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# The Co-ingestion of Caffeine and Alcohol: Influences and Experiences- A Qualitative Study

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## ABSTRACT

**Background:** Caffeine is a mild psychoactive drug consumed daily by 80 % of people worldwide and 71-96 % of New Zealanders. Caffeine may be consumed in conjunction with alcohol. All beverages containing caffeine and alcohol, whether premixed or self-made, have different concentrations of caffeine and alcohol, hence the ratio is an important factor to consider as different ratios may impact an individual's experience. Neurologically, caffeine is classified as a stimulant and alcohol as a depressant. When these substances are mixed together, caffeine's stimulant effects masks alcohol's sedation effects, resulting in the individual feeling less drunk. A caffeine consumption and habits questionnaire (CaffCo) has previously been developed to determine caffeine consumption in New Zealand. At present, it is unclear if CaffCo is suitable in assessing the co-ingestion of caffeine and alcohol. Currently there are significant gaps in understanding the patterns, habits and reasons for caffeine and alcohol co-ingestion (CAC).

**Aim:** To gain an insight into caffeine and alcohol co-ingestion in New Zealand (NZ) and the potential modification of CaffCo to accurately evaluate CAC intake patterns, habits and influences on consumption and both positive and negative experiences across a range of beverage mixtures in NZ adults aged 18 years and older.

**Methods:** A total of five focus groups were conducted. The focus group discussions were audio-recorded and facilitated by a moderator guide. The guide included seven topics (initial thoughts, product use, functional expectations, the context of use, product experiences, product perceptions and health perceptions). Data was transcribed and thematically analysed to identify the main themes derived from the discussions. This data was then manually compared to CaffCo to check CaffCo's suitability in assessing the co-ingestion of caffeine and alcohol in New Zealand.

**Results:** After conducting the focus groups, five main themes were identified. Firstly, the consumption of caffeine and alcohol were associated with having fun, although caution was highlighted around the potential for abuse (theme one). Taste, cost, alcohol percentage and setting were important factors in deciding whether to co-ingest caffeine and alcohol (theme two). Participants indicated that bright colours and

lettering attracted them to beverages containing caffeine and alcohol (theme three). However, one participant observed that the advertisement of co-ingestion was embedded into our general culture. Participants found that co-ingestion caused the amplification of their emotions, regardless of the type of emotion (positive or negative) (theme four). The final theme highlighted the initial and delayed effects of co-ingesting significant amounts of these beverages. Initial effects included behavioural changes and/or loss of coordination, resulting in injuries as a direct outcome, whereas delayed effects included insomnia, agitation and grogginess. Comparing these themes to questions currently present in CaffCo, it was determined that it is important to provide a definition of what “beverages containing caffeine and alcohol” are before commencing data collection. CaffCo is currently able to obtain quantitative data on co-ingestion however; it is unable to effectively assess qualitative aspects of CAC, specifically around people’s personal experiences pre- and post-consumption. Several sample definitions and questions have been developed and piloted to amend CaffCo’s suitability.

**Conclusion:** Co-ingestion is predominantly carried out by participants to experience the alcoholic effects of the beverage. The alcohol percentage is one of the main factors taken into consideration before consumption. Both initial and delayed effects of co-ingestion mimic the hangover effects of over-ingesting alcohol, leading to the conclusion that alcohol percentage is of higher importance to the public. CaffCo requires minor modifications to properly assess co-ingestion in New Zealand. More observational data is needed to observe people’s natural patterns of co-ingesting caffeine and alcohol. Additionally, our data suggests that the development of informative tools may be useful to explain the caution around the abuse of co-ingestion.

*Key words: Caffeine, Alcohol, Co-ingestion, New Zealand, CaffCo.*

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## LIST OF ABBREVIATIONS

<b>ADORA</b>	Adenosine receptor
<b>ADORA2A</b>	Adenosine 2a receptor gene
<b>CAC</b>	Caffeine and alcohol co-ingestion
<b>CaffCo</b>	Caffeine consumption habits questionnaire
<b>cAMP</b>	Cyclic adenosine monophosphate
<b>CYP1A2</b>	Cytochrome P450 1A2
<b>NAD</b>	Nicotinamide adenine dinucleotide
<b>NADH</b>	Reduced nicotinamide adenine dinucleotide
<b>NZ</b>	New Zealand
<b>SNP</b>	Single nucleotide polymorphism
<b>US</b>	United States of America

## CHAPTER 1- INTRODUCTION

### 1.1 BACKGROUND

Caffeine is one of the world's most commonly used drugs (Oliveto et al., 1992), with approximately 80% of people worldwide consuming caffeine on a regular basis (Alsene et al., 2003, Yang et al., 2010). In New Zealand (NZ), caffeine consumption is predicted to occur in 71-96% of people daily (Thomson et al., 2014). Caffeine levels are highest in beverages such as coffee (33.2 mg per 100 mL), kola (11 mg per 100 mL), and energy drinks (31.2 mg per 100 mL) (Bunker and McWilliams, 1979) and are most commonly consumed from these sources. Although caffeine is also present in foods such as chocolate (20 mg per g) (Bunker and McWilliams, 1979), the total amount per gram consumed is considerably lower when compared to caffeinated beverages. Individuals may consume additional caffeine from other sources such as pain relief (aspirin) or cold medications (ranging from 50-200 mg) (Lee et al., 2013). It is of concern that the public may consume these products without realising caffeine is present (Curhan et al., 1998, Yang et al., 2010).

When ingested, caffeine has various physiological effects: firstly caffeine directly impacts the central nervous system (CNS) by stimulating the sympathetic nervous division (Evans and Griffiths, 1992, Heckman et al., 2010); increasing heart rate, blood pressure and respiration rate (Childs and de Wit, 2006); caffeine also provides a feeling of alertness, energy and cheerfulness (Childs and de Wit, 2006); and can affect cognitive functions such as mood and performance (Ammon, 1991). Caffeine consumption can impact individuals differently, with factors such as dosage, genetics and gender influencing the overall effect (Beaumont et al., 2017). The same dose of caffeine can impact each person differently due to their tolerance levels and physiological adaptation (Beaumont et al., 2017). In some individuals, caffeine can cause long-term effects such as insomnia, restlessness and nervousness (Lorist and Tops, 2003). The genotype of an individual has been shown to impact the metabolism of caffeine. Caffeine blocks the adenosine receptor (ADORA) as it is able to pass the blood-brain barrier (Alsene et al., 2003) and causes competition between the binding of adenosine molecules and caffeine molecules (Alsene et al., 2003).

Caffeine overuse has been linked to an increased risk of seizures, heart palpitations and tachycardia (Heckman et al., 2010). Due to its vasodilatory effects, it is advised

that caffeine consumption is restricted in those with a heart condition, as it can contribute to arrhythmias (Heckman et al., 2010). However, there have been conflicting results from research conducted on the effects of caffeine on cardiovascular diseases (Heckman et al., 2010), with some studies suggesting potentially beneficial effects. Other studies, (Whitsett et al., 1984) found no effect of caffeine consumption (single dose of 2.2mg per kg, equivalent to two cups of coffee) on cardiovascular responses in a 24-hour time period. Further research is needed to conclude the impact of caffeine on the cardiovascular system and if these effects are positive, negative or neutral (Winkelmayer et al., 2005).

Caffeine is commonly consumed in conjunction with other substances (Gray, 1998), such as milk, water or, of particular concern to our research, alcohol. Alcohol is processed in the body, primarily in the liver and provides a negative stimulus on the CNS (Cederbaum, 2012). Alcohol has short- and long-term effects such as dehydration, impaired judgment and an increased risk of liver disease (Cederbaum, 2012). Alcohol consumption is associated with addiction, dependency and withdrawal effects (Cederbaum, 2012). New Zealand has a high binge drinking culture, recent data shows four out of five adults consume alcohol of whom half drink hazardously (Alcohol Agency, 2018).

Co-ingestion of caffeine with alcohol is mainly, but not limited to energy or kola drinks (as the caffeine source) mixed with spirits such as vodka (Marczinski et al., 2011). When ingested separately, caffeine and alcohol elicit effects that are directly opposite on the CNS, as caffeine is classified as a stimulant and alcohol a depressant (Gray, 1998). However, the net effects of co-ingesting caffeine and alcohol are poorly understood and under-researched. With the co-ingestion of caffeine and alcohol, the depressant effects of alcohol are thought to be diminished by the presence of caffeine (Gray, 1998). This results in a feeling of being less drunk, which may lead an individual to underestimate their level of intoxication and potentially continue drinking (Pennay et al., 2015), thus leading to an increase in the amount of both caffeine and alcohol consumed.

The ratio of caffeine and alcohol consumed in a beverage is important to take into consideration when assessing co-ingestion as different ratios can impact an

individual's experience (Childs and de Wit, 2006). In addition, different people may have different experiences despite consuming the same drink and relative doses of caffeine and alcohol (Childs and de Wit, 2006). A proposed theory of "wide-awake drunkenness" explains that following co-ingestion of alcohol and energy drinks, the consumer experiences an increase in stimulation and reduction in sedation (Pennay et al., 2015). A randomised controlled, double-blinded study involving 15 adults demonstrated that people consuming a mix of caffeine and alcohol had a higher risk of injury, drink driving and other substance use (Liguori and Robinson, 2001).

Caffeine and alcohol co-ingestion is under-researched resulting in a limited understanding in this field. There are significant gaps in the literature in areas such as chronic consumption, dependency and overdose and there is little to no research on the effects of co-ingesting caffeine and alcohol. Therefore, we are currently unable to comment on the potential physiological, emotional and social effects of co-ingesting caffeine and alcohol. There is the potential for detrimental effects on the public due to the co-ingestion of caffeine and alcohol, but until this area is more thoroughly researched, no conclusions can be drawn.

## 1.2 STUDY JUSTIFICATION

Caffeine and alcohol are both commonly consumed by New Zealanders. However, there are significant gaps in the current literature around the levels of co-ingestion of these substances. The goal of this project was to obtain a deeper understanding of caffeine and alcohol co-ingestion influences, experiences and patterns of co-ingestion in New Zealand by undertaking several focus groups in a qualitative enquiry. This will help determine the relationship, understanding and concerns around the co-ingestion of caffeine and alcohol. More information will help inform the potential alterations needed to CaffCo to assess co-ingestion adequately or subsequently highlight that there is a need to develop a new tool. Such a tool can be used to gather further information on the co-ingestion of caffeine and alcohol among a large and representative sample of New Zealanders. This information is needed to undertake further research to understand the potential health and behavioural effects of co-ingestion of caffeine and alcohol. On a national scale, such findings may inform policy and practice related to co-ingestion and recommendations for future product labelling.

To this end, this study will focus on New Zealanders aged 18 years and older who are fluent in English.

### 1.3 AIMS AND OBJECTIVES

#### 1.3.1 AIMS

To gain an insight into caffeine and alcohol co-ingestion (CAC) in New Zealand and the potential modification of CaffCo to accurately evaluate CAC intake patterns, habits and influences on consumption and both positive and negative experiences across a range of beverage mixtures in New Zealand adults aged 18 years and older.

#### 1.3.2 OBJECTIVES

- To explore initial data on intake patterns, influences of consumption and experiences across a range of caffeine and alcohol-containing products among focus group participants based in Auckland, New Zealand.
- To conduct focus groups on New Zealand adults to understand caffeine and alcohol consumption, factors influencing consumption and caffeine and alcohol co-ingestion related physiological and emotional experiences.
- To assess CaffCo's suitability in assessing caffeine and alcohol co-ingestion, to then make alterations as appropriate or alternatively recommendations for a new questionnaire if needed.

### 1.4 STRUCTURE OF THE THESIS

This thesis is comprised of four main chapters and crucial appendices. Chapter 1 provides a brief introduction to this study, outlining the study's purpose, aims and objectives. Chapter 2 consists of a review of the current literature on caffeine, alcohol and co-ingestion. Chapter 3 is a complete primary research manuscript prepared for the journal "Appetite". The final chapter (Chapter 4) summarises the key findings from the study, its limitations along with recommendations for future research. A series of appendices are present, which contains supporting materials such as ethics approval, participant information, screening and consent forms. Additionally, included are the moderator guide and its' justification.

It is important to note, the last study objective regarding CaffCo's suitability in assessing the co-ingestion of caffeine and alcohol does not fit fluently within the scope of the manuscript hence this objective will be addressed in appendices I-L.

## 1.5 RESEARCHER CONTRIBUTIONS

<b>Researchers</b>	<b>Qualifications</b>	<b>Contribution</b>
<b>Associate Professor Kay Rutherford-Markwick</b>	Associate Professor in Pathophysiology, Massey University.	Primary supervisor to provide supervision for the study design, ethics application, conduct of the research, the write-up of all chapters and manuscript preparation for this thesis.
<b>Schynell Coutinho</b>	Current Masters student of Nutrition and Dietetics.	Research proposal, ethics application, literature review, recruitment of participants, data collection, running focus groups, data entry/cleaning and analysis, formulation of results and associated discussion, preparation of thesis and manuscript.
<b>Associate Professor Ajmol Ali</b>	Associate Professor Sports Nutrition, Massey University.	Provide supervision for the study design, ethics application, conduct of the research, write-up of all chapters and manuscript preparation for this thesis.
<b>Professor Carol Wham</b>	New Zealand Registered Dietitian and Professor, Massey University.	Provide supervision for the study design, ethics application, conduct of the research, the write-up of all chapters and manuscript preparation for this thesis.

## **CHAPTER 2- LITERATURE REVIEW**

### **2.1 BACKGROUND**

Caffeine is the most commonly consumed psychoactive drug worldwide (Josse et al., 2012). Globally, approximately 90% of adults consume caffeine daily, including at least 71-93 % of New Zealanders (Josse et al., 2012, Thombs et al., 2011). Alcohol is also a commonly consumed psychoactive drug, with four out of five New Zealand adults having consumed it in 2018 (Alcohol Agency, 2018). Alcohol is found in beverages fermented by yeast; it is classified as a sedative-hypnotic drug (Alcohol Agency, 2018). Alcohol is commonly consumed to cope with stress or enhance sociability (Abbey et al., 1993).

This chapter will explore caffeine sources, as well as the physiological effects, tolerance and adaptation resulting from caffeine consumption. In conjunction, it will focus on the co-ingestion of caffeine and alcohol containing-beverages and current research available, highlighting the gaps currently present in the literature.

### **2.2 CAFFEINE SOURCES**

#### **2.2.1 BEVERAGES & DIETARY SOURCES**

Although the word “caffeine” has a strong association with the word “coffee”, caffeine is found in a number of different sources in our diet, which often is not realised by the consumer (Childs and de Wit, 2006). There is high variability in the caffeine content between and within different beverages due to different processing methods, preparation methods and plant growing conditions (Bunker and McWilliams, 1979). Table 2.1 displays several products containing caffeine and their caffeine content per portion.

Table 2.1: Caffeine content of foods and beverages in New Zealand

<b>Product Type</b>	<b>Portion size</b>	<b>Caffeine content (mg)*</b>
<b>Coffee<sup>1</sup></b>		
-Instant coffee powder	1 tsp	~83
-Decaffeinated instant coffee powder	1 tsp	~1.9
-Plunger/ drip coffee	Single shot	~120
-Espresso	Double shot	~210
<b>Tea<sup>1</sup></b>		
-Black tea	250 mL made with 1 teabag	~57
-Green tea	250 mL made with 1 teabag	~31
-Decaffeinated black tea	250 mL made with 1 teabag	~4.7
<b>Hot chocolate</b>		
<b>Chocolate<sup>1</sup></b>		
-Milk chocolate	100 g	~20
-Dark chocolate	100 g	~60
-Cocoa powder	1 tsp	~2
<b>Kola drinks<sup>1</sup></b>		
-Regular kola	100 mL	~11
-Diet kola (diet, zero, max, etc.)	100 mL	~14
<b>Energy drinks<sup>2</sup></b>	100 mL	~31.2
<b>Energy shots<sup>2</sup></b>	60 mL	~162.6
<b>Caffeinated RTDs<sup>2,3</sup></b>	100 mL	~14.4
<b>Pre-workout<sup>4</sup></b>	100 g	~2110
<b>Sports gel<sup>2</sup></b>	100 g	~77.7
<b>Caffeine Tablets<sup>3</sup></b>	1 tablet	~50-200

1 The New Zealand Institute for Plant and Food Research Limited and New Zealand Ministry of Health (2015)

2 Thomson and Jones (2013)

3 Beer Wine and Spirits Producers (2015)

4 Supplements.co.nz (average content of 15 common products available)

\*Estimated caffeine content (This varies according to preparation and brand of product)

RTDs= ready to drink alcoholic pre-mixed drinks

Tsp= teaspoon

Table adapted from Stachyshyn (2017)

People frequently tend to consume more than one cup of coffee per day, which means their average coffee intake is higher than 83 mg per day (Rowe, 2015). When comparing coffee products, espresso double shots have the highest quantity of caffeine (210 mg), due to the concentration being more than double the amount of a standard single shot (Weinberg and Bealer, 2004).

