Testing the Effectiveness of a Combined Web-Based and Ecological Momentary Intervention for First-Year University Students

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Abstract

First year university students engage in heavy alcohol use. Concerns around adverse alcohol-related health outcomes has prompted research on methods to reduce alcohol consumption in university students. The current study investigated the effectiveness of a combined Web-Based Intervention (WBI) and Ecological Momentary Intervention (EMI) on reducing alcohol consumption in first-year university students. Participants were randomly allocated to one of three conditions: Ecological Momentary Assessment (EMA), EMA+WBI, or EMA+WBI+EMI. The WBI consisted of personalized feedback on participants' alcohol consumption while the EMIs consisted of a combination of social norms, potential alcohol-related consequences, and protective behavioural strategies. To assess the impact of the intervention, participants completed three surveys across the academic year (i.e., pre-university, end of semester 1, end of semester 2) and responded to fortnightly EMA text messages to report their weekend alcohol consumption. Results revealed that alcohol consumption reported by those in the EMA+WBI+EMI and EMA+WBI conditions did not differ from that of participants in the EMA control condition. Further, although participants in the EMA+WBI+EMI condition reported an average of one less harm than those who received the EMA+WBI condition, it was not significantly different from the number of harms reported by those in the EMA control condition.

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First-Year University Students

At the end of high school (aka. secondary school), students are faced with the choice of

entering the job market or pursuing higher education. Gaining further qualifications can provide

individuals with the necessary skills and knowledge required for certain occupations (Robst,

2007). In that sense, a higher level education increases job prospects and provides career

opportunities. Other reasons for attending university (aka. college) may be for interest, to be

intellectually stimulated, and for personal achievement (Fazey & Fazey, 2001). Furthermore, the

value that society places on education may motivate an individual to pursue higher education.

There are many reasons why an individual may choose to study, which is reflected in the

increasing enrolment rates in tertiary education institutions; from 306,165 to 404,730 students

between 2000 and 2017 (Ministry of Education, 2019). While there are many benefits of attaining

a higher level qualification, there are also downsides to undertaking tertiary study.

Although commonly referred to as our best and brightest, tertiary students report higher

levels of hazardous drinking than age-matched peers. For example, Kypri, Cronin, and Wright

(2005) conducted an online survey to measure alcohol consumption and consequences among

students. The researchers compared the hazardous drinking of students to an age-matched sample

from the general population using the Alcohol Use Disorders Identification Test (AUDIT). The

AUDIT is a 10-item questionnaire that examines 3 dimensions of alcohol use; (1) amount and

frequency, (2) dependence, and (3) alcohol-related problems (Bohn, Babor, & Kranzler, 1995).

An AUDIT score of eight or more is indicative of hazardous drinking (Bohn et al., 1995; Reinert

& Allen, 2007). When directly compared to the age-matched sample, Kypri, Cronin, et al. (2005)

found that the prevalence of hazardous drinking in students was nearly double that of the general

population (65% vs 36%, respectively). Furthermore, students scored over 50% higher on the

AUDIT than their non-studying peers. This issue is not restricted to New Zealand students as similar findings having emerged from student populations internationally (O'Malley & Johnston, 2002; Slutske et al., 2004).

Higher rates of hazardous drinking in student populations and concerns about health-related outcomes from hazardous drinking have catalysed research into investigating the factors which predict these drinking behaviours. Longitudinal data that spans the transition period from secondary school to university has shed light on factors which predict heavy alcohol use. For example, a study examining the consumption behaviours of female twins found no difference in pre-university alcohol consumption (Slutske et al., 2004). However, females who attended university reported more frequent consumption, binge drinking episodes and intoxication. Further, twins who attended university consumed greater volumes of alcohol on single occasions than their non-student counterpart. Consistent with these findings, O'Malley and Johnston (2002) noted that secondary school students who do not pursue tertiary study consume more during their final year of study, however, those who continue with tertiary study consume more alcohol than their non-studying peers during their university years. More recently, a comprehensive literature review examining predictors of alcohol use found that approximately 40 to 50% of non-drinking high school students who attend university start drinking during their first year of study (Borsari, Murphy, & Barnett, 2007). Even students who engaged in heavy consumption before attending university further increased their consumption during their first year of tertiary study.

