical problem?	
	Yes	1
	No	2

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SECTION HA: DISPOSITIONAL CHARACTERISTICS

QHA1. Next we would like to ask you some questions about how well each of the following statements describes you.

START BY READING ITEM HA1.1 followed by "WOULD YOU SAY THIS DESCRIBES YOU QUITE A LOT, SOME, A LITTLE OR NOT AT ALL?" Repeat for all remaining questions

Would you say that this describes you [Symbol]	Quite a Lot	Some	A Little	Not at All
HA1.1. I often act on the spur-of-the-moment without stopping to think.	1	2	3	4
HA1.2. I get a real kick out of doing things that are a little dangerous.	1	2	3	4
HA1.3. I like to test myself every now and then by doing something a little chancy.	1	2	3	4
HA1.4. I'm always up for a new experience.	1	2	3	4
HA1.5. I like to try new things just for the excitement.	1	2	3	4
HA1.6. I go for the thrills in life when I get a chance.	1	2	3	4
HA1.7. I like to experience new and different sensations.	1	2	3	4
HA1.8. You might say I act impulsively.	1	2	3	4
HA1.9. Many of my actions seem to be hasty.	1	2	3	4
HA1.10. I don't let the risk of getting hurt a little stop me from having a good time.	1	2	3	4

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SECTION I: BACKGROUND INFORMATION

QG07	In the past 12 months, have you needed to go to an emergency department for an injury or accident? *(Not counting this time)*	
	Yes	1
	No *(skip to QG08a)*	2
	Don't know *(skip to QG08a)*	77

QG08	How many times have you been seen in an emergency department for an injury in the last year? *(Not counting this time)*		
	Number of emergency department visits		

QG08a	Have you ever been told by a doctor or other health professional that you had a serious health condition such as hypertension, a heart or coronary problem, diabetes, stroke, cancer, or any other serious health condition?	
	Yes	1
	No *(skip to QI01)*	2
	Refused *(skip to QI01)*	88
	Don't know *(skip to QI01)*	77

QG08b	At what age were you first told?	
	Age	
	Refused	888
	Don't know	777

QI01	What is your ethnicity? [CHECK ALL THAT APPLY]	
	Caucasian	1
	Chinese	2
	South Asian (e.g. East Indian, Pakistani, Sri Lankan)	3
	Black (e.g. African, Jamaican or Caribbean)	4
	Filipino	5
	Latin American	6
	Southeast Asian (e.g. Cambodian, Indonesian, Laotian, Vietnamese, etc)	7
	Arab (e.g. Arabic speaking, Maghrebi)	8
	West Asian (e.g. Afghan, Iranian, Israeli, Turk)	9
	Japanese	10
	Korean	11
	Aboriginal (North American Indian, Metis, Inuit)	12
	Other (specify):_____	13
	Refused	88
	Don't know	77

QI02	What is the highest level of education you have completed? *(check ONE box only)*	
	No schooling	1
	Some elementary schooling	2
	Completed elementary school	3
	Some high school	4
	Completed high school	5
	Some community college	6
	Completed community college	7
	Some technical school (college classique CEGEP)	8
	Completed technical school (college classique CEGEP)	9
	Some university	10
	Completed Bachelor's Degree	11

	Post graduate training: MA, MSc., MSW	12
	Post graduate training: PhD, “Doctorate”	13
	Professional degree (Law, Medicine, Dentistry)	14
	Refused	88
	Don’t know	77

QI03	**How would you describe your employment status? *(check one box only)***	
	Full time paid work (including any paid leave, e.g., vacation, pregnancy, illness)	1
	Part time paid work	2
	Sick leave, maternity leave, strike etc. (not paid by the employer)	3
	Unemployed	4
	Retired	5
	Homemaker	6
	Self-employed	7
	Disability	8
	Seasonal worker / Season lay-off	9
	Other (Specify _____)	10
	Refused	88
	Don’t know	77

QI03a	**What is your current marital status? (Check ONE box only)**	
	Married	1
	Living common-law (living with partner)	2
	Widowed	3
	Separated	4
	Divorced	5
	Single, never married	6
	Refused	88
	Don’t know	77

QI05	**Could you please tell me your approximate net (take home) personal monthly income?** (after tax)					

QI07	**Which city do you currently live in?**	

QI07b	**What are the first 3 numbers and letters of your Postal Code?**			

Page Break

QI08. That is my last question. Thank you very much for helping us with this study. Do you have any comments you would like to make?

_____

_____

INTERVIEWER: Please rate the quality of this interview in terms of the interviewee's responses:

- High(cooperative and forthcoming)
- Medium(some reluctance to answer a few questions)
- Low(some answers may be unreliable)
- Very Low(many answers may be unreliable)

Interviewer's comments:

_____

_____

_____

_____

SECTION K: TERMINATION OF INTERVIEW

QK01	**Time interview ended** *(use 24 hour clock* – hh:mm*)*	*h*	*h*	*m*	*m*

QK02	**Total interview length** *(in minutes)*			

Screening Reference Sheet

ACCIDENT/INJURY/POISONING	MEDICAL CONDITION/ ILLINESS
Cut, scrape, or puncture wound	Heart condition (congestive heart failure, heart attack, chest pain)
Bruise	Shortness of breath
Fracture/dislocation	Other respiratory condition (cold, cough, flu, asthma)
Sprain/strain	Liver condition (cirrhosis, ascites, hepatitis, jaundice)
Burn	Pancreatic condition
Near drowning	Ulcers
Head injury	Other stomach condition (stomach pain or stomach Ache not caused by overeating)
Internal injury	Vitamin deficiency
Ingestion other than alcohol or drugs (Drano/lye, poison, etc.)	Anemia
Bite or sting (by insect or animal)	Alcohol withdrawal or alcohol related seizures
Human bite	Alcohol intoxication/overdose
Other injury	Drug intoxication/overdose
	Other medical condition/illness

*12oz/341ml Bottle or can of 5% beer *2x12oz/341ml bottles or cans of 2.5% beer *2/3 of a 12oz/341ml bottle of	*5oz/142ml glass of 12% wine *2oz/57ml of 18% sherry	1.5oz/42 ml Shot of 40% spirits	12oz/341ml bottle of 6% cider or cooler