In contrast, approximately 138 g of dark chocolate or 415 mg of milk chocolate must be consumed to achieve the same level of caffeine ingestion as a standard cup of coffee (83 mg) (The New Zealand Institute for Plant and Food Research Limited and

New Zealand Ministry of Health, 2015). Consuming 138 g of dark chocolate is an unusually high amount of chocolate to consume per day, however it is common for people to drink at least one cup of coffee, which illustrates how coffee may be a more common and highly contributing caffeine source.

Tea has a significantly lower caffeine content than coffee (57 mg and 83 mg, respectively) also deeming itself as a non-major source of caffeine unless drunk in high amounts. The caffeine content in tea is directly associated to the origin of the plant leaves, growth and processing conditions (Komes et al., 2009). In addition, kola has a comparatively low caffeine content (27.5 mg per 250 mL).

## 2.2.2 PHARMACEUTICAL & OTHER CAFFEINE SOURCES

Caffeine can be 'hidden' in several non-dietary sources such as cold medications and pain relievers (Lee et al., 2013). This is due to individuals not realising the drug is present in their medication. The addition of caffeine to medications increases the effectiveness, allowing a lower dose of medication to be administered (Lee et al., 2013).

Caffeine tablets have a high concentration of caffeine (50-200 mg) compared to caffeine-containing beverages (Lee et al., 2013). They are readily available from supermarkets and pharmacies without a prescription. They are used to reduce mental fatigue and drowsiness (Lee et al., 2013). Due to their high concentration of caffeine and unknown patterns of consumption by the public, this is an area that is under-researched in terms of the potential risk of overconsumption.

## 2.3 PHYSIOLOGICAL EFFECTS OF CAFFEINE

### 2.3.1 ABSORPTION AND DISTRIBUTION

Caffeine absorption occurs primarily in the stomach and small intestine (Marks and Kelly, 1973). Caffeine is released into the bloodstream and reaches approximately 100 % bioavailability post-ingestion (Blanchard and Sawers, 1983a, Blanchard and Sawers, 1983b, Bonati et al., 1982, Marks and Kelly, 1973). Caffeine concentration peaks in the bloodstream approximately 120 minutes post-ingestion (Callahan et al., 1982, Fredholm et al., 1999), and is distributed around the body according to the water content of body tissues (Axelrod and Reichenthal, 1953). This means the distribution

of caffeine around the body is varied and higher amounts are found in organs with higher water content such as the brain and muscles (Mentzakis et al., 2013).

### 2.3.2 METABOLISM, ELIMINATION AND GENETICS

Caffeine is primarily metabolised by the cytochrome p450 1A2 (CYP1A2) enzyme (Josse et al., 2012). A single nucleotide polymorphism (SNP) can alter the activity of the CYP1A2 enzyme, as the wild type A allele is highly active (Josse et al., 2012). Homozygosity for the wild type A allele results in individuals being “fast” caffeine-metabolisers (Cornelis et al., 2006, Dobrinas et al., 2012, Sachse et al., 1999). The variant C allele causes lower activity. It is unknown if heterozygotes A/C and homozygotes for C/C alleles should be considered “intermediate” and “slow” caffeine metabolisers respectively, or if both should be considered as “slow” (Cornelis et al., 2006, Dobrinas et al., 2012, Sachse et al., 1999). This highlights the potential impact of genetics on an individual’s rate of metabolism, clearance and elimination of caffeine (Grant et al., 1983).

CYP1A2 is an important hepatic enzyme. Hepatic metabolism of caffeine is slower among people who commonly suffer from sleep disturbances after consuming caffeine when compared to those who do not (Levy and Zylber-Katz, 1983). This can be due to an inherent capacity or an inductive effect of caffeine on the hepatic enzymes (aspartate aminotransferase, alanine aminotransferase, gamma-glutamyl transferase and alkaline phosphatase) (Levy and Zylber-Katz, 1983). Genetic factors are also present in addition to other potential attributing factors, such as caffeine dose and habitual consumption. A SNP on the adenosine 2a receptor gene (ADORA2A) is associated with anxiety and disturbances during sleep, post-caffeine consumption (Alsene et al., 2003). The cardiovascular effects of caffeine have no association with this SNP (Alsene et al., 2003).

The main metabolite of caffeine is paraxanthine (Biaggioni et al., 1991). The average adult eliminates less than 2 % of caffeine molecules via their urine, the rest is metabolised into demethylated xanthines and urates (Aldridge et al., 1979). These molecules induce the cardiovascular effects of caffeine. P-450 dependent activities vary between Oriental and Caucasian groups (Grant et al., 1983), however xanthine oxidase activity does not vary between individuals or ethnicity (Grant et al., 1983).

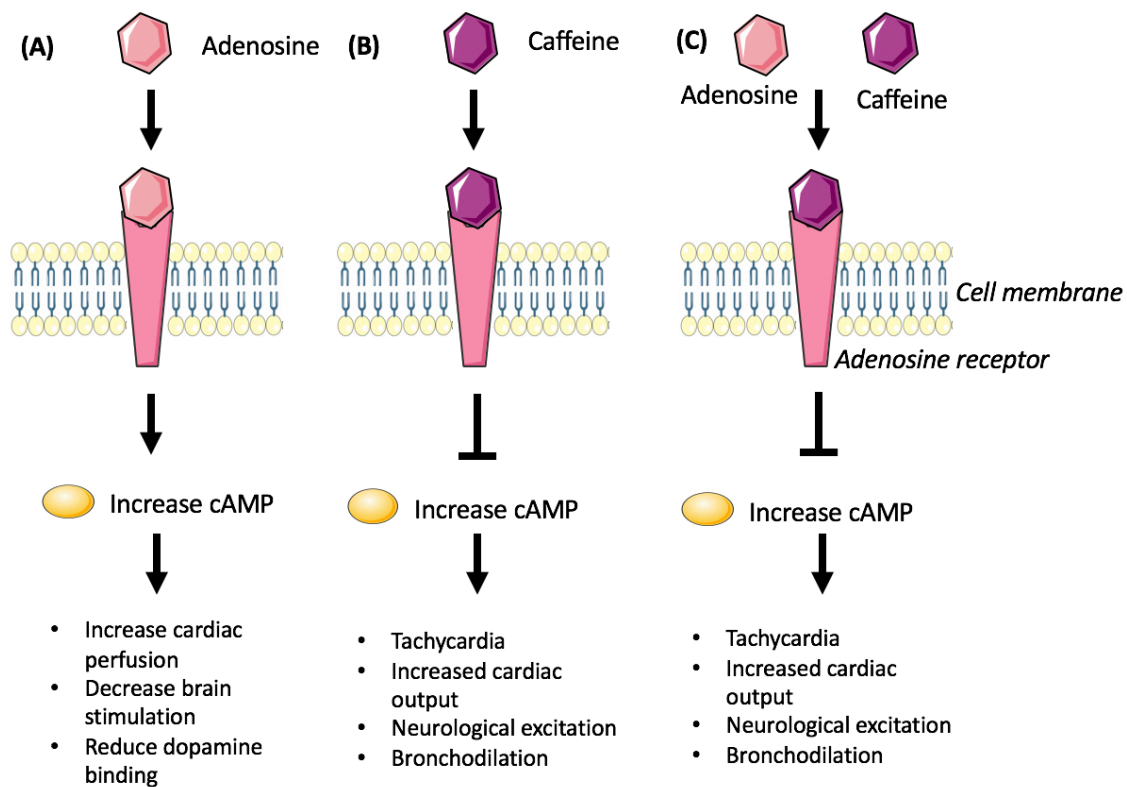
### 2.3.3 ADENOSINE ANTAGONIST

Chemically, caffeine is structured as 1,3,7-trimethylxanthine (Fredholm, 1985). Caffeine is an example of an adenosine antagonist; molecules that compete with adenosine to bind to its receptor (adenosine receptor) (Biaggioni et al., 1991).

The adenosine receptor allows binding to the cell membrane and directly impacts cAMP (cyclic adenosine monophosphate) which is a secondary messenger in biological processes (Ribeiro and Sebastiao, 2010). Caffeine is an adenosine antagonist and therefore when it binds to the adenosine receptor it elicits the opposite effects to adenosine (Ribeiro and Sebastiao, 2010). Caffeine binding affects several brain functions such as sleep, cognition, learning, and memory (Biaggioni et al., 1991). Caffeine antagonism of the adenosine receptor can have implications for neurological diseases such as Alzheimer's, Parkinson's, depression and schizophrenia (Ribeiro and Sebastiao, 2010). Targeting the adenosine receptor pathway via caffeine could theoretically enhance potential brain dysfunctions for people with these diseases (Ribeiro and Sebastiao, 2010).

Figure 2.1A (Part A) shows the effects of adenosine binding to the adenosine receptor. When bound, cAMP activity is increased causing increased cardiac perfusion, decreased brain stimulation and reduced dopamine binding. The caffeine molecule can also bind to the adenosine receptor (Fig 1B), with opposite effects to adenosine, as cAMP activity is decreased. Figure 2.1C indicates the antagonistic effects of caffeine and adenosine where caffeine binds to the receptor over adenosine and thus influences the receptor and cAMP accordingly.

Figure 2.1. Competitive binding of caffeine and adenosine molecules\*



\* (Ammon, 1991, Greenberg et al, 2008).

## 2.4 ALTERNATIVE EFFECTS OF CAFFEINE

### 2.4.1 SLEEP AND FATIGUE

Restful sleep is important for general health and wellbeing (Clark and Landolt, 2017, Shilo et al., 2002). Caffeine is often used to reduce feelings of sleepiness at differing times of the day. After consuming caffeine, people feel more “awake”. Caffeine prolongs sleep latency, reduces total sleep time and sleep efficiency (Clark and Landolt, 2017) which worsens perceived ‘sleep quality’ (Clark and Landolt, 2017), this has been termed as “coffee wakefulness”. Those who report “coffee wakefulness” have been shown to consume less coffee than those who did not experience coffee wakefulness (Levy and Zylber-Katz, 1983). When caffeine is consumed, the lightest stage of non-REM sleep and arousals were shown to increase (Clark and Landolt, 2017). Age and tolerance may also be factors that affect caffeine intake and sleep as caffeine affects the prefrontal cortex to a greater extent in older people (Clark and Landolt, 2017). This means that older adults may find it more difficult to sleep after drinking caffeinated beverages when compared to younger adults (Clark and Landolt, 2017). A study focusing on the habitual use of caffeine found that 600 mg, approximately 7 cups of coffee per day, was not associated with decreased duration

of sleep (Sanchez-Ortuno et al., 2005). This suggests there is a definite link between reduced sleep/quality of sleep and the ingestion of caffeine. In addition, moderate doses of caffeine reduce the reaction time on performance tasks, improve subjective alertness, and diminish self-reported fatigue and sleepiness (Sanchez-Ortuno et al., 2005). This can be attributed either to caffeine ingestion or self-perception of fatigue levels.

#### 2.4.2 ANXIETY

Caffeine ingestion causes mild psychoactive effects by impacting the adenosine A1 and A2a receptors. More specifically, caffeine increases anxiety in people who are not habitual consumers (Rogers et al., 2013). This may cause individuals who do not usually drink caffeine to avoid caffeine containing products. In general, higher doses of caffeine have been shown to elicit a higher anxiety response (Childs, 2008). The reason behind the association between ADORA2A polymorphism and self-reported anxiety at moderate caffeine doses is unknown (Childs, 2008).

Increased periods of work stress have been shown to increase caffeine consumption (Malone et al., 2014). Caffeine influences the neuroendocrine system, which is associated with the psychophysiological stress response (Malone et al., 2014). This implies that there is a direct relationship between stress levels and caffeine intake (Malone et al., 2014). In contrast, a double-blind study focused on anxiety and depression involving 157 participants administered two doses of three differing caffeine concentrations (0 mg, 150 mg and 300 mg) per 45.3 kg of body weight (controlling for caffeine tolerance) (Veleber and Templer, 1984). This study found caffeine increases anxiety, depression and hostility (Veleber and Templer, 1984). These two studies provide contrasting results as it is unclear why stress levels increase caffeine intake, if caffeine intake, in turn, can increase stress levels.

#### 2.4.3 CARDIOVASCULAR IMPACTS OF CO-INGESTION

Caffeine has potential protective effects on the heart at low doses (Noordzij et al., 2005). It is hypothesised that caffeine consumption increases blood hormone levels (epinephrine) and subsequently blood pressure, resulting in caffeine having a vasodilatory effect (Ammon, 1991). Since caffeine consumption increases blood pressure, this results in an increase in overall systolic and diastolic blood pressure

between 5 to 15 mmHg respectively (Ammon, 1991), which in turn, directly increases heart rate (Ammon, 1991). In conjunction, The Framingham Heart Study population concluded that caffeine consumption was associated with a 43% decreased risk of cardiac heart disease mortality as well as a decreased risk of heart valve disease development (Greenberg et al., 2008).

Studies show that medications containing caffeine (<35 mg per day and >35 mg per day) are associated with an increased risk of haemorrhagic stroke (Lee et al., 2013) due to increased caffeine in blood plasma causing an increase in blood pressure (Lee et al., 2013).

## 2.5 CAFFEINE TOLERANCE/ ADAPTATION

Habitual caffeine consumption can lead to the development of caffeine tolerance (Yang et al., 2010). This means that over time, a larger amount of caffeine must be consumed to achieve similar outcomes, due to the upregulation of ADORA receptors. An upregulation of ADORA means that a higher dose of caffeine molecules must be present in order to block the same proportion of adenosine receptors (Beaumont et al., 2017). The upregulation of A1 receptors results in increased binding of adenosine, making caffeine seem less effective, however, this can be overcome by consuming higher doses of caffeine (Beaumont et al., 2017).

Caffeine tolerance and adaptation is dependent on factors such as caffeine dosage, environment, time and genetics (Chait, 1992). These factors can either increase or decrease tolerance, respectively (Chait, 1992).

When caffeine consumption is discontinued, withdrawal effects are frequently observed. This can vary from a headache to lethargy (Kalmar and Cafarelli, 1999). Some individuals never experience drinking caffeine out of habit (caffeine habituation) or caffeine withdrawal effects (Kalmar and Cafarelli, 1999). Therefore, further research on stopping habituation and managing withdrawal effects would be beneficial.

## 2.6 CAFFEINE AND ALCOHOL CO-INGESTION

### 2.6.1 DIFFERENT TYPES OF MIXES

There are several different types of beverages containing both caffeine and alcohol. Firstly, drinks made by the addition of a caffeine-containing liquid and alcohol-containing liquid: these are known as caffeinated alcohol drinks, alcoholic caffeinated beverages or cocktails (Marczinski and Fillmore, 2006). It is difficult to monitor the concentration of caffeine and alcohol of these beverages as each individual makes their drink differently and often does not measure the ratio. In bars and other venues where these beverages are served, they are loosely measured and are often made with a lower alcohol to caffeine ratio than when made in a non-commercial environment (Marczinski and Fillmore, 2006). Table 2.2 outlines several different sources of beverages containing caffeine and alcohol.

The next category of beverages containing caffeine and alcohol are drinks that are purchased already containing both of these substances e.g. ready to drink alcoholic pre-mixed drinks (RTDs), cocktails and coffee liquors (Thombs et al., 2011). RTDs and coffee liquors are generally easier to measure the alcohol and caffeine content of as the packaging theoretically states the amount of each of these substances. They are easier to keep track of in regard to “amount consumed” when compared to mixing two substances together. They may also be more commonly consumed due to convenience, size and availability (Thombs et al., 2011).

Lastly, people may co-ingest caffeine and alcohol by consuming them from separate sources at the same time e.g. eating chocolate and drinking rum. It is extremely difficult to measure the overall caffeine and alcohol content ingested under such circumstances and for the purposes of our research, such ingestion, particularly of caffeine is likely to be low.