The uniqueness of student alcohol consumption has led to a growing amount of research focussing on the drinking behaviours of this population. For example, Kypri et al. (2009) investigated the alcohol-related behaviours of students across five New Zealand universities whereby students were sampled over three consecutive years. The researchers investigated a battery of alcohol-related factors; frequency of binge drinking, alcohol consumption, typical

consumption (daily and weekly), hazardous drinking, and alcohol-related problems. Sixty-eight percent of students who reported consuming alcohol in the previous 12 months displayed hazardous levels of alcohol consumption. Furthermore, 36.9% had engaged in at least one binge drinking session in the past week. Here, binge drinking was defined as four or more drinks for females and five or more drinks for males in a single session.

Social Influence and Individual Behaviour

The transition period to university overlaps with a life stage commonly referred to as emerging adulthood (Johnson, Gans, Kerr, & LaValle, 2010; Quinn & Fromme, 2011; White et al., 2006). During this stage, there is significant identity development. For incoming undergraduates there is a shift in social context which grants students autonomy from parents and allows peers to become more influential. Many studies have emerged demonstrating how social factors play a large role in student drinking behaviours.

For example, Larsen, Engels, Granic, and Overbeek (2009) used a naturalistic bar setting in which university students sat with an age and gender matched experimental confederate. The confederate either consumed no alcohol, one alcoholic beverage for light consumption, or three alcoholic beverages (if female) or four alcoholic beverages (if male) for heavy drinking. Participants tended to mirror the drinking behaviours of the confederate, demonstrating the role of social influence in modelling drinking behaviours. This modelling of drinking behaviours has also been observed when using non-sex matched confederates (Larsen, Overbeek, Granic, & Engels, 2010). These studies show how students modify their drinking behaviours when in the presence of their peers.

Approaching individual behaviours from a group dynamics viewpoint further illustrates how social factors influence student drinking. All social groups have a set of norms and attitudes which regulate the behaviours of in-group members (Johnston & White, 2003; Terry & Hogg,

1996; White, Smith, Terry, Greenslade, & McKimmie, 2009). Behaviours that are believed to be approved by members of a group are referred to as injunctive norms (White et al., 2009). When these norms are violated, the individual fears they may face negative social repercussions (Lapinski & Rimal, 2005). Therefore, group members tend to act in ways which they believe their in-group members deem appropriate. Students tend to overestimate the drinking norms of their peers, which is reflected in the higher rates of consumption. Kypri and Langley (2003) found that University of Otago students tended to misjudge the drinking behaviours of their peers such that they believe other students consume more alcohol and experience more alcohol-related harms than they really do. Further, there was a strong positive correlation between the participants' perceptions of student drinking and the amount of alcohol they consumed. Specifically, students who viewed the drinking norms as more hazardous tended to drink more hazardously. Students that overestimate consumption norms are also more likely to overestimate the level of consumption used to define binge drinking, and thereby underestimate the severity of their own consumption (Weitzman, Nelson, & Wechsler, 2003). These misperceptions of alcohol-use among peers are not restricted to New Zealand students, and have been observed in many students populations internationally, such as in the United States, United Kingdom, France, and Germany (DeJong et al., 2006; França, Dautzenberg, & Reynaud, 2010; Haug, Ulbricht, Hanke, Meyer, & John, 2011; McAlaney & McMahon, 2007; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007; Pedersen, Neighbors, & LaBrie, 2010; Perkins, 2002).