Table 2.2: Commonly known/consumed beverages containing both caffeine and alcohol

<b>Beverage types<sup>1</sup>:</b>	
<b>Caffeinated alcohol drinks</b>	
<ul style="list-style-type: none"> <li>• Rum and coke</li> <li>• Whiskey and coke</li> <li>• Vodka and coke</li> </ul>	<ul style="list-style-type: none"> <li>• Jager and Red Bull</li> <li>• Four Loko</li> <li>• Kombucha</li> </ul>
<b>Alcoholic caffeinated beverages</b>	
<ul style="list-style-type: none"> <li>• Irish coffee</li> </ul>	<ul style="list-style-type: none"> <li>• Caffe Corretto</li> </ul>
<b>Ready to Drink (RTDs)</b>	
<ul style="list-style-type: none"> <li>• Canadian club</li> <li>• Gentleman Jack &amp; Cola</li> <li>• Smirnoff ice double black</li> <li>• Long white</li> <li>• Coruba &amp; Cola</li> <li>• Woodstock</li> </ul>	<ul style="list-style-type: none"> <li>• Cody &amp; cola</li> <li>• Jim Beam &amp; cola</li> <li>• Diesel</li> <li>• Jack Daniels</li> <li>• Tui (bourbon &amp; cola)</li> <li>• KGB</li> </ul>
<b>Cocktails</b>	
<ul style="list-style-type: none"> <li>• Tallulah</li> <li>• Espresso Martini</li> <li>• Tom Collins</li> </ul>	<ul style="list-style-type: none"> <li>• Manhattan</li> <li>• White Russian</li> <li>• Black Russian</li> </ul>
<b>Coffee Liqueurs</b>	
<ul style="list-style-type: none"> <li>• Kahlua</li> <li>• Baileys</li> <li>• Allen's coffee brandy</li> <li>• Café Rica</li> <li>• Kamora</li> </ul>	<ul style="list-style-type: none"> <li>• Sombai</li> <li>• Tia Maria</li> <li>• Toussaint coffee liqueur</li> <li>• Midnight espresso coffee liqueur</li> </ul>

1. (Liquor Land 2019).

A standard drink is a unit of measurement used to measure alcohol consumption. This unit is used for educational and research purposes and is equivalent to approximately 9.2-23 grams of pure alcohol (Carruthers and Binns, 1992). A regular beer (4.9 % alcohol) or a 100 mL glass of wine or a 30 mL shot of spirits are all equivalent to one standard drink (Carruthers and Binns, 1992). A caffeinated alcohol drink made with a single shot of alcohol to the total volume of 250 mL (a standard glass) contains 21 mg caffeine and 9.4 grams of alcohol.

Alcoholic drinks in cans typically state the alcohol percentage of the beverage on the label, which allows the consumer to calculate how much alcohol is present per ml. Similarly, if caffeine concentration was of interest, the public are unable to monitor their intake as it is currently not mandatory to provide this information on the labelling.

## 2.6.2 PHYSIOLOGICAL EFFECTS OF CAFFEINE AND ALCOHOL CO-INGESTION

Caffeine is classified as a stimulant and its physiological effects are discussed in Section 2.4. In contrast, alcohol is classified as a depressant. The rate of metabolism of alcohol is not constant and increases in accordance to dose (Goldberg, 1966). Similar to caffeine, the distribution of alcohol in the body is relative to the water content of the body tissue (Cederbaum, 2012). Additionally, alcohol absorption is dependent on gastric emptying and is more rapid in a fasted state (Cederbaum, 2012). Liver alcohol dehydrogenase is the main enzyme involved in the metabolism of alcohol (Cederbaum, 2012). Utilising the co-factor nicotinamide adenine dinucleotide (NAD), two products are formed, acetaldehyde and reduced NAD (NADH) (Cederbaum, 2012). Acetaldehyde is then oxidised to acetate, which is similar to other major macronutrients (carbohydrates, fats and proteins) (Cederbaum, 2012). Acetaldehyde can be converted to fatty acids, ketone bodies, cholesterol, steroids and carbon dioxide (Cederbaum, 2012), and is a contributing factor to “hangovers” (Cederbaum, 2012). Alcohol has been shown to decrease anticipatory fear by impairing cognitive-processing capacity (Curtin et al., 2001). During intoxication, individuals experience reduced attentional processing of threat cues, causing changes in cognitive processing, emotional responses and adaptive behaviour (Curtin et al., 2001).

Studies have found that when alcohol is mixed with energy drinks, the stimulant side effects are greater and sedation is lower compared to the ingestion of alcohol only (Droste et al., 2017, Rossheim et al., 2016). This causes a perception of feeling “less drunk” than the individual actually is. Consuming alcohol mixed energy drinks (AmED) is associated with perceived changes in the physiological stimulant and sedation side effects of alcohol (Droste et al., 2017). This is due to caffeine dampening the effects of drunkenness caused by alcohol. The possibility of side effects is positively associated with energy drink dosage (Droste et al., 2017, Thombs et al., 2011).

Several physiological effects such as exhaustion, confusion, slurred speech and walking difficulties occurred less often after AmED ingestion when compared to alcohol-only ingestion (Peacock et al., 2012). In contrast, AmED drinking sessions were likely to cause increased heart palpitations, agitation and tremors when compared to alcohol-only drinking sessions (Peacock et al., 2012).

There have been reductions in objective intoxication and perceived intensity of intoxication after AmED consumption (Forward et al., 2017). This can be termed as “wide-awake drunkenness theory”. However, it is unclear if these effects are due to alcohol mixers containing sugars (causing objective intoxication) or caffeine (increasing the intensity of intoxication) (Forward et al., 2017) in the beverages.

## 2.7 INTRODUCTION TO ALCOHOL

### 2.7.1 USAGE OF ALCOHOL

US consumption patterns of alcohol between 2001 - 2002 to 2012 - 2013 increased by 7 % from 8.25 L to 8.82 L (Dawson et al., 2015). In particular, the consumption of wine and spirits increased by 34 % and 22 % respectively (Dawson et al., 2015). In New Zealand, The Alcohol Agency reported four out of five people over 15 years had drunk alcohol in the past year (Ministry of Health, 2018), confirming people under the legal age consume alcohol. In 2016 - 2017, 15 % of people who consumed alcohol drank six or more standard drinks on one drinking occasion per week (Ministry of Health, 2018), which is evidence of New Zealand’s high binge-drinking culture. Men were more likely than women to consume large amounts of alcohol weekly. One in five women in 2012/13 consumed alcohol while pregnant (Ministry of Health, 2018) despite current medical recommendations. Among all people, potential hazardous drinking patterns were most common in people aged 18-24 in 2016 - 2017 (Ministry of Health, 2018). The Alcohol Use Disorders Identification Test (AUDIT-C), a validated screening tool, is designed to evaluate heavy drinking and/or alcohol abuse or dependence (Bush et al., 1998). This tool is not suitable for assessing co-ingestion.

### 2.7.2 CONSEQUENCES OF ALCOHOL CONSUMPTION

Alcohol is a major contributor to the global burden of disease, contributing to 3.8 % of all deaths (Mentzakis et al., 2013). Alcohol is also associated with adverse health effects and economic consequences globally. Chronic drunkenness has been identified as a prominent social issue associated with violence, poverty and crime (Ritson, 2009).

Ireland has a strong culture associated with alcohol consumption (Hogan et al., 2014). A study involving postgraduate students found that during their studies their attitude towards alcohol consumption altered (Hogan et al., 2014). As students developed

greater feelings of responsibility, self-reflection and experience, they were able to adopt a more controlled approach towards alcohol consumption (Hogan et al., 2014).

In England it was found that lay understandings of health risks and stigma around alcohol problems may be the reason public health messages may not reduce drinking rates in this age group (Wilson et al., 2013). This highlights the importance of appropriate education around public health policies. Similarly, it was found that white-collar individuals consumed alcohol on a daily basis, public health interventions were not made relevant enough to them to cause a change, resulting in a small impact to this particular group (Ling et al., 2012).

In New Zealand, an investigation to lower the minimum alcohol purchasing age from 20 to 18 years old highlighted that lowering the minimum age increased weekend assaults, resulting in hospitalisation among young males aged 15-19 years (Kypri et al., 2014). This suggests that drinking alcoholic substances can have direct effects on an individual's behaviour. Since there is a noticeable behavioural change, altering public access based on age can have a direct impact on negative behaviours (assaults and hospitalisation). Applying this principle of restricted alcohol to caffeine, if caffeine was to become restricted, the effects on the public and their behaviour would be unpredictable.

## 2.8 CAFFEINE AND ALCOHOL CONSUMPTION RECOMMENDATIONS

The current intake recommendations for caffeine and alcohol (separately) are dependent on states of "health". For example, an individual with heart disease has no restriction placed on their caffeine intake (Greenberg et al., 2008). Pregnant women however, are recommended to have no alcohol intake (Bailey and Sokol, 2008). There are currently no definitive recommendations for "healthy" individuals to limit their daily caffeine intake. Similarly, there are no recommendations or guidelines on safe levels of co-ingestion of caffeine and alcohol (together). This is a prominent gap in New Zealand guidelines and is due to there being limited research in the area to inform guidelines for New Zealanders to follow when consuming these substances.

## 2.9 INTAKE REGULATIONS AND LEGISLATION

### 2.9.1 CAFFEINE INTAKE: REGULATIONS AND LEGISLATION

Many consumers are unaware that over-consumption of caffeine is possible and has potential health risks. Caffeine regulations have been put in place to reduce the risk of caffeine intoxication to the public, however these vary between countries; hence there is no international standard (F.S.A.N., 2015). In New Zealand, if a product naturally contains caffeine, manufacturers are not required to regulate the total caffeine content or declare levels of caffeine on the nutrition information panels (F.S.A.N., 2015). However, if caffeine is added to a product, there are regulatory standards controlling maximum amounts permitted (F.S.A.N., 2015). In September 2019, a restriction on purchasing energy drinks was imposed by the Australian-owned retail company Woolworths (New Zealand Herald, 2019). Identification is needed to verify that the customer is of at least sixteen years of age; this restriction affects customers of Countdown stores based in New Zealand (New Zealand Herald, 2019). This restriction was enforced due to concerns around safety, sustainability and how caffeine, sugar and servings sizes affect children specifically (New Zealand Herald, 2019).

### 2.9.2 ALCOHOL INTAKE: REGULATIONS AND LEGISLATION

In New Zealand it is illegal for those under 18 years of age to purchase alcohol (Alcohol Act., 2012). The legal alcohol and driving laws since December 2014 for those aged above 20 years old allow 250 mcg per litre of breath, and those under 20 years of age have zero limit (Land Transport., 2014). The Alcohol Agency, along with the Ministry of Health recommends consumption of no more than two standard drinks per day for women, and no more than three standard drinks daily for men (Alcohol Agency, 2018, Ministry of Health., 2018). In addition, they recommend women have no more than 10 standard drinks a week and men ingest no more than 15 standard drinks (Ministry of Health, 2018). It is also advised to have two alcohol free days a week, however these are just guidelines and not the law.

## 2.10 UNDERSTANDING AND ASSESSING CO-CONSUMPTION BEHAVIOURS

### 2.10.1 INTAKE PATTERNS OF CAFFEINE AND ALCOHOL CO-INGESTION

Individuals have various reasons for co-ingesting caffeine and alcohol (Evans and Griffiths, 1992), for example, some individuals prefer to consume RTDs as they can monitor how many standard units of alcohol they consume (Rowe, 2015). Consumers consider RTDs as being easier to monitor than drinks made using two different beverage sources e.g. rum and cola (Rowe, 2015). Frequently people who make mixed beverages may not be the ones consuming it e.g. a bartender. This adds another complication in monitoring how many standard units of alcohol and caffeine is consumed. Additionally, taste, convenience and price are potential factors in the co-ingestion of caffeine and alcohol.

A caffeine consumption and habits questionnaire (CaffCo) has been developed to determine caffeine consumption in New Zealand (Wham et al., 2017). This tool is validated to collect information from people aged over 15 years, living in New Zealand and are fluent in English (Wham et al., 2017). Currently CaffCo is limited to collecting information primarily on caffeine intake. A previous study using the CaffCo questionnaire determined that from a sample of 317 New Zealanders, overall, 38.5 % co-ingested caffeine and alcohol (Wham et al., 2017). Of these people, 27.4 % of participants consumed kola drinks with alcohol, 18.6 % consumed energy drinks with alcohol and 18.3% reported ingesting caffeinated RTDs (Wham et al., 2017).

### 2.10.2 EXPERIENCES WITH CAFFEINE AND ALCOHOL CO-INGESTION

A study investigating CAC that focused on the use of energy drinks (EDs) found 76 % of participants deliberately mixed alcohol with EDs (Price et al., 2010). Participants reported drinking significantly more alcohol when co-ingesting with EDs (Price et al., 2010). This is consistent with the aforementioned theory of CAC causing the decreased perception of intoxication, causing increased total ingestion of alcohol when consumed alone. This practice is concerning as increased total ingestion increases the risk of overdosing on either or both substances. Since CAC has been poorly studied, understanding the effects of CAC is crucial in identification and treatment of potential detrimental effects.

The types of experiences following CAC is a difficult domain to assess, as it is opinion based. There are several public health models that can be applied to assess people's experiences and understanding of CAC. This is a significant gap in the literature, which will be aided by our research.

## 2.11 AWARENESS AND KNOWLEDGE OF CAFFEINE AND ALCOHOL CO-INGESTION

### 2.11.1 SIDE EFFECTS OF CAFFEINE AND ALCOHOL CO-INGESTION

A potential risk associated with caffeine and alcohol co-ingestion is poisoning or overdose. New Zealanders have been shown to display a high prevalence of binge-drinking behaviours, particularly in tertiary students or those of lower socioeconomic status (Thomson et al., 2014). As with other countries, Food Standards Australia New Zealand have released warning statements about the potential detrimental public health effects associated with co-ingesting alcohol and energy drinks (F.S.A.Z., 2015). Findings indicate that the public would benefit from enhanced product labelling requirements (Thombs et al., 2011). This is due to caffeinated alcoholic drinks and alcohol mixed with energy drinks causing people to leave bars more intoxicated than when consuming alcohol only (Thombs et al., 2011).

### 2.11.2 SOCIAL AND ENVIRONMENTAL INFLUENCES IN CONJUNCTION WITH CAFFEINE AND ALCOHOL CO-INGESTION

There are several negative behaviours associated with CAC, including driving while intoxicated and illegal substance use (Marczinski et al., 2011). Hence it is believed that those who co-ingest caffeine and alcohol are more likely to display these risky behaviours (Marczinski et al., 2011). Some behaviours include a greater likelihood of being physically hurt, aggression, lack of contraception, drunk driving (Peacock et al., 2015), smoking and hazardous driving compared to when they consumed alcohol only (Peacock et al., 2015).

Alcohol is a strong inhibitor of caffeine metabolism (George et al., 1986). Alcohol consumption has been shown to inhibit metabolism of caffeine and social drinking (Mello et al., 1980). The mechanisms are unclear; however, it may be related to altered membrane function or inhibition of drug binding to cytochromes (George et al., 1986). Using validated measures of cognitive performance and subjective intoxication in

social drinkers (Marczinski and Fillmore, 2006), it was found that co-administration of caffeine counteracted the effects of alcohol but had no effect on the degree to which alcohol increased errors (Marczinski and Fillmore, 2006). This means that the perceived intoxication levels were decreased, however, incidences associated with drinking remained the same regardless of caffeine. Utilising subjective measures of intoxication, they showed that co-administration of caffeine with alcohol reduced participants' perceptions of alcohol intoxication compared with administration of alcohol alone, which aligns with the results from several other studies (Ferreira et al., 2006). This study is reliable but limited due to its low participant number (n=12), suggesting a larger study could produce more conclusive results.

A study in New York evaluated caffeinated alcoholic beverage intake and intimate partner violence victimization (IPV), utilising the responses of 100 people (40 % females) (Crane et al., 2019). Results showed that physical and sexual victimization had taken place across three domains of sexual coercion, physical assault and injury (Crane et al., 2019). This outcome can be attributed also to behavioural and environmental factors. It was found that the use of caffeinated alcoholic beverages may increase the engagement in high-risk behavioural exchanges via extending the victim's ability for remaining in high-risk situations compared to alcohol only sessions (Crane et al., 2019). A point to note is that there was little evidence of sex differences in the strength of the relationship between caffeinated alcoholic beverage and IPV hence consumption of caffeinated alcoholic beverages may place both sexes at greater risk of IPV victimization.