The strength to which an individual identifies with a group also determines how behaviours are performed. Here, behaviours tend to resemble the group that they most closely identify with. Patrick, Neighbors, and Lee (2012) demonstrated how the more strongly an individual identifies with a group, the more similar their behaviour will be to the other group members'. They investigated social norms of student consumption at 21st birthday celebrations. A week before their 21st birthday, students reported the perceived social drinking norms for such

celebrations for three social groups: (1) friends, (2) other students, and (3) the general population. Students also reported their own drinking intentions and consumption on their birthday. Patrick et al. (2012) noted that the closer the groups were to the student, the more the students' drinking behaviour reflected the group's norms. In other words, the students' consumption most closely resembled their friend's consumption than other students or the general population. The perceived social norms of other students' consumption was the next most similar, while the perceived social norms of the general population were the least influential. These findings suggest that the more closely an individual identifies with a group, the more influential the group's behaviour will be on the individual's behaviour.

Lastly, attitudes towards a particular behaviour determine how the behaviour will be performed (Armitage & Christian, 2003). With regard to alcohol use, students tend to hold liberal attitudes. Watt (1999) examined the attitudes and consumption of alcohol in a sample of 400 Australian students. In total, 62% (248 out of 400) of the students believed that a change in student drinking culture was not necessary. Similarly, 69% (276 out of 400) engaged in hazardous drinking themselves. In support of this, Weitzman et al. (2003) mentioned that individuals who developed heavy drinking behaviours in college are also more likely to hold liberal alcohol-related views, such as a belief that the minimum legal purchasing age should be lowered.

Alcohol-Related Harms

Alcohol use can result in physical, mental, social, and economic harms. These consequences can be categorized into first-hand and second-hand harms (Abar, Mallett, Turrisi, & Abar, 2016). Primary harms refer to those that occur as a result of one's own drinking. (e.g. getting in trouble with police or overdosing and requiring medical treatment) (Weitzman & Chen, 2005). In contrast, second-hand harms are those that result from another individual's drinking (e.g. being assaulted, humiliated, or having property damaged) (Weitzman & Chen, 2005).

Heavy drinking is a common feature of student drinking that can result in a range of harms; such as intoxication, assaults, unwanted sexual experiences, blackouts, hangovers, and academic problems (El Ansari, Stock, & Mills, 2013; White & Hingson, 2013; White, Jamieson-Drake, & Swartzwelder, 2002). Moreover, students are more likely to be diagnosed as having alcohol abuse disorder than non-studying emerging adults (Slutske, 2005). The relationship between alcohol-use and the risk of experiencing an alcohol-related harm has been described as dose-dependent (Taylor et al., 2010). In other words, the more an individual drinks, the more likely they are to experience harm. Taylor et al. (2010) examined the rates of vehicular and non-vehicular related harms as a result of alcohol consumption, and found a strong relationship between recent use and negative outcomes for both harms. Hence the amount of alcohol consumed resulted in an increasing number of harms experienced. Of interest, the minimum level of consumption at which harm was experienced was two standard drinks, which suggests that even low quantities of alcohol come with risks.

With the high levels of alcohol use in New Zealand student populations, it is not surprising that the prevalence of alcohol-related harm in this population is also high. McGee and Kypri (2004) examined the alcohol-related consequences experienced by a sample University of Otago students during a three-month period. Of the 1464 students sampled, 70.8% experienced a hangover, 45.6% had vomited, 46.8% had blacked out, 28.3% had an emotional outburst, and 15.0% reported stealing property. Students also suffered academic problems, including being late for class (26.3%), missing class (45.3%), having trouble concentrating (40.7%), and handing in an assignment late (9.0%).