A commonly associated activity with CAC is smoking, with an enhanced rate of cigarette smoking observed post-alcohol consumption (Griffiths et al., 1976). Another study investigating the effects of a single dose of alcohol and caffeine on cigarette smoke puffing behaviour, found that an alcohol dose of 0.7 grams per kilogram intensified smoking of the second cigarette by increasing a tidal carbon dioxide, average puff volume, and total puff volume per cigarette (Nil et al., 1984).

A potential risky behaviour that may be associated with the CAC is smoking (Stachyshyn, 2017). Caffeine clearance usually takes six hours in non-smokers but is reduced to 3.5 hours in smokers (Parsons and Neims, 1978). This can affect caffeine consumption as increased clearance causes increased frequency of consumption,

increasing the total amount of caffeine consumed. Smoking is identified as a risk behaviour; this allows smoking to be a marker to identify those who are more likely to overdose of caffeine and/or alcohol.

A study utilising CaffCo found that paid employees were 1.72 times more likely to co-consume caffeine and alcohol than those who did not work (Stachyshyn, 2017). This suggests that co-ingestion of energy drinks with alcohol is associated with employment status and smoking characteristics. The CaffCo data also found that, in New Zealand, participants who smoked were 3.43 times more likely to co-ingest caffeine and alcohol than those who did not smoke (Stachyshyn, 2017).

## 2.12 GAPS IN THE CURRENT LITERATURE INVESTIGATING CAFFEINE AND ALCOHOL CO-INGESTION

Currently there are significant gaps in the literature investigating the co-ingestion of caffeine and alcohol. Although significant research exists on caffeine and alcohol physiology and the effects of consuming these substances alone, the effects of their co-ingestion on our physiology, emotions and social stability are not well understood.

Current research on caffeine, alcohol and co-ingestion is summarised in Table 2.3 with major findings and research gaps.

Table 2.3. Findings and critical gaps surrounding caffeine, alcohol and co-ingestion of caffeine and alcohol.

Topic	Caffeine only	Reference	Alcohol Only	Reference	CAC	Reference
<b>Cognitive effects</b>	↑ Headache ↑ Nausea	(Rapoport et al., 1981)	↓ inhibitions (impaired inhibitory control)	(Fillmore and Vogel-Sprott, 2000)	↓ performance measure of cognitive functioning (visuospatial/constructional and language performance)	(Curry and Stasio, 2009)
	↑ working memory ↓ feeling of fatigue ↑ tension and vigour	(Giles et al., 2012)	↓ thinking time before responding ↓ item recognition ↓ working memory	(Weissenborn and Duka, 2003)		
	↑ Vigilance ↑ learning ↑ memory ↑ mood state	(Lieberman et al., 2002)	↓ reaction time	(Cox et al., 1999)		
	↑ attention ↑ problem solving	(Warburton, 1995)				
<b>Chronic consumption</b>	↑ blood pressure by 2.04mmHg in systolic blood pressure ↑ blood pressure by 0.73mmHg in diastolic blood pressure.	(Noordzij et al., 2005)	↑ Cerebral neurotoxic consequences. ↑ Risk of dementia	(Rogers et al., 1983)	No research present	
	↑ chronic daily headache onset	(Scher et al., 2004)				
<b>Dependency</b>	↑ dependence	(Griffiths and Chausmer, 2000)	↑ alcohol abuse ↑ thinking disorder, anxiety and depression) ↑ physical symptoms (cardiovascular, digestive and nervous systems)	(Skinner and Allen, 1982)	No research present	
	↑ dependence	(Ogawa and Ueki, 2007)				

	↑ potential for caffeine abuse			
<b>Withdrawal</b>	↑Caffeine withdrawal (doses as low as 100mg per day) ↑headaches ↑fatigue ↑mood changes ↑flu-like symptoms ↑nausea ↑vomiting ↑cravings for caffeine  ↑ moderate or severe headaches ↑ fatigue	(Griffiths and Chausmer, 2000)      (Silverman et al., 1992)	↑insomnia ↑severe seizures ↑delirium medically managed via beta blockers, haloperidol, clonidine and phenytoin.	(Saitz et al., 1994)        No research present
<b>Overdose</b>	Only case studies present, no original research		No research present	No research present

### 2.13 SUMMARY OF LITERATURE REVIEW

There is a fundamental gap in assessing the patterns and behaviour of CAC among New Zealanders. Being able to understand the influences and experiences of caffeine and alcohol co-ingestion on individuals and groups of people is essential to ensure relevant information is collected efficiently, for analysis and interpretation.

## CHAPTER 3: MANUSCRIPT

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## Understanding the Co-ingestion of Caffeine and Alcohol: Influences and Experiences.

S Coutinho, C Wham, A Ali, K Rutherford-Markwick

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### Abstract

**Background:** Currently there are significant gaps in the understanding of caffeine and alcohol co-ingestion. The purpose of this study was to gain an insight into the habits, patterns, influences and experiences of co-ingestion in New Zealand adults over 18 years.

**Methods:** Five focus groups were conducted. Focus group discussions were audio-recorded and informed by a moderator guide. The guide included seven topics (initial thoughts, product use, functional expectations, the context of use, product experiences, product perceptions and health perceptions). Data was transcribed and thematically analysed to identify the main themes derived from the discussions.

**Results:** Five main themes were identified from the focus group discussions. Firstly, co-ingestion of caffeine and alcohol were associated with having fun, although caution was highlighted around the potential for abuse (theme one). Taste, cost, alcohol percentage and setting were important factors in deciding whether to co-ingest caffeine and alcohol (theme two). Participants indicated that bright colours and lettering attracted them to beverages containing caffeine and alcohol (theme three). Moreover, one participant observed that advertising related to co-ingestion was embedded into the general culture. Co-ingestion was observed to amplify the emotions of the participants' (theme four). Finally, the initial and delayed effects of co-ingesting significant amounts of these beverages were underlined in theme five. Initial effects

included behavioural changes or loss of coordination, leading to injuries, whereas delayed effects included insomnia, agitation and grogginess.

**Conclusion:** The co-ingestion of beverages containing caffeine and alcohol allowed the participants to experience the alcoholic effects of the beverage. Participants were cognisant of the percentage of alcohol and this was one of the main factors considered prior to consumption.

### 3.1 INTRODUCTION

Caffeine is a mild psychoactive drug consumed daily by 80 % of people worldwide and 71-96 % of New Zealanders (Alsene et al., 2003, Thomson et al., 2014, Yang et al., 2010). Caffeine levels are highest in beverages such as coffee (33.2 mg per 100 mL), kola (11 mg per 100 mL) and energy drinks (31.2 mg per 100 mL) (Bunker and McWilliams, 1979) and is commonly consumed from these sources. Other sources may also contribute such as chocolate (20-60 mg per 100 g) aspirin or cold medications (range 50-200 mg). Many people may not read the labels of their medications causing them to not realise how much caffeine they consume in a day (Curhan et al., 1998, Yang et al., 2010).

Co-ingestion of caffeine and alcohol can occur through several means; beverages made by mixing alcohol with a caffeine containing mixer (such as kola); or by mixing alcohol with an energy drink (containing caffeine) or from premade mixes such as RTDs, cocktails and coffee liquors (Marczinski and Fillmore, 2006, Thombs et al., 2011). Co-ingestion of alcohol with food containing caffeine may also occur e.g. a glass of wine with chocolate, however the caffeine content is likely to be significantly lower when compared to co-ingestion through beverages. For the purposes of this study, the focus is spent on ingestion of both caffeine and alcohol through beverages only, as this is more likely to have unusual outcomes.

Premade drinks that contain the same amount of caffeine and alcohol can affect individuals differently. The ratio of these substances and the total amount consumed are important factors to consider as this impacts the total amount ingested and subsequent experiences. Neurologically, caffeine is classified as a stimulant and alcohol as a depressant (Goldberg, 1966). When these substances are mixed together, caffeine's stimulant effects mask alcohol's sedation effects, resulting in the individual feeling less drunk (Droste et al., 2017, Rossheim et al., 2016). This may lead an individual to underestimate their level of intoxication and potentially continue drinking (Pennay et al., 2015), leading to an overall increase in the amount of both caffeine and alcohol consumed.

Studies confirm that consuming caffeine causes neurologic dependency (Griffiths and Chausmer, 2000, Ogawa and Ueki, 2007), as does with alcohol consumption (Skinner

and Allen, 1982). However, there is currently no research on caffeine and alcohol co-ingestion (CAC) dependency, patterns of co-ingestion, influences and habits due to co-ingestion or their impact on health. Similarly, caffeine has been shown to cause withdrawal effects such as headaches and cravings (Griffiths and Chausmer, 2000), whereas alcohol causes insomnia and delirium withdrawal effects (Saitz et al., 1994). Since both these substances separately have withdrawal effects, it is safe to assume CAC would also, however no research has been conducted in this area. Additionally, it is possible to overdose on both, caffeine and alcohol respectively, if consumed in copious amounts.

Currently there are significant gaps in the understanding of CAC motivators, patterns and factors influencing co-ingestion. The purpose of this research was to gain an insight into the influences and experiences of New Zealanders over 18 years old who co-ingest caffeine and alcohol by undertaking focus groups among a diverse range of adults.

## **3.2 METHODS**

### **3.2.1 PARTICIPANT RECRUITMENT**

Thirty-four volunteers aged between 19-57 years old were recruited through advertisements in workplaces, word of mouth, and social media platforms (such as Facebook and Instagram). Prospective participants were provided with an information sheet through email and were invited to complete a screening and demographic questionnaire to determine their eligibility.

Participants were purposively selected in the Auckland region based on ethnicity (NZ European, Maori, Pacific, Asian and Other); gender (male and female); age (over 18 years); and working status (blue-collar e.g. mechanics and white-collar e.g. office workers); part-time workers (retail and nanny); as well as university students.

The study procedures were explained to the participants through email or verbally and the importance of confidentiality of the session was emphasised. Participants were informed the information collected would be stored in a de-identifiable manner and that their identities would not be published.

Once they agreed to participate and expressed interest, the primary researcher screened potential participants to ensure they had met the inclusion criteria (aged above 18 years, living in Auckland, New Zealand and fluent in English). When this was determined, a suitable time, date and location were decided upon by the primary researcher to suit all participants. Participants attended the focus group session held at the most convenience time for them. Recruitment occurred in August 2019 and focus groups were held between August to September 2019. Informed consent forms were completed by each participant prior to the commencement of each focus group and personally checked by the primary researcher.

Ethics approval was granted by the Massey University Human Ethics Committee Southern A (Application Ref. 18/61 Appendix A).

### 3.2.2 FOCUS GROUP PROCEDURES

Utilising a focus group methodology to collect data is the most appropriate form of gathering individuals' opinions and ideas around a particular topic (Krueger and Casey, 2015). It provides specific information about many individuals' feelings and experiences (Krueger and Casey, 2015).

In order to follow best practice, each focus group was limited to between five and eight participants (Hennink, 2013, Krueger and Casey, 2015). Groups larger than ten participants may not achieve the depth of data desired, as people's opinions are not effectively heard (Hennink, 2013, Krueger and Casey, 2015). Groups smaller than five participants may also fail to obtain the richness of data required (Hennink, 2013, Krueger and Casey, 2015).

Focus groups were held in private locations (mostly office meeting rooms), due to ease of access and at the most convenient time for participants. Overall, university students preferred to meet midday, whereas full time workers preferred after work hours. Data saturation was achieved after five focus groups, when no new themes or data resulted from the focus group discussions.

### 3.2.3 MODERATOR GUIDE

A moderator guide was developed to guide the conversation in order to identify how past and present experiences influenced participants' thoughts and opinions on the CAC.

Topics around co-ingestion were discussed in differing order depending on the flow of the conversation in each respective focus group. The moderator guide facilitated the flow of those discussions to enrich the findings. Key focus group topics were informed by a review of the literature and were designed to be open and non-judgemental to encourage conversation.

The topic of caffeine and alcohol co-ingestion was limited to co-ingestion of beverages only. While co-ingestion can also occur with medications, caffeine tablets or with food (in a lower overall concentration compared to beverages), it would not have been viable to explore all these differing combinations given the time restrictions on the focus group sessions.

Key moderator guide topics are highlighted in Table 3.1. In section A, participants were invited to introduce themselves and describe what "co-ingestion of caffeine and alcohol" meant to them. This helped obtain a baseline understanding of the participants' perceptions and to build rapport. Section B highlighted the participants' knowledge of product use (of beverages containing caffeine and alcohol). Moderator guide items were formulated around brands, mixes, and motivations for consumption and avoidance. Section C focused on the accessibility of beverages containing caffeine and alcohol, i.e. where people obtained these drinks and how individuals made the decision on whether to consume them or not.

Section D sought to explore not just participants' experiences with co-ingestion of beverages and the environment they consumed it in, but any potential patterns in consumption. This topic allowed a smooth transition into section E, which focused on product experiences, both personal and from their observations, learnings or stories from others. Section F focused on product perceptions around advertising and label reading to gauge perceptions of the broader media impact on CAC. Section G focused on health perceptions of co-ingesting caffeine and alcohol, including lifestyle,

awareness of ingredients present, warning labels, side effects and the potential impact on pre-existing conditions. Participants were prompted to recall any health effects they may have experienced or been aware of related to co-ingestion.

Table 3.1. Moderator Guide Topics and Prompts

<p>A. Exploring “caffeine” and “alcohol” co-ingestion</p> <ul style="list-style-type: none"> <li>• Define co-ingestion of caffeine and alcohol</li> </ul>
<p>B. Product Use</p> <ul style="list-style-type: none"> <li>• Examples of beverages</li> <li>• Influences on consumption</li> <li>• Factors impacting choice</li> </ul>
<p>C. Functional Expectations</p> <ul style="list-style-type: none"> <li>• Access to beverages</li> </ul>
<p>D. Context of Use</p> <ul style="list-style-type: none"> <li>• Times of consumption</li> <li>• Provide examples of occasions</li> </ul>
<p>E. Product Experiences</p> <ul style="list-style-type: none"> <li>• Context of consumption</li> <li>• Experiences when consumed</li> <li>• Emotions when consumed</li> <li>• Other substance use</li> </ul>
<p>F. Product Perceptions</p> <ul style="list-style-type: none"> <li>• Advertising</li> <li>• Label reading</li> <li>• Emotions associated to products</li> </ul>
<p>G. Health Perceptions</p> <ul style="list-style-type: none"> <li>• Fitting into your lifestyle</li> <li>• Physiological feelings</li> <li>• Potential benefits/side effects</li> </ul>

Once the discussions came to a gradual end or the one-hour mark was approaching, the moderator closed the conversation, invited any final comments, and the audio recording was terminated. Participants were thanked for their time and attention and

once again reminded that the conversation must not be discussed further to ensure confidentiality is upheld.

### 3.2.4 DATA ANALYSIS

All focus group conversations were audio-recorded (using a Sony ICD-UX543F IC recorder and Samsung S8 plus) and commercially transcribed verbatim. Two separate recorders were used to ensure that if one device failed, the other device would capture the relevant data. The audio devices were placed in the middle of the room in order to clearly capture everyone's voice. All thematic analysis and data coding were conducted using NVivo Version 12. Themes were generated for this study by an integrated approach using a code development structure (Bradley et al., 2007). This approach preserved inductive reasoning (reading transcription line by line) while allowing the predetermined codes to be supported during data analysis and interpretation (Chenail, 2012). Transcriptions were coded under focus group topics outlined in Table 3.1; these topics were further divided into questions under each topic. Once all transcriptions had been categorized, quotes were analysed for similarity within various topics discussed by each group and then categorized into a raw data table. The raw data table was then further analysed by the researchers in discussions to determine the main themes arising from all focus group discussions.

### 3.3 RESULTS

Thirty-four participants took part in a total of five focus groups containing five to eight participants per group. The specific characteristics of the participants are detailed in Tables 2 and 3. Half of the participants were men, and most were aged between 19 to 25 years. Additionally, half were of Asian ethnicity and full-time workers.

Table 3.2: Focus Group Participants Age and Occupation.

	<b>Participant group</b>	<b>n</b>	<b>Age Range (Years)</b>
1	University students	5	19- 25
2	University students	8	19- 25
3	White-collar workers	8	26- 35
4	White-collar women	6	36- 56
5	Blue-collar men	7	36- 57

Table 3.3: Participant Characteristics.