The nature of alcohol use within the university context makes it common for students to also experience a range of second-hand harms. Langley, Kypri, and Stephenson (2003) surveyed 1564 University of Otago students about their experiences of harm as a result of someone else's

drinking. Students reported how many times they had experienced each of 11 harms in the past month (e.g., "insulted or humiliated," "pushed, hit, or otherwise assaulted," "property damage," etc.). In total, 84% of students reported experiencing at least one second-hand harm. Interestingly, there was a positive correlation between the respondents own consumption and the number of second-hand harms they experienced; students who drank more often were also more likely to experience harm due to another individual's drinking. One could argue that those who drink have more contact with others that drink, and hence, would have more opportunities to experience secondary harm. It is important to note, however, that the prevalence of second-hand harm experienced by non-drinkers was also high with 72% experiencing at least one second-hand harm (e.g., 29% had been insulted or humiliated, 8% had been physically assaulted, etc.).

Until recently, the relationship between alcohol use and harm over time had not been examined. In their study, Merrill et al. (2017) used time varying effect models to compare the relationship between alcohol consumption and harm over the course of multiple academic years. Of those who consumed alcohol in the first week of study, approximately half reported experiencing at least one harm during this time. At the end of the year 40% of females and 30% of males reported experiencing harm in the previous week. The strength of relationship between time and harm decreased during the following year. In general, the relationship between alcohol use and harm changed such that overtime students were at a less risk of experiencing harm from their alcohol use.

There are multiple possible explanations for this. Firstly, given that the relationship between consumption and harm is exponential, the high rates of consumption during the first week of university could explain the high rates of harm during this week. Secondly, residential arrangements change throughout the course of study. Many attend residential colleges in their first year, which have been identified as environments in which particularly hazardous drinking

occurs and high levels of harm are experienced. For example, Carey et al. (2009) found that 66%

of ambulance call outs to Halls of Residence were alcohol-related. Lastly, over time students

may develop protective strategies to avoid harms (e.g., learning personal drinking limits, having

a drinking buddy to look out for one another, etc.) (Benton et al., 2004; Delva et al., 2004;

Sugarman & Carey, 2007).

Patterns of Alcohol Consumption

Patterns of consumption vary throughout the academic year and across the course of a

degree. Del Boca, Darkes, Greenbaum, and Goldman (2004) assessed both when and how much

students consume during their first year of study. Students reported their daily consumption at

the end of each month. Firstly, the researchers noted that student consumption peaked during

Thursdays to Saturdays. Consistent with this finding, Wood, Sher, and Rutledge (2007) noted

that a greater proportion of students consume on these days, and consume larger quantities on

these days. Secondly, Del Boca et al. (2004) found that weekly consumption tended to decrease

over time. However, weeks containing holidays/events (i.e. such as Halloween, Thanksgiving,

Christmas, New Years, and Spring Break) did not fit this trend. During weeks where

holidays/events occurred, a larger proportion of students consumed alcohol and consumed more

heavily. The nature of consumption was congruent with the academic calendar. For instance,

students consumed more at the beginning of the semester when there were few assessments.

Similarly, student consumption decreased during examination periods. Del Boca et al. (2004)

described student consumption as being contingently driven, such as their drinking tends to

reflect academic workload.

Event-specific drinking refers to specific occasions that are characterised by excessive

consumption. For example, particularly heavy consumption is commonly observed for events

such as Spring Break, New Year's Eve, and 21st Birthday Celebrations (Kushnir & Cunningham,

2014). During these events, the risk of experiencing alcohol related harms are also heightened

(Neighbors, Walters, et al., 2007; Riordan, Flett, Lam, Conner, & Scarf, 2016). Indeed, event-specific drinking appears to be a common feature of student alcohol consumption. Greenbaum, Del Boca, Darkes, Wang, and Goldman (2005) categorized students based on variations their drinking trajectories. From the sample, five drinking trajectories were identified which described the initial intensity of consumption at baseline (low, medium, or high), and the intensity of consumption at the end of the academic year. Interestingly, across all of the drinking trajectories identified, peak alcohol consumption aligned with a holiday/event. This suggests that event-specific drinking creates windows of higher consumption for all students, regardless of their typical consumption.