<b>Categories</b>	<b>n (%)</b>
<b>Gender</b>	
Men	17 (50)
Women	17 (50)
<b>Age group (years)</b>	
19-25	13 (38.2)
26-35	10 (29.4)
36-45	6 (17.6)
46-50 +	5 (14.7)
<b>Ethnicity</b>	
NZ European	9 (26.5)
Asian	17 (50)
Other	8 (23.5)
<b>Occupation</b>	
Full time	17 (50)
Part time	4 (11.8)
Student	13 (38.2)

A thematic analysis of the focus group participants' perspectives and experiences with co-ingestion of caffeine and alcohol identified five main themes. Theme one highlighted that co-ingestion of caffeine and alcohol was essential for "having a good time", but "you can have too much of a good thing". This explores the initial thought process of participants around co-ingestion. Theme two involves having the right product in the right place - "you know, a posh dinner". This theme identifies factors that influence the decision of co-ingestion of caffeine and alcohol. Theme three concerns the external influences, "It is kind of living outside of marketing". It portrayed the participants' views on marketing and external influences around beverages containing caffeine and alcohol. Two advertising methods were commented on by various participants which impacted their decision on co-ingestion. Theme four related to the co-ingestion of caffeine and alcohol in amplifying emotions. The final theme is titled "Your body just doesn't want to co-operate with you at all". It focused on the after effects, in particular the participants' physical feelings post-co-ingestion.

## **Theme 1: Essential for “having a good time”, but “you can have too much of a good thing”**

Several participants described co-ingesting caffeine and alcohol as essential when partying and having fun, however some participants cautioned that you can have too much of a good thing.

Participants described that co-ingestion of caffeine and alcohol allowed them to have a good time, and that drinking beverages such as vodka and Red Bull was associated with its enjoyable taste and previous positive experiences. Most participants expressed that consuming caffeine and alcohol together allowed them to have more fun and that there was no other reason for drinking these substances. For example, when asked “*what comes to mind when co-ingesting*”, participants said:

*“Partying”;*

*“Think of a good time”;*

*“Pretty positive thoughts all round”;*

*“Purely to have fun, there is no other motive behind it”;*

*“Vodka and Red Bull is yum”;*

*“Caffeine and alcohol are great drugs. They facilitate many useful things like lots of fun”.*

However, one participant cautioned that “*you could have too much of a good thing*”. Others suggested they try to limit the amount of caffeine and alcohol they consumed in one sitting. Participants indicated:

*“It’s just that when it’s too much you should watch out”;*

*“The drug doesn’t kill you, the abuse does”.*

Although some participants urged caution in consuming caffeine and alcohol together due to the potential for abuse (i.e. when overconsumed), the majority expressed that they consumed these substances to have fun and viewed this practice as being essential to having a good time.

## **Theme 2: Having the right product for the right occasion - “you know a posh dinner”**

Participants actively made decisions to co-ingest caffeine and alcohol based on factors such as taste, alcohol percentage, cost, and the occasion being attended. When asked to recall beverages containing caffeine and alcohol, the most common beverages reported were rum and kola; Jäger bombs; RTDs; Baileys; bourbon and kola; cocktails; Espresso martinis; and Irish tea.

Participant comments indicated that taste can either encourage or discourage people from consumption of beverages containing caffeine and alcohol, with one participant saying, “*I feel like taste really impacts it though*”. Participants expressed concern over sweet tasting beverages containing caffeine and alcohol, saying “*it’s too sweet*” and has “*too much sugar*.” The sweetness of beverages deterred participants from drinking them due to its undesirable taste.

The percentage of alcohol was seen as an important factor impacting on beverage choice. Beverages containing the highest percentage of alcohol were the preferred option. One participant explained that checking “*alcohol percentage, is like habit*”.

While on the other hand, one student explained cost was an important factor in deciding what beverage to buy, especially among students.

“*I know that I can get drunk for cheaper [on alcohol-only drinks rather than beverages containing caffeine and alcohol]*”.

Participants indicated that because beverages containing caffeine and alcohol can be more expensive than consuming alcohol alone, they purchased alcohol-only

containing products instead. Students chose to consume drinks that were affordable and within their budget.

Lastly, the setting had a major influence on co-ingestion of caffeine and alcoholic beverages. Participants explained that co-ingestion commonly occurred at “celebrations” with friends and family. One participant explained co-ingestion was common when “celebrating something like someone’s birthday or someone’s graduated or someone’s overseas”. Specifically, participants indicated they chose to consume these beverages at clubs, anniversaries, family events, festivals, sports events, weddings and parties.

These comments indicated that caffeine and alcohol co-ingestion was a common occurrence at celebrations, regardless of the event, and it was normal for these beverages to be present at a range of occasions. Generally, participants indicated that co-ingestion was “more a social thing” rather than co-ingesting when alone. Celebrations commonly occurred at “night time” or during weekends.

*“During the day you would have something more sweet and easy”;*

*“As the night progressed on it would get stronger, more stronger flavours added” ;*

*“I enjoy having one of those [espresso martini] like at the start of a night...”.*

Overall, participants considered several factors before co-ingesting caffeine and alcohol; with taste, alcohol percentage, cost and the occasion, generally being taken into consideration by participants before co-ingestion occurred.

### **Theme 3: “It is kind of living outside of marketing”**

Participants were attracted to beverages containing caffeine and alcohol that had well marketed packaging and advertising on billboards, buses, or seen in movies and music. One participant noticed marketing schemes around co-ingestion were subtle and sometimes less obvious than traditional marketing methods.

Several participants explained the packaging of beverages containing caffeine and alcohol had “*bright colours*” and lettering. This attracted participants to these products, and they felt it made these products stand out amongst others, making them more appealing. Participants stated:

*“Fruity flavours like watermelon, they stick with like pinks and greens and those stand out really nicely because they are nice colours when they are put together”;*

*“Judge a book by its cover. Or if it had like heaps of words and typography on it then I am like – ooh, that looks nice”;*

*“The bottles are fairly obnoxious or in your face.”*

Another participant said that they felt marketing techniques around co-ingestion were subtle and embedded into general culture and that this type of marketing is harder to identify as it is not presented as a marketing scheme.

*“Basically my experience is kind of living out, outside marketing, it is kind of leads in to general culture right now, all the teens are up on it because, because of the music which is coming out, rap music and all sorts of music, it is constantly talking about going to the clubs, getting high you know”.*

The marketing around beverages containing caffeine and alcohol had one participant indicate concern that, “*They want to minimise the negative health effects*” of the drinks. Another participant agreed, stating:

*“They want to minimise the health effects of it and the target market for most of these energy drinks people just want to use it for what it does and they are probably not that interested in what it does. In the negative kind of way and long-term health effects as well”.*

These comments generally indicate that participants were concerned that advertising only displayed the positive aspects of consuming the drink, while not making the public fully aware of the beverages' potential side effects.

In summation, most participants were attracted to the bright colours and well-presented packaging seen on billboards, buses, movies and music videos, while one participant noticed more indirect methods of advertising and targeting. During this discussion, concerns were raised around the intention of marketing and if negative health effects were being masked or minimised in an effort to upsell products to the public.

#### **Theme 4: It amplified my emotions, “I’m personally really happy or else I feel down”**

It was reported that co-ingestion of caffeine and alcohol appeared to amplify any emotions currently experienced by the participants. One participant explained:

*“It just amplifies your day and then if you have had an average day it will bring it up. Average and upwards is just up and beyond, but anything below average is like ... you will really know you had a shit day”.*

Other participants perceived feelings of happiness when co-ingesting which made them feel more confident in their environment and their interactions with others.

*“Really happy, really excited”;*

*“Some drinks make me feel really motivated and I sort of turn into a group therapist”;*

*“You get a boost of confidence and you get a bit taller and everything and you are like – we’ve got this. We are fine”;*

*“Hyper”;*

*“Felt pumped”;*

*“I feel like it kind of gets you out of your shell”.*

In some cases, participants explained feeling down, for example:

*“Some people might get emotional, and maybe cry”;*

*“Depressed”.*

One participant observed a friend become angry.

*“Some people get angry, but it is just the alcohol ingestion. But yeah, I feel personally really happy or else I feel down and then I will just stop and pack it up for the night”.*

Overall, participants identified a varied degree of emotion when co-ingesting caffeine and alcohol. They indicated that everyone responds differently to co-ingestion as it amplifies the emotions currently being experienced by the individual. This amplification occurred regardless of the emotion – happiness, hyperactivity, sadness or anger.

#### **Theme 5: “Your body just doesn’t want to cooperate with you at all”**

Participants expressed that after co-ingesting large amounts of caffeine and alcohol, certain physiological and behavioural changes were apparent, with some of these changes being experienced immediately, while others were significantly delayed.

Some participants described behaviours initially after co-ingestion as undesirable. They described either injuring themselves or having witnessed friends and family with injuries when these beverages were consumed in large amounts. In some cases, participants mentioned loss of co-ordination and not being able to walk in a straight line. Participants recalled:

*“Lots of bruises from falling off things or running into things”;*

*“He dropped a knife on his foot”;*

*“I walked into a pole”;*

*“I try to avoid the Jäger bomb because every time I have Jäger bomb I become a Woo girl”;*

*“Coordination goes out the window”;*

*“Your body just doesn’t want to cooperate with you at all”;*

*“If someone says ‘catch this’ it’s not going to happen, or you tried it and you feel all fine but then your body just doesn’t want to do what you are thinking it is. You go right of somewhere, it’s not straight in front”;*

*“I can’t walk straight”;*

*“It makes me exhibit embarrassing behaviour”.*

Additionally, participants revealed they had experienced delayed effects the following day after co-ingesting caffeine and alcohol. Most participants further explained they felt *“Horrible”* and suffered from *“Insomnia and agitation”*. Most participants complained of having disturbed sleep resulting in lower energy and motivational levels the following day, terming this as a *“Crash”*. They explained:

*“I feel a bit groggy the whole day”;*

*“I just plan that out, so we don’t have work the next day”;*

*“It’s in your head, it’s in your stomach. You just feel like weak and you just feel like you are going to throw up”;*

*“Not getting that nice deep sleep, it gives you really low energy all day like something is off”;*

*“The next day you have a hangover, it is not just because of alcohol but because of the high caffeine and the crash you go through”.*

Overall, participants continuously chose to co-ingest caffeine and alcohol despite being aware of the initial and delayed impacts of these beverages. They chose to plan around the undesirable effects of co-ingestion by making sure they had no prior commitments or obligations the following day.

### **3.4 Discussion**

Overall, the findings from this study have revealed new perceptions towards the co-ingestion of caffeine and alcohol among adults aged over 18 years old. The thematic analysis revealed five key themes. Firstly, the consumption of beverages containing caffeine and alcohol was associated with partying and having fun. Participants described that from their experiences, drinking beverages containing caffeine and alcohol in moderate amounts, was a “great idea” but over-indulgence of these substances is something that should be avoided due to potentially adverse effects. Cautionary comments were made, reinforcing that co-ingestion should be controlled and can be hazardous when “too much” is consumed.

Participants commented on noticing bright colours and pretty designs on premixed beverages containing caffeine and alcohol. This positively impacted the styling of the product as they were more likely to purchase these products due to their attractive designs. Marketers use a tactic known as the Four P’s (product, placement, price and promotion) in order to attract customers (Jager, 2007). “Product” takes into consideration the brand, functionality, styling and quality (Jager, 2007). A subcategory of functionality is alcohol percentage. Participants described how they chose beverages with a higher alcohol percentage in order to become intoxicated. From this we can surmise that potentially the alcohol concentration may be more important to individuals than caffeine content, as they consume these beverages to gain an intoxicated effect from the alcohol present, rather than an alert effect, from the caffeine

present. A subcategory of product quality is taste. Participants explained that taste was important; in particular if a beverage was too sweet, it would cause them to avoid the product.

The price of beverages containing caffeine and alcohol was important to several participants, particularly the students on a lower income. The “value of money” model is applicable as individuals consider the comparative worth between the price and utility of a product (Sweeney et al., 1999). The weighing of price depends on the individual’s budget e.g. higher income individuals will be less concerned with price when compared to lower income individuals (Jager, 2007, Sweeney et al., 1999). University students generally have lower income, hence gravitate towards cheaper beverages and higher alcohol percentage where possible.

Co-ingestion occurs at celebratory functions such as weddings, birthdays and sports events. At all of these social events co-ingestion appeared to be part of the culture or tradition as a social normality. A study exploring the prevalence and magnitude of heavy drinking found that 90.3% of students celebrating their 21<sup>st</sup> birthday reported consuming alcohol, with no significant difference between males and females (Neighbors et al., 2005). This supports the notion that alcohol is commonly present during celebrations which may inherently be the reason co-ingestion commonly occurs during these events.

Participants noticed advertising and marketing on billboards, buses, in movies, and music featuring beverages containing caffeine and alcohol. They commented on bright colours and typography which caught their attention, making the product more appealing to them. The packaging is the first attribute of a product a consumer is exposed to (Argo and White, 2012). Having bold colours and attractive typography increases the attention given to the product by the consumers (Underwood et al., 2001). This increase in attention helps the consumer set expectations and visualisation around them consuming the product (Underwood et al., 2001). This expectation and visualisation of product consumption is used to entice the consumer into purchasing the product.

Another participant noted that the marketing of beverages containing caffeine and alcohol was embedded into our general culture and therefore harder to identify. Smoking is a similar activity embedded into the general culture and has been shown to have positive responses (64%) from school-age students as being associated with success, sociability, coolness and popularity (Watson et al., 2003). This exemplifies promotion - the fourth "P" with regards to marketing. Promotion helps keep the product in the mind of potential customers, to stimulate demand for products (Jager, 2007). It has been observed that marketing around beverages containing caffeine and alcohol adopts promotional strategies similar to beverages containing alcohol only. This supports and aligns with our focus group findings where participants explained that alcohol percentage was of greater importance to them than caffeine content.

Overall, participants explained that co-ingesting caffeine and alcohol amplified the emotions they were already feeling prior to the time of ingestion. Various emotions were recalled, such as happiness, confidence, sadness and anger. A study investigating the effects of alcohol on mood found that post alcohol ingestion, participants felt more euphoric and extroverted at high doses (0.85 g alcohol per kg of body weight) (Persson et al., 1980), similar to the reports of the participants from this study. In the United States, a study on women with HIV identified that alcohol allowed them to feel better, have confidence and help socialise (Cook et al., 2016). These studies indicate that alcohol alone promoted and elevated positive emotions however, our participants reported amplification of any emotion experienced prior to co-ingestion. This presents a possibility that the mix of caffeine and alcohol affect mood differently to that of alcohol-only ingestion.

When consuming caffeine and alcohol together, participants recalled initial effects such as losing control of co-ordination and balance. These experiences around co-ingestion are similar to that of alcohol-only consumption (Bonomo et al., 2001, Watt et al., 2004) as opposed to caffeine-only consumption (increased productivity, alertness and increased focus) (Brice and Smith, 2002). This suggests that alcohol is the cause of feelings of impairment and experiences as opposed to caffeine. This may relate to the choice of beverages with a higher alcohol percentage, since the participants desired to become intoxicated.

The delayed effects of co-ingesting caffeine and alcohol described by participants were grogginess, headaches and insomnia; all symptoms which seemed to mimic the concept of a hang-over (Wiese et al., 2000). These symptoms are thought to occur due to dehydration and the “toxic” effects of alcohol (Wiese et al., 2000), however further research is needed to determine the link between alcohol-only; and post-caffeine and alcohol ingestion.

From the main findings of this study, participants formed thoughts around co-ingestion based on previous co-ingestion experiences. They chose whether to co-ingest caffeine and alcohol based on several influences such as taste, alcohol percentage, cost and the occasion. Furthermore, marketing also influenced the individuals’ feelings or emotions to purchase and co-ingest. Once ingested, the beverage itself amplifies the emotions of the consumer, regardless of the emotions currently experienced. Initial and delayed effects are experienced by individuals who co-ingest significant amounts of these beverages. This effects the overall experience and impacts the individuals’ decisions to co-ingest again in the future. Figure 3.1 displays how all these themes link with one another around the central concept of co-ingestion of caffeine and alcohol.



Figure 3.1: Key Themes Identified Around Co-ingestion of Caffeine and Alcohol.

#### *Study limitations and future directions*

This study is limited by the exclusion of those in retirement and those under 18 years of age. Under 18-year olds were excluded as they did not meet the age inclusion criteria and it is illegal to buy and therefore consume alcoholic beverages. Similarly, retired individuals were excluded due to time constraints This impacts our results as we are unaware of the patterns and influences present within these demographics. Additionally, the study enquiry focused on co-ingestion via beverages only. As discussed earlier, co-ingestion through food has a significantly lower caffeine and alcohol concentration and was therefore excluded. Co-ingestion through medications were also not included as the literature suggests this would be intermittent. It is important to note, limiting our study to co-ingestion via beverages only may impact the subsequent results of this study e.g. factors in deciding to co-ingest and the experiences of co-ingestion overall.

This study is based on various adults' perceptions in a qualitative approach, however future research may consider the addition of a quantitative approach and the inclusion of older adults in retirement (excluded from this study). The exploration of underage alcohol and caffeine co-ingestion is also required. An increase in overall qualitative and quantitative data is needed for a deeper understanding around physiological and emotional impacts of co-ingestion on individuals.

It is evident from the results of this study that participants had only limited information and knowledge around co-ingestion of caffeine and alcohol. The results from our study can be used to inform educational tools for the public, particularly around limiting the total intake of beverages containing caffeine and alcohol. Further investigations should focus on collecting information around the patterns (amounts and frequency) of co-ingestion of caffeine and alcohol, as well as motivations and factors influencing consumption. This information could then be used to determine if CAC abuse is a potential issue and therefore if guidelines around recommended intake levels of beverages containing caffeine and alcohol should be made available. Additionally, the labelling on such products could be altered, to include appropriate warning labels. Implementation of health guidelines and product labelling laws for beverages containing caffeine and alcohol may help avoid any potential detrimental health effects from co-ingesting these products in large amounts.

### **3.5 Conclusion**

The co-ingestion of caffeine and alcohol was suggested to occur due to the alcoholic content of the beverage, rather than the effects of caffeine. Post co-ingestion, the effects experienced by participants mimicked the hangover effects of alcohol. This suggests that the alcohol content plays a more significant role in the decision to co-ingest compared to the caffeine concentration. Participant's based their decisions on whether or not to co-ingest caffeine and alcohol on both personal preferences (e.g. taste, cost and previous experiences) and also on external factors such as marketing and social normalities.

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## **CHAPTER 4- CONCLUSION & RECOMMENDATIONS**

### **4.1 RESEARCH PROBLEMS AND AIMS OF THE STUDY**

Caffeine and alcohol are both commonly consumed by New Zealanders, separately and in conjunction with one another. Currently, there are significant gaps in the literature around the levels of co-ingestion of these substances. In addition, areas such as motivation, experiences, emotions and short- and long-term side effects are yet to be adequately researched.

The aim of this study was to gain an insight into caffeine and alcohol co-ingestion (CAC) in New Zealand and to develop or modify the current CaffCo questionnaire to accurately evaluate CAC intake patterns, influences on consumption and both positive and negative experiences across a range of beverage mixtures in New Zealand adults aged 18 years and older.

### **4.2 SUMMARY OF RESULTS AND MAIN FINDINGS**

Five main themes were identified from the focus group discussions. Firstly, the consumption of caffeine and alcohol together was associated with having fun, although caution was highlighted around the potential for abuse. Theme two suggested that taste, cost, alcohol percentage and the setting of consumption were important contributing factors for participants in deciding whether to co-ingest caffeine and alcohol. The third theme focused on the marketing of beverages containing caffeine and alcohol. Participants noticed bright colours and letting attracted them to beverages containing caffeine and alcohol. Additionally, one participant observed that advertising around co-ingestion was embedded into our general culture. Theme four found that co-ingestion caused the amplification of participants' emotions, regardless of the type of emotion. The final theme highlighted the initial and delayed effects of co-ingesting significant amounts of co-ingesting beverages containing caffeine and alcohol. Initial effects experienced by co-ingesting large amounts included loss of co-ordination and behavioural changes which increased the likelihood of injuries, whereas delayed effects included insomnia, agitation and grogginess.

Individuals co-ingest caffeine and alcohol primarily due to the alcoholic effects of the beverage. Alcohol percentage was one of the main factors taken into consideration

before it's consumption. Both initial and delayed effects of co-ingestion mimic the hangover effects of alcohol, leading to the conclusion that the alcohol percentage is of more importance to the public than caffeine content. Evaluating the topics included in CaffCo, CaffCo is designed only to collect quantitative data on co-ingestion. CaffCo is currently unable to effectively assess qualitative aspects on CAC, specifically around people's personal experiences pre- and post-consumption. Sample definitions and additional questions (Appendix K) are required to modify CaffCo's appropriateness to include both qualitative and quantitative assessment of co-ingestion.

#### 4.3 STUDY STRENGTHS

This study included a diverse demographic of participants including, but not limited to a range of ages, genders, occupations and ethnicities. This reduces any potential reporting bias and allows a more valid perception to be obtained from several different views. Thematic analysis was used to allow themes to easily be identified and categorised. It allows exploration of meanings within the data. This is a novel study, providing new information to help fill gaps in the current literature.

#### 4.4 STUDY LIMITATIONS

This study had several limitations: firstly, it was limited to co-ingestion through beverages only, it did not include co-ingestion through medications or food items. This is due to co-ingestion through medications or food to be at a lower dose than co-ingestion through beverages. The study is also limited by the exclusion of retired individuals and those under 18 years of age. Under 18-year olds were excluded as they did not meet the age inclusion criteria and it is illegal for them to buy and therefore consume alcoholic beverages. This is out of the scope of our ethics approval however; future research should explore underage alcohol and caffeine co-ingestion. Similarly, retired individuals were excluded due to time constraints which impacts our results as we are unaware of the patterns and influences present within these demographics. Future research may consider including retired adults.

Additionally, the study population was a different ethnic composition compared to the general NZ population. The study had a higher percentage of people of Asian ethnicity (50%) compared to the general NZ population (13.7%) (Stats NZ, 2020). This impacts our results as individuals have different beliefs and practices around eating and

drinking related to their ethnicity. Having a study population which closely resembles that of New Zealanders' could result in different themes emerging. This highlights the need for more research to be conducted in this area.

There were three major limitations present during the focus groups. Firstly, participants were subject to potential self-reporting bias. This could change an individual's responses due to their feelings and fears of being judged. Secondly, discussions were limited by the skills of the moderator. By conducting the focus groups with a more experienced moderator, focus group discussion may have been more clearly expressed, yielding more in-depth discussion and additional information on which to draw conclusions from. Lastly, it was difficult for participants to discuss the perceived effects of co-ingestion compared to the individual effects of alcohol and caffeine. This could potentially be attributed to participants' lack of knowledge and awareness that they were co-ingesting two different "drugs" simultaneously when consuming beverages such as rum and coke.

#### 4.5 USE OF STUDY FINDINGS

- This study demonstrated that the participants had limited knowledge around co-ingestion of caffeine and alcohol as a number of individuals were not aware, they were consuming beverages which contained both caffeine and alcohol. It was also found that there are significant gaps in the literature surrounding the patterns and motivations around co-ingestion as well as the resulting physiological effects. This means that more in-depth observational studies are required around the co-ingestion of caffeine and alcohol.
- Since some participants urged caution with regards to overconsumption of beverages that contain caffeine and alcohol, it may be useful to develop educational resources to inform the public on possible effects of co-ingestion. Such resources may help to reduce potential abuse of caffeine and alcohol when consumed together.
- Similarly, the development of appropriate warning and caution labelling on beverages containing caffeine and alcohol may be useful to help reduce potential abuse.

- If it is found that the public is consuming large amounts of caffeine, implementing a caffeine restriction may be useful in limiting the public's intake, providing a guide to refer to.
- Based on the literature review, which highlights a high binge drinking culture and caffeine consumption rates, I suggest studies should be conducted using the modified CaffCo questionnaire tool to better assess co-ingestion in New Zealand.

#### 4.6 RECOMMENDATIONS FROM STUDY

More observational data needs to be conducted to observe individuals' natural patterns of co-ingesting caffeine and alcohol. This observational data will also provide additional data on the influences and experiences (emotional and physiological) of co-ingestion. Additionally, our data suggests that the development of educational tools and warning labels may be useful to explain the caution around the abuse of co-ingestion.

Only minor changes are required to CaffCo in order to make it suitable for analysing the qualitative aspects around co-ingestion. At the beginning of the relevant section, CaffCo must provide a clear definition of what "co-ingestion of caffeine and alcohol" is in order to avoid any misunderstandings. An additional seven questions should be added to collect more comprehensive qualitative information on co-ingestion such as habits, patterns and influences resulting in the co-ingestion of caffeine and alcohol (Refer to appendices for sample definition (K), sample questions (K) and pilot test results (L)). Once these changes are made, CaffCo can be utilised to assess both qualitative and quantitative data on New Zealand's co-ingestion of caffeine and alcohol. This information can then be used to help understand the co-ingestion habits, patterns and influences in New Zealand. It will additionally provide quantitative data around how often people co-ingest, how much and which co-ingestion combinations are the most common. This mix of qualitative and quantitative data may then influence any future public health actions needed e.g. recommendations around co-ingestion concentrations if data suggests high levels of co-ingestion.

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## APPENDICES

### A. ETHICS CERTIFICATE



Date: 20 November 2018

Dear Schynell Coutinho

Re: Ethics Notification - NOR 18/61 - Caffeine and alcohol co-ingestion, influences and experiences: the potential modification of the New Zealand Caffeine Consumption Habits Questionnaire (Caffco)

Thank you for the above application that was considered by the Massey University Human Ethics Committee: Human Ethics Northern Committee at their meeting held on Thursday, 25 October, 2018.

On behalf of the Committee I am pleased to advise you that the ethics of your application are approved.

Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely



Professor Craig Johnson  
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

# What do we know about co-ingestion of Caffeine and Alcohol?

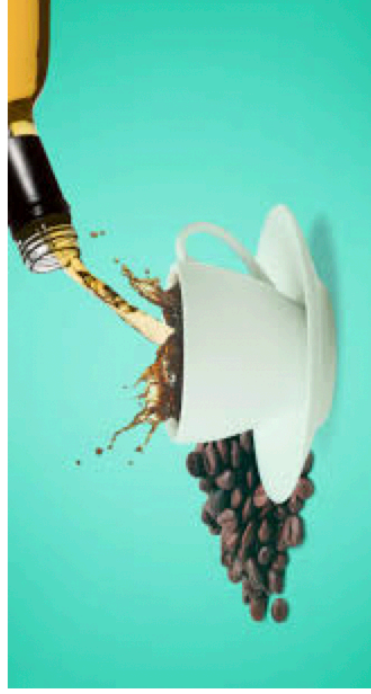
## Help us find out by participating in a focus group!

Are you 18 years or older and willing to engage in conversation in spoken English?

We'd like to invite you to take part in an exploratory study to understand habits, influences, knowledge and potential effects of co-ingestion of caffeine and alcohol

Participants will engage in a one hour group discussion, where these issues will be explored.

Light refreshments will be provided, and you will be offered a \$20 MTA petrol voucher to help with travel costs.



### Interested?

**Please Contact:** Schynell Coutinho

Email: [caffeinestudy@outlook.co.nz](mailto:caffeinestudy@outlook.co.nz)

Mobile: [REDACTED]



UNIVERSITY OF NEW ZEALAND

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/61.

If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Committee Chair).

Massey University Human Ethics Committee: Northern, email [humanethicsnorth@massey.ac.nz](mailto:humanethicsnorth@massey.ac.nz).

## C. PARTICIPANT INFORMATION SHEET



**MASSEY**  
**UNIVERSITY**  
TE KUNENGA KI PŪREHUROA

UNIVERSITY OF NEW ZEALAND

Institute of Food, Nutrition and Human Health  
Massey University  
Private Bag 102904  
North Shore City 0745, Auckland  
New Zealand

# Factors affecting caffeine and alcohol co-ingestion

## INFORMATION SHEET

We are looking for individuals over 18 years old to take part in a study looking at the patterns, and reasons behind caffeine and alcohol co-ingestion.

### Researcher Introduction

Hello, my name is Schynell Coutinho and I am currently studying towards a Master of Science degree in Nutrition and Dietetics at Massey University (to become a Dietitian). This project is being undertaken as part of my degree. My supervisors are Associate Professors Kay Rutherford-Markwick, Ajmol Ali and Carol Wham. Together, my supervisors have an extensive background of research in the fields of nutrition, physiology and public health.

### Project Description

World-wide, caffeine is consumed by approximately 80% of the population. Caffeine consumption most commonly occurs via coffee however there are several other sources. In addition, caffeine is commonly co-ingested with other substances, and consumption of caffeine with alcohol is an increasing occurrence. In order to accurately assess patterns of caffeine and alcohol co-ingestion, reasons behind it and effects, it is important to ensure the most appropriate tool is used to capture the data. You are invited to participate in a 1-hour focus group, where caffeine and alcohol co-ingestion and the reasons behind it will be discussed. The focus group discussion will be audio-recorded. Information gained from these discussions will be used to analyse if the current caffeine consumption habits questionnaire (CaffCo) is suitable to assess caffeine and alcohol co-ingestion or if another tool is needed. Light refreshments will be provided during the focus groups.

### Participant Identification and Recruitment

Participants are being recruited by flyers placed around universities, community settings, places of work and social media such as Facebook. Once first contact has been made, we will contact you by email and/or phone prior to the focus groups.

You must be:

- 18 years of age or older
- Fluent in spoken and written English
- Living in New Zealand
- Available to participate in a 1-hour long focus group located in either Auckland or Whangarei

We will undertake five to seven focus groups with 6-8 participants in each session (30-56 participants in total).

You will be offered a \$20 MTA voucher to cover any travel expenses.

### **Project Procedures**

During the focus group, you will be asked to contribute to group discussions about usual patterns of consumption of different drinks which contain caffeine and alcohol. The focus groups will be moderated by the student researcher Schynell Coutinho, with the help of an assistant and will be voice-recorded. The focus groups will take place at a time convenient to the participants at either the Massey University Albany campus or in suitable public venues. You will also be invited to complete an online questionnaire later in the year.

You are welcome to discuss any concerns regarding the focus group discussion or online questionnaire with the researcher. If you do not feel comfortable at any time, there is no obligation to respond in either the group discussions or the online questionnaire.

### **Data Management**

Audio recordings of the focus groups will be transcribed. Individuals will not be able to be identified, and only the researchers will have access to any information collected. All information collected will be kept strictly confidential, and in locked storage at the Massey University School of Health Sciences. After 5 years, the data will be destroyed by a staff member.

Data collected from this study will be used to analyse if the CaffCo questionnaire is suitable to assess caffeine and alcohol co-ingestion or if another tool is needed. Results from this study may be presented at conferences or published and will be made accessible to focus group participants.

### **Participant's Rights**

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- Decline to answer any particular question;
- Withdraw from the study up until the start of the focus groups;
- Ask any questions about the study at any time during participation;
- Provide information on the understanding that your name will not be used unless you give permission to the researcher;

### **Project Contacts**

If you have any questions regarding this project, please contact the researcher and/or one of the supervisors.

#### Student researcher:

Schynell Coutinho

Massey School of Food and Nutrition

Email: [caffeine@outlook.co.nz](mailto:caffeine@outlook.co.nz)

Phone: [REDACTED]

#### Supervisors:

Associate Professor Kay Rutherford-Markwick

School of Health Sciences

Email: [K.J.Rutherford@massey.ac.nz](mailto:K.J.Rutherford@massey.ac.nz)  
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Associate Professor Ajmol Ali  
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Email: [A.Ali@massey.ac.nz](mailto:A.Ali@massey.ac.nz)  
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Associate Professor Carol Wham  
School of Sport, Exercise and Nutrition  
Email: [C.A.Wham@massey.ac.nz](mailto:C.A.Wham@massey.ac.nz)  
Phone: +64 (09) 414 0800 ext. 43644

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/61. If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Committee Chair), Massey University Human Ethics Committee: Northern, email [humanethicsnorth@massey.ac.nz](mailto:humanethicsnorth@massey.ac.nz).

D. SCREENING FORM



**MASSEY**  
**UNIVERSITY**  
TE KUNENGA KI PŪREHUROA

UNIVERSITY OF NEW ZEALAND

School of Sport, Exercise and Nutrition  
Massey University  
Private Bag 102904  
North Shore City 0745, Auckland  
New Zealand

## Exploring the co-ingestion of caffeine and alcohol among New Zealand adults

An exploratory study to inform the potential refinement of a caffeine consumption habits questionnaire to examine the patterns, influences, awareness and knowledge of the effects of co-ingestion of caffeine and alcohol

### Participant Screening Questionnaire

Thank you for expressing interest in our study.

Please complete the following questions to make sure you are able to participate.

Are you fluent in spoken English? Yes / No

Are you fluent in written English? Yes / No

Do you currently live in New Zealand? Yes / No

What age group do you fall into?