Orientation Week Drinking

As noted above, alcohol consumption tends to increase in concert with the occurrence of holidays/events (Del Boca et al., 2004; Greenbaum et al., 2005; Tremblay et al., 2010). Orientation Week is an annual occurrence that commences the university year. It precedes the academic semester and differs from other weeks as it consists of no formal academic work. Orientation Week was designed as a way to introduce students to university life and to foster the transition to this context. To achieve this, the university holds daily events (e.g., concerts, toga parties, rugby matches, etc.). This period is recognized as a time in which students engage in particularly heavy and hazardous drinking and, consequently, also tend to report experiencing more harms (Riordan et al., 2016).

A handful of studies have looked at student drinking over the course of Orientation Week. For example, Riordan, Scarf, et al. (2017) used breathalysers to measure the Blood Alcohol Concentration (BAC) of students attending an Orientation Week event. The BAC data revealed that 66.2% (223 out of 337) of those breathalysed had consumed over the New Zealand drink diving limit (0.05 g/dl) before attending the event. Moreover, a large number of participants were excluded due to the fact they had consumed alcohol in the 10 minutes prior to being approached.

In commenting on this exclusion criterion, Riordan, Scarf, et al. (2017) found that 30% of the 902 individuals approached were excluded because of recent alcohol consumption. These findings demonstrate the practice known as 'pre-gaming' (i.e., consuming alcohol prior to attending an event) (Pedersen & LaBrie, 2007; Riordan, Conner, Flett, et al., 2018).

Research into drinking behaviours during orientation week has identified the act of pre-gaming as common among university students. Using a similar method to the one above, (Riordan, Conner, Flett, et al., 2018) sampled 569 undergraduate students enrolled at the University of Otago. Attendees of three university-run concerts during Orientation Week gave self-reports on alcohol consumption prior to the event. Eighty-eight percent of the participants reported consuming alcohol prior to attending the event. Further, these participants reported consuming an average of 6.9 standard drinks during the pre-game session. The researchers' stated that students who arrived later to the concerts had engaged in longer pregame sessions and consumed larger quantities of alcohol.

Orientation Week in particular is characterized by heavy consumption, and research has suggested that this period sets a precedent for academic year drinking. Riordan, Conner, Flett, and Scarf (2015) assessed the drinking behaviours before university, during orientation week, and throughout the academic year. First-year university students residing in a University of Otago Hall of Residence completed an online survey about their typical pre-university consumption. Participants responded to ecological momentary assessments (EMAs) each day during orientation week with the amount they had consumed the previous day, while monthly EMAs measured typical weekend consumption throughout the academic year. Not surprisingly, students tended to drink more heavily during Orientation Week than during a typical pre-university or semester weekend. Most notably, Orientation Week consumption predicted drinking throughout the academic year for males. Males who consumed heavily during

orientation week also tended to consume heavily throughout the academic year. This was

observed for all students regardless of whether they engaged in low or high levels of consumption