- |                                             |                                            |
|---------------------------------------------|--------------------------------------------|
| <input type="checkbox"/> Under 15 years old | <input type="checkbox"/> 31 – 50 years old |
| <input type="checkbox"/> 15 - 18 years old  | <input type="checkbox"/> 51 years or over  |
| <input type="checkbox"/> 19 – 30 years old  |                                            |

Which ethnicity do you identify with?

- |                                            |                                                 |
|--------------------------------------------|-------------------------------------------------|
| <input type="checkbox"/> European          | <input type="checkbox"/> Southeast Asian        |
| <input type="checkbox"/> NZ European       | <input type="checkbox"/> Chinese                |
| <input type="checkbox"/> Maori             | <input type="checkbox"/> Indian                 |
| <input type="checkbox"/> Samoan            | <input type="checkbox"/> Korean                 |
| <input type="checkbox"/> Cook Island Maori | <input type="checkbox"/> Middle Eastern         |
| <input type="checkbox"/> Tongan            | <input type="checkbox"/> Latin American         |
| <input type="checkbox"/> Niuean            | <input type="checkbox"/> African                |
| <input type="checkbox"/> Tokelauan         | <input type="checkbox"/> Other (please specify) |
| <input type="checkbox"/> Fijian            | .....                                           |

What is your occupation? .....

Which gender do you identify with?

- Male
- Female
- Other
- Please provide an email address so that we can contact you:.....

Full Name – Printed: .....

Date: .....

Thank you for your interest in participating in this research project.  
We will be in touch soon to give you more information. Feel free to contact the researcher at the email address listed below if you have any questions.

Student Researcher: Schynell Coutinho

Email: [caffeinestudy@outlook.co.nz](mailto:caffeinestudy@outlook.co.nz)

Phone: [REDACTED]

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/61. If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Committee Chair), Massey University Human Ethics Committee: Northern, email [humanethicsnorth@massey.ac.nz](mailto:humanethicsnorth@massey.ac.nz).

E. CONSENT FORM



**MASSEY**  
**UNIVERSITY**  
TE KUNENGA KI PŪREHUROA

UNIVERSITY OF NEW ZEALAND

School of Sport, Exercise and Nutrition  
Massey University  
Private Bag 102904  
North Shore City 0745, Auckland, New Zealand

## Exploring the co-ingestion of caffeine and alcohol among New Zealand adults

An exploratory study to inform the potential refinement of a caffeine consumption habits questionnaire to examine the patterns, influences, awareness and knowledge of the effects of co-ingestion of caffeine and alcohol

### FOCUS GROUP PARTICIPANT CONSENT FORM

- I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.
- I agree to the focus group session being sound recorded.
- I agree not to disclose anything discussed in the focus group.
- I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Full name (printed): \_\_\_\_\_

Phone number: \_\_\_\_\_ Date of Birth: \_\_\_\_\_

Address: \_\_\_\_\_

Email: \_\_\_\_\_

Are you willing to be contacted regarding future research projects within the School of Sport, Exercise and Nutrition? Your name and email address will be saved in a secure location. You will be sent periodic newsletters regarding research studies within the School. You can opt out of this newsletter at any time.

Tick here if you accept.

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/61. If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Committee Chair), Massey University Human Ethics Committee: Northern, email [humanethicsnorth@massey.ac.nz](mailto:humanethicsnorth@massey.ac.nz).

## F. MODERATOR GUIDE

### Moderators guide

Aim: To gain an understanding of caffeine and alcohol use among NZ adults aged 18 years and older to inform the development or modification of a questionnaire to evaluate caffeine and alcohol co-ingestion (CAC).

Objectives:

- Conduct five to seven focus groups to understand caffeine and alcohol consumption, factors influencing consumption and caffeine and alcohol related experiences.
- To explore intake patterns, influences of consumption and experiences across a range of caffeine and alcohol products among focus group participants.

Sample:

Focus group participants will be invited from their workplace, university or through mutual friends. The sample population will consist of volunteers who live in Auckland, New Zealand, are fluent in English and over the age of 18 years.

A total of five to seven focus groups of six to eight participants. Collection will continue until data saturation is achieved.

Equipment:

Audio recorder, pens, paper, paperwork regarding study (information sheets, advertisements, contact information, consent forms), refreshments and MTA vouchers.

## Conducting the focus group

### I. Background/ Introductions

Moderator

Hello everyone, my name is Schynell Coutinho, I am a student dietitian at Massey University and this focus group is part of my thesis project. We are interested in understanding about caffeine intake in NZ adults and how people use products containing caffeine and alcohol. Thank you all for taking the time to attend today.

Before we begin the session, I would just like to double check if everyone has signed a consent form?

Just to highlight some information on how this focus group will be run, this session will take approximately an hour. Please contribute your various thoughts, feelings and opinions on drinks containing caffeine and alcohol. I would like to hear everyone's opinion. I am here only to facilitate the group. Please feel free to contribute and add to each other's thoughts and examples. If you are ever uncomfortable at any point. Please feel free to leave.

Additionally, this session is being audio recorded to ensure no comments are missed. There will be no names attached, making everything confidential. What is shared in this room remains here to ensure these conversations remain private. There are no right or wrong answers.

## II. Discussion Topics

### a) Exploring “caffeine” and “alcohol” co-ingestion

Main themes: What comes to mind

- Participants introduction activity: Please tell us your name and tell us what comes to mind when you hear, “Drinks containing caffeine and alcohol”

### b) Product use

Main themes: Brands, mixes, consumption/ avoidance

- Do any examples come to mind? (follow on question from activity)
- What has influenced you drinking beverages/products containing caffeine and alcohol?
- What factors impact your choice in drinks? (e.g. cost, amount, alcohol percentage)

### c) Functional Expectations

Main theme: Accessibility

- Where are some places you know of that you can access these beverages from?

### d) Context of Use

Main themes: Environment, people and patterns

- At what times of day?
- Explain some occasions people might drink beverages containing caffeine and alcohol?

### e) Product Experiences

Main themes: Personal and other

- Tell me in what context they were consumed?
- What were your experiences?
- What was your experience when caffeine and alcohol containing beverages were present?
- What are some emotions you associated with drinks containing caffeine and alcohol?
- Are there any other substances used with these drinks?

#### f) Product Perceptions

Main themes: Emotions, marketing and appropriateness

- Are you aware of any advertising?
- Where do you find access to these?
- What does the label say?
- How helpful is the labelling? How did it make you feel?
- Does CAC make you experience any particular emotions?

#### g) Health Perceptions

Main themes: Effects (positive/negative), ingredients and warning labels

- How do these products fit into your lifestyle?
- What about similar products i.e. relative use?
- How do they make you feel?
- What makes them enjoyable?
- What might be the less beneficial effects?
- What might be some health effects of having drinks containing caffeine and alcohol?
- What conditions do you take into consideration with these drinks? Why?

If needed: Now that we have explored \_\_\_\_\_. What other examples of drinks containing caffeine and alcohol can you recall?

### III. Closing

Our session is now coming to an end, does anyone have any final short comments they would like to add?

Thank you all for your participation, I greatly appreciate it. Please remember everything discussed today must remain in this room and is not discussed further to remain confidential. If anyone has any questions privately or in the future, please feel free to contact me via my details provided on your various forms.

Thank you!

## G. MODERATOR GUIDE JUSTIFICATION

General gaps are present in the literature	What has not been answered/touched on at all?
<ul style="list-style-type: none"> <li>▪ How often people co-ingest? (sources of caffeine and alcohol)</li> <li>▪ Are people aware they are co-ingesting</li> <li>▪ Patterns &amp; frequency of co-ingestion</li> <li>▪ Do people know the sources of caffeine and of alcohol?</li> <li>▪ Do they limit/monitor their alcohol consumption?</li> <li>▪ Are they influenced into co-ingestion?</li> <li>▪ Is co-ingestion related to a particular emotion? (the reason for co-ingestion)</li> <li>▪ Does co-ingestion effect sleep and fatigue?</li> <li>▪ Any tolerance/ adaptation/ withdrawal with co-ingestion?</li> <li>▪ Behaviours experienced when co-ingesting?</li> <li>▪ Co-ingestion amount recommendations</li> <li>▪ Overdosing on co-ingestion</li> <li>▪ Knowledge and awareness of co-ingestion</li> <li>▪ Unknown side effects of co-ingestion</li> <li>▪ No research on contraindications of co-ingestion</li> </ul>	<ul style="list-style-type: none"> <li>▪ Commonly participants are restricted in choice of drink to meet inclusion criteria of a study, we are unsure of what the public gravitates to e.g. common brands, mixes etc.</li> <li>▪ Long term studies focusing on co-ingestion</li> </ul>

### Justification of discussion topics

#### A. Defining caffeine and alcohol co-ingestion

Prior to caffeine and alcohol co-ingestion (CAC), it is important to understand the positive and negative impacts on the body. The ability to identify what caffeine and alcohol is and which beverages contain both is essential in this understanding. This topic is to ensure there is a baseline understanding present in all participants.

#### Recommended Questions:

Participants introduction activity- state your name and explain what comes to mind when I say, "caffeine and alcohol co-ingestion".

Group identifications activity: match the beverages to the correct column- "only caffeine, only alcohol, both caffeine and alcohol"

## B. Product use

Product use encompasses caffeinated and alcoholic beverage brands, various mixes and consumption/avoidance of CAC. The popularity of beverage brand and mixes can be determined by openly asked questions in the focus group.

The Stages of Change Model (Transtheoretical model) is a framework utilized to understand an individual's modification and/or addition to behaviours (DiClemente and Prochaska, 1998). This is based on decision making by an individual. There are three major constructs of this model: the stage of change, the processes of change and the levels of change (DiClemente and Prochaska, 1998). Several factors impact "change", this includes emotions, cognition, self-efficacy and temptation (Wu and Chu, 2015). "Product use" requires the stages of change model as individuals must make a behavioural change to consume or avoid CAC.

The self-regulation theory utilizes cognitive and behavioural therapies. Self-regulation is a process that enables an individual to make goal-based decisions over time and over changing circumstances (Hall and Fong, 2007). This type of regulation requires thought, effort, behaviour and attention (Hall and Fong, 2007). Self-regulation with CAC is important as this determines what type of brands and mixes an individual consumes, and if they decide to consume it.

### Recommended Questions:

What are some common brands used in co-ingestion?

What are some common mixes?

Do you know of anyone who avoids or encourages co-ingestion?

## C. Functional expectations

The functional expectations section revolves around the accessibility to beverages containing caffeine and alcohol. A person's access to these beverages directly impacts the likelihood of their consumption (Kavanagh et al., 2011).

### Recommended Questions:

Where do you commonly buy these beverages from?

#### D. Context of use

There are several different contexts and cues to which people conduct certain behaviours. This can be environmental factors, influential people or general habits/patterns. Influencing factors can be from microsystem, mesosystem, or exosystem as highlighted from Bronfenbrenner's ecological theory (Bronfenbrenner, 1992).

The social cognitive theory can be linked to the ecological theory as it states behavioural change is affected by the environment, the person and attributes of the behaviour itself (Bandura, 2001). Self-efficacy is central to this as it impacts adaptation and change (Bandura, 2001). Having self-efficacy fuels self-regulation and motivation. This in turn drives the context in which caffeine and alcohol is co-ingested. The health belief model also highlights self-efficacy as an important domain in an individual's likelihood of engaging in health-related behaviours (Janz and Becker, 1984).

Recommended Questions:

Where do you commonly consume these beverages?

#### E. Product experiences

There are two main types of experiences, personal and non-personal. Each of these types of experiences can be used as a learning tool. It is a type of discovery learning which is inquiry based. Exploration and manipulation are needed so that the individual is more likely to remember the experience and base decisions on these accordingly.

Recommended Questions:

What are your personal or observed experiences with co-ingestion?

#### F. Product perceptions

Product perceptions considers the emotions, marketing and appropriateness of beverages containing caffeine and alcohol. Emotions can shape our actions (behaviour) (Dolan et al., 2012). It is debated that all perceptions contain emotion (Dolan et al., 2012). Provoking emotion has been shown to change health behaviours (Dolan et al., 2012). Previously when promoting soap, it was advertised along with the benefits (Curtis et al., 2007). This did not increase soap-use however it was observed

that soap-use provoked feelings of disgust (Curtis et al., 2007). When soap-use promotion targeted feelings of disgust, soap-use increased after toilet-use and before eating by 13% and 41% respectively (Curtis et al., 2007). Identifying emotions associated with CAC can be extrapolated and linked to potential harmful behaviours.

Marketing affects CAC. Regulation, public health and social marketing is the trinity of behavioural change (Hoek and Jones, 2011). Marketing shapes public perception of a product as it is generally their first product introduction. Regulation between social marketing and public health goals is needed to benefit the consumers choice environment (Hoek and Jones, 2011). This is not to constrain the public's voluntary behaviour, but to rather provide them with sufficient information to make an informed decision on CAC (Hoek and Jones, 2011). This would also help to address appropriateness because if the product is not being appropriately consumed this can increase potential health risks to the public (Hoek and Jones, 2011).

The theory of planned behaviour hypothesizes that ones' beliefs and behaviours are linked (Ajzen, 1991). It is a simple chain of "I believe" therefore "this is my attitude" subsequently "this is my intended focus" resulting in a behaviour (Ajzen, 1991). Identifying the "I believe" for CAC can help us determine the subsequent attitude and intention associated with CAC. Human behaviour is goal directed (Ajzen, 1985). This can be either habitual or routine, overtime skills can require no conscious thought (Ajzen, 2002). This can help us determine the public goal in consuming caffeine and alcohol containing beverages.

Recommended Questions:

What are your thoughts on co-ingestion?

How does it make you feel?

Are you aware of any marketing around co-ingestion?

#### G. Health perceptions

Health perceptions address the ingredients in the beverage, the effects of CAC (both positive and negative) and warning labels. Ingredients can be deduced from section B; hence no questions are required.

The health belief model highlights perceived benefit/barriers as an integral step in the likelihood of engaging a health-related behaviour. Understanding individuals positive and negative health perceptions associated with CAC enables us to have a deeper understand behind their behaviours and thought processes.

Acknowledgement of warning labels is of interest as this may impact the publics ingestion of caffeine and alcohol containing substances. Analysing the publics acknowledgement of warning labels can be further applied into policy development. The empowerment theory is applicable as it is the recognition of an individual's autonomy. It is the role of a company to make recommendations on CAC however it is the individual's choice to make informed decisions. This means that the company must inform the public of any side effects however the individuals is still free to consume the product. It is in the company's best interest to allow the customer to feel valued persuading them to consume their beverage.

Recommended Questions:

What could be some benefits of co-ingestion?

What could be some side effects of co-ingestion?

Have you come across any warning labels on mixing caffeine and alcohol?

## H. RAW FOCUS GROUP RESULTS

Sections	Ideas discussed and (total number of focus groups mentioning idea)		Main themes
<b>Exploring “caffeine” and “alcohol” co-ingestion</b>	<ul style="list-style-type: none"> <li>• Good time (4)</li> <li>• Partying (5)</li> <li>• “You would die” (1)</li> <li>• Terrible idea (3)</li> <li>• Are great drugs (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Lots of fun (3)</li> <li>• Positive thoughts (3)</li> <li>• Not good for your health if you have it every day and too much (4)</li> <li>• Not good together (2)</li> </ul>	<ul style="list-style-type: none"> <li>• Two split opinions either positive or negative.</li> </ul>
<b>Product Use-Examples</b>	<ul style="list-style-type: none"> <li>• RTDs (5)</li> <li>• Jager bombs (5)</li> <li>• Vodka and red bull (5)</li> <li>• Rum and kola (5)</li> <li>• Sweet carbonated drinks (4)</li> <li>• Premixes at bar (5)</li> <li>• African elephant (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Baileys (5)</li> <li>• Irish whiskeys (3)</li> <li>• Special coffees (4)</li> <li>• Coffee liquor (4)</li> <li>• Jack Daniels with kola (5)</li> <li>• Bourbon and kola (5)</li> </ul>	<ul style="list-style-type: none"> <li>• Two main categories as highlighted in the literature review.</li> </ul>
<b>Influences/factors of CAC</b>	<ul style="list-style-type: none"> <li>• Health reasons (3)</li> <li>• Experimenting (2)</li> <li>• Friends (5)</li> <li>• Cost (4)</li> <li>• Alcohol percentage (5)</li> <li>• Convenience (4)</li> <li>• Design of bottle (2)</li> <li>• Calories (4)</li> <li>• Sugar (5)</li> <li>• Environment (4)</li> </ul>	<ul style="list-style-type: none"> <li>• Religion (2)</li> <li>• Parental control (2)</li> <li>• Articles read (1)</li> <li>• Previous experiences (3)</li> <li>• News (1)</li> <li>• Fizziness (1)</li> <li>• Taste (4)</li> <li>• Weather (2)</li> <li>• Addiction (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Influences and factors mainly from the packaging.</li> <li>• The next common influence is from previous experience.</li> </ul>
<b>Functional Expectations-Access</b>	<ul style="list-style-type: none"> <li>• Friends/ family (5)</li> <li>• Bars (5)</li> <li>• Restaurants (5)</li> </ul>	<ul style="list-style-type: none"> <li>• Liquor stores/ DIY (5)</li> <li>• Duty free (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Predominantly social places.</li> </ul>
<b>Context of Use Occasions</b>	<ul style="list-style-type: none"> <li>• Parties (5)</li> <li>• Dinners (5)</li> <li>• Restaurants (5)</li> <li>• Clubs/ Bars (5)</li> <li>• During the weekend (5)</li> <li>• Anniversaries (3)</li> <li>• Summer (2)</li> </ul>	<ul style="list-style-type: none"> <li>• Before catching a flight (1)</li> <li>• Festivals (3)</li> <li>• Stags (1)</li> <li>• Family gathering (5)</li> <li>• School party (2)</li> <li>• Sporting events (2)</li> </ul>	<ul style="list-style-type: none"> <li>• Consumed mainly in social settings and for events parties.</li> </ul>

	<ul style="list-style-type: none"> <li>• Student night (Wednesday) (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Holidays (2)</li> </ul>	
<b>Time of day</b>	<ul style="list-style-type: none"> <li>• Day events (3)</li> <li>• At night (5)</li> </ul>	<ul style="list-style-type: none"> <li>• During lunches/ meetings (1)</li> <li>• Summer time (2)</li> </ul>	<ul style="list-style-type: none"> <li>• Mainly during nights and socially.</li> </ul>
<b>Product Experiences- Context consumed</b>	<ul style="list-style-type: none"> <li>• Socially (5)</li> <li>• Partying (5)</li> </ul>	<ul style="list-style-type: none"> <li>• When younger (3)</li> <li>• Habit (1)</li> </ul>	<ul style="list-style-type: none"> <li>• CAC consumption is socially influenced.</li> </ul>
<b>Emotions associated</b>	<ul style="list-style-type: none"> <li>• Anxiety (3)</li> <li>• Avoidance (4)</li> <li>• Amplifies any emotions (3)</li> <li>• Anger (2)</li> <li>• Happiness (5)</li> <li>• Motivated (4)</li> </ul>	<ul style="list-style-type: none"> <li>• Confidence/ extroverted (4)</li> <li>• Sadness (4)</li> <li>• Emotional (5)</li> <li>• Hyper (5)</li> <li>• Included (3)</li> </ul>	<ul style="list-style-type: none"> <li>• CAC overall boosts the emotion you are already feeling.</li> <li>• Some people get a positive boost, feeling happy and extroverted</li> <li>• Others become emotional and sad.</li> </ul>
<b>Experiences</b>	<ul style="list-style-type: none"> <li>• Did not enjoy (3)</li> <li>• Getting intoxicated faster (4)</li> <li>• Reckless behaviour (5)</li> <li>• Drink a lot before special ended (2)</li> <li>• Many bruises (4)</li> <li>• Non-logical thinking (4)</li> <li>• Vomiting (3)</li> <li>• Alcohol kicks in slower (3)</li> </ul>	<ul style="list-style-type: none"> <li>• Intoxication lasts longer (3)</li> <li>• Initially enjoyable taste (4)</li> <li>• Accidents/ violence (4)</li> <li>• Begin with caffeine and alcohol then move to just alcohol (2)</li> <li>• Spike in energy then crash (4)</li> </ul>	<ul style="list-style-type: none"> <li>• Overall negative experiences experienced e.g. peer pressure to drink, spikes and crashes in energy and needing more to achieve drunkenness.</li> <li>• Risky behaviours taking place causing unsafe situations, bruising and non-logical thinking.</li> </ul>
<b>Other substances</b>	<ul style="list-style-type: none"> <li>• Binge eating (1)</li> <li>• Smoking tobacco (5)</li> <li>• Smoking weed (4)</li> <li>• Ecstasy (2)</li> </ul>	<ul style="list-style-type: none"> <li>• Amphetamine (1)</li> <li>• Cocaine (2)</li> <li>• Aspirin (1)</li> <li>• Nurofen (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Smoking tobacco and weed is the most commonly mentioned.</li> </ul>

<b>Product Perceptions-Awareness of advertising</b>	<ul style="list-style-type: none"> <li>• Instagram (2)</li> <li>• Billboards (4)</li> <li>• Buses (3)</li> <li>• Car stickers (2)</li> <li>• Promotional girls (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Music festival sponsorship (2)</li> <li>• Student car stickers (1)</li> <li>• Towards teenagers (4)</li> <li>• Music and movies (4)</li> </ul>	<p>Mainly through</p> <ul style="list-style-type: none"> <li>• Billboards (traditional advertising)</li> <li>• Music and television (hidden advertising).</li> </ul>
<b>Thoughts on labelling</b>	<ul style="list-style-type: none"> <li>• Nicely presented (5)</li> </ul>	<ul style="list-style-type: none"> <li>• Very little detail on ingredients (3)</li> </ul>	<ul style="list-style-type: none"> <li>• Bright to catch consumers eye and entice them.</li> </ul>
<b>Read on labels</b>	<ul style="list-style-type: none"> <li>• Percentage alcohol (5)</li> <li>• Sugar (5)</li> <li>• Calories (5)</li> <li>• Sodium (3)</li> </ul>	<ul style="list-style-type: none"> <li>• Carbohydrates (3)</li> <li>• Guarana (1)</li> <li>• Caffeine content (1)</li> <li>• Potassium (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Caffeine is not commonly a concern.</li> <li>• Alcohol percentage is only a concern to achieve getting drunk.</li> <li>• Sugar of concern due to weight gain.</li> <li>• Sodium of concern due to potential heart affects.</li> </ul>
<b>Health perceptions-Health conditions to consider</b>	<ul style="list-style-type: none"> <li>• Heart conditions (4)</li> <li>• Diabetes (4)</li> <li>• Pregnancy (2)</li> </ul>	<ul style="list-style-type: none"> <li>• Lactating (2)</li> <li>• Allergies (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Heart conditions is of concern due to the caffeine and diabetes due to the sugar content.</li> </ul>
<b>CAC fitting into lifestyle</b>	<ul style="list-style-type: none"> <li>• Drink less cause not as young (4)</li> <li>• Avoid due to experiences (4)</li> <li>• Drink socially (5)</li> <li>• Drink when I want to have fun (4)</li> <li>• Avoid if busy the next day (4)</li> </ul>	<ul style="list-style-type: none"> <li>• Causes poor decisions (2)</li> <li>• Quick pick me up (1)</li> <li>• Rarely (3)</li> <li>• Parental influence to avoid (2)</li> <li>• Avoid due to calories (3)</li> <li>• Drunk due to peer pressure (3)</li> </ul>	<ul style="list-style-type: none"> <li>• CAC is predominantly a socially consumed drink.</li> </ul>
<b>Potential health and</b>	<ul style="list-style-type: none"> <li>• Insomnia (4)</li> <li>• Agitation (3)</li> </ul>	<ul style="list-style-type: none"> <li>• Increased stomach pain (2)</li> </ul>	<ul style="list-style-type: none"> <li>• All the physiological effects are</li> </ul>

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<b>physiological effects</b>	<ul style="list-style-type: none"> <li>• Feeling horrible the next day (4)</li> <li>• Increase blood pressure (3)</li> <li>• Rotten teeth (1)</li> <li>• High cholesterol (1)</li> <li>• Diabetes (4)</li> </ul>	<ul style="list-style-type: none"> <li>• Impaired special judgement (4)</li> <li>• Impaired memory (4)</li> <li>• Effects the liver (2)</li> <li>• Dehydration (2)</li> <li>• Addiction (2)</li> <li>• Boost serotonin (1)</li> </ul>	<p>negative and more or less temporary.</p> <ul style="list-style-type: none"> <li>• Predominantly affecting people's cognitive function and cardiovascular health.</li> </ul>
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## I. ASSESS CAFFCO'S SUITABILITY IN ASSESSING CAFFEINE AND ALCOHOL CO-INGESTION

This Appendix addresses the third study object, to assess CaffCo's suitability in assessing caffeine and alcohol co-ingestion.

Table 1 shows comparisons between the questions currently included in CaffCo around the co-ingestion of caffeine and alcohol and the themes from the focus group moderator guide.

Table 1 Identification of themes currently present in CaffCo questionnaire compared to themes in the moderator's guide

<b>Question from CaffCo</b>	<b>Themes from Moderators guide</b>
Which of these items do you drink / eat? Include those that you only consume occasionally	Exploring "caffeine" and "alcohol" co-ingestion
Think about your own reasons for drinking kola drinks Option: as a mixer for alcohol	Product Use
In which environments do you drink kola drinks? Option: A bar environment, a party environment, other	Product Use
Think about your own reasons for drinking energy drinks. Option: as a mixer for alcohol	Product Use
Caffeinated alcoholic RTDs are premixed alcoholic drinks with either a kola base or with added caffeine or guarana. Examples of RTDs included.	Product Use
How often do you drink caffeinated RTDs (on average)?	None
Think about your own reasons for drinking Caffeinated RTDs.	Product Experiences
What time of day do you drink RTDs?	Context of Use
In which environments do you drink caffeinated RTDs?	Context of Use
For the following products, please select the main reasons why you might not consume them. Option: Caffeinated alcoholic RTDs	Health Perceptions, Product Perceptions, Product Experiences
The following are statements on attitudes and behaviours around caffeinated products Option: Caffeinated RTDs are more socially acceptable way to drink alcohol than spirits	Health Perceptions, Product Perceptions

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Is there an age group that you think of as being the main consumers for each product?      None

Option: Caffeinated RTDs

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Is there a gender that you think of as being the main consumers for each product?      None

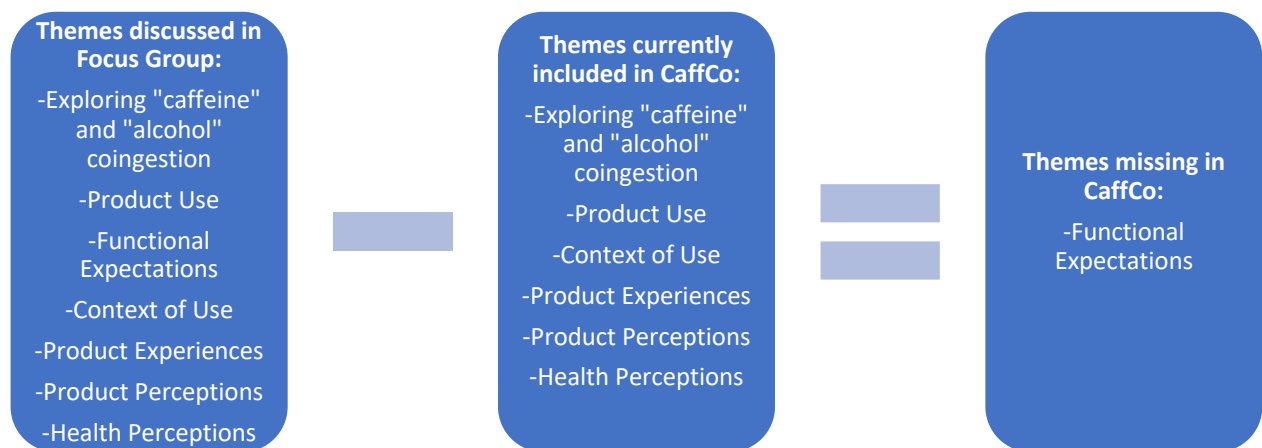
Option: Caffeinated RTDs

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\*CaffCo version 2017

Some questions in CaffCo around co-ingestion do not fit into any category outlined in the moderator guide used for this study (Table 1). This highlights that CaffCo currently contains qualitative questions around the co-ingestion of caffeine and alcohol which is valuable to collect information on but not appropriate to be covered in the focus group sessions.

Figure 1 Key themes on the co-ingestion of caffeine and alcohol currently included or missing from CaffCo



When comparing the moderators guide to the content of CaffCo, the only theme missing, which is essential in order to properly assess CAC is “functional expectations”. This topic primarily revolves around accessibility to beverages containing caffeine and alcohol. By adding questions about accessibility, CaffCo would become a more comprehensive questionnaire in its’ ability to assess caffeine intake, influences and experiences in New Zealanders (which it currently already does), as well as providing information on the intake, influences and experiences with the co-ingestion of caffeine and alcohol in New Zealanders. In addition, CaffCo currently only explores co-ingestion of caffeine and alcohol via RTDs. CaffCo will need alterations to

include additional sources of caffeine and alcohol containing beverages such as the mixing of spirits with kola drinks.

It is important to note Table 1 does not consider the depth at which CaffCo explores each theme in the moderator guide. CaffCo contains additional questions around intake, perceptions and qualitative themes that were not considered appropriate to cover during the focus groups, however, these questions do yield valuable data for future research.

## J. ADDITIONAL DISCUSSION

It is important to provide a definition of what “beverages containing caffeine and alcohol” are before data collecting on this topic. This is because if the topic is not well understood by the reader answering the relevant questions, incorrect responses could occur, such as the participant believing they should provide information on beverages containing only caffeine or only alcohol.

CaffCo is currently unable to effectively assess qualitative aspects on CAC, specifically around people’s personal experiences pre and post consumption (e.g. the environment, influences, gaining access, feelings and side-effects). In order to rectify this deficiency, open ended questions could be added, where people are asked to write, or audio record their experiences (providing specific details such as setting, emotions and quotes etc.). Additionally, CaffCo does not include any questions around advertising or label reading/awareness for beverages containing caffeine and alcohol. The inclusion of such questions would allow us to gain insight on the public’s decision making and overall awareness and knowledge around beverages containing caffeine and alcohol.

## K. SAMPLE DEFINITION AND QUESTIONS

### SAMPLE DEFINITION OF CO-INGESTION OF CAFFEINE AND ALCOHOL

The ingestion of caffeine and alcohol simultaneously or within a short frame of time  
e.g. a beverage containing rum and coke or eating chocolate while drinking wine.

### SAMPLE QUESTIONS:

1. Where do you obtain beverages which contain both caffeine and alcohol in a single product?

- Bars/ Pubs
- Restaurants
- Liquor store
- Friends/Family
- Other [please write]

2. How do beverages containing both caffeine and alcohol fit into your daily life?

(Check all that apply)

- Drink daily
- Drink weekly
- Drink monthly
- Drink socially
- Drink to get drunk
- Drink due to stress
- Drink for fun
- Drink due to peer pressure
- Other [please write]

3a. What information do you usually read on the labels of beverages which contain both caffeine and alcohol?

- Alcohol percentage
- Sugar/calories
- Sodium
- Other [please write]

3b. Is there any information not currently on the label of beverages containing caffeine and alcohol which you would like to know?

4. What factors impact on your choice of drinks containing caffeine and alcohol? (Check all answers that apply and rank in order of importance, with 1 being most important).

-Cost

-Alcohol percentage

-Design of bottle

-Volume

-Friends

-Sugar

-Environment

-Taste

-Other [please write]

5. After drinking a beverage containing caffeine and alcohol how does it make you feel?

6. Have you experienced any of the following after drinking beverages containing caffeine and alcohol (Check all that apply)

-Bruising

-Vomiting

-Nausea

-Accidents / violence

-Memory loss

-Getting intoxicated faster

-Spike and crash in energy

-Other [please write]

7. Do you have any concerns around co-ingesting caffeine and alcohol? If so, please explain

[Open]

## L. PILOT TEST

### PILOT TESTING OF SAMPLE QUESTIONS

Pilot testing of the additional questions around co-ingestion of caffeine and alcohol was required to check for readability and understanding. Twenty individuals were invited to complete this pilot testing. These individuals are non-focus group participants, full-time workers ranging from 20-30 years old. Only 10 individuals participated.

### PILOT TESTING FEEDBACK

The questions were presented to participants and feedback on readability and understanding was requested by the student researcher. Participants felt the questions were clearly worded and easy to understand, they particularly enjoyed having options to choose from.

It is recommended that these questions are included in the latest version of CaffCo to enhance the tools ability to assess the co-ingestion of caffeine and alcohol in New Zealanders.