pre-university. Females showed this general trend too, however, it was not statistically significant
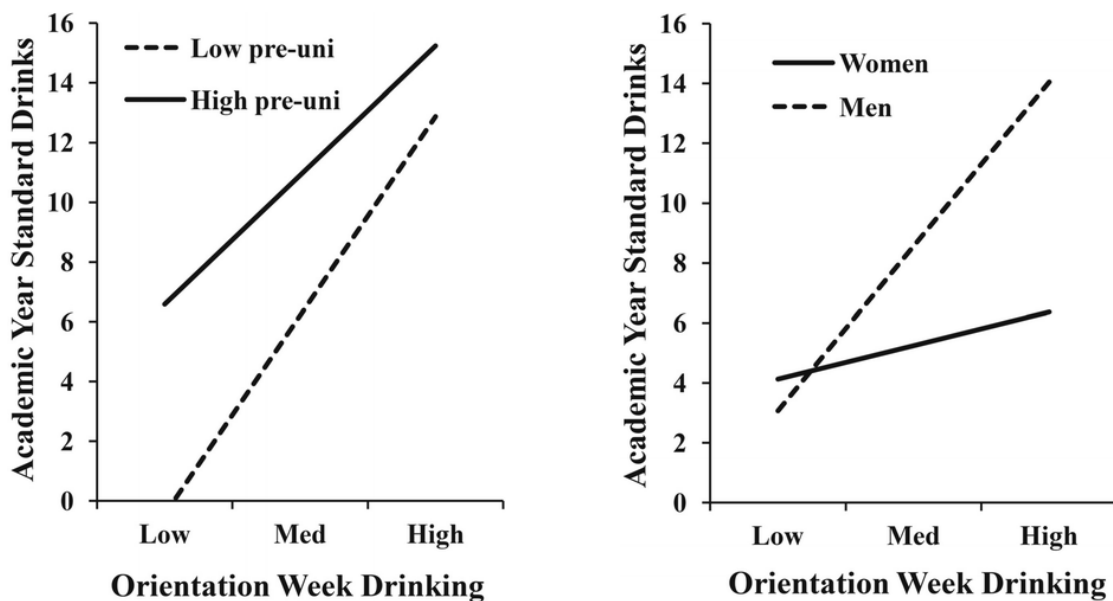
(see Figure 1 below).

Figure 1. The influence of pre-university weekend consumption and orientation week consumption on mean academic year weekend consumption (left). Interaction of gender and orientation week consumption on mean academic year weekend consumption (right). Both figures retrieved from (Riordan, Scarf, & Conner, 2015).

Alcohol Interventions

Concerns about student drinking and harms have catalysed research into developing

effective interventions. Advances in technology have allowed for a shift in the way that

interventions can be administered. Traditional methods required in-person screening and

interventions. Barriers to face-to-face interventions have been well-defined. For example,

stigma, cost, accessibility, and lack of anonymity prevent individuals from seeking treatment

(Schuler, Puttaiah, Mojtabai, & Crum, 2015). Web-Based Interventions are computer delivered

interventions which can be accessed using the internet. These are arguably more convenient and

less resource intensive. Furthermore, they tend to be cost-effective, easily accessible, quick to administer, and may be rolled out on a large scale. Therefore, the use of WBIs has the potential to reach those who may otherwise not seek treatment (Cunningham & Breslin, 2004; Hansen et al., 2012; Postel, De Jong, & De Haan, 2005). These factors make the use of WBIs for reducing alcohol consumption in undergraduates an appealing prospect.

Web-based Interventions. In the past decade, a great deal of research has examined the effectiveness of WBIs in reducing alcohol consumption in tertiary students with varying levels of success. For instance, Kypri et al. (2004) sampled 167 university students from the University of Otago. Participants completed an online survey assessing their drinking behaviours. Of these, 104 (52 males and 52 females) were identified as hazardous drinkers at baseline and were included in the study. AUDIT scores measured hazardous drinking at the time of recruitment, six weeks later, and six months later. The WBI consisted of personalized feedback following an initial online assessment. The feedback was based off of recommended health guidelines for alcohol consumption, diet, smoking, and exercise. Normative feedback with relation to their peers was also given. The intervention group reported less academic problems and personal problems than the control groups at the six-week and six-month follow-up assessments. However, any difference in the level of consumption between the two groups had disappeared at the six-month assessment.

In a subsequent study, Kypri et al. (2014) recruited students from seven New Zealand universities. Students were screened for problematic drinking and were included if they scored four or higher on the AUDIT-C indicating hazardous consumption. At baseline, the intervention group engaged in slightly more hazardous drinking than the controls (AUDIT-C = 6.8 and 6.6, respectively). The researchers focused on six factors; (1) typical drinking occasion volume, (2) typical weekly volume, (3) frequency of consumption, (4) academic problems, (5) risk of acute

harm, and (6) risk of chronic harm. Students who received the intervention consumed less during typical drinking sessions at the five month follow-up. However, no differences were observed across the other measures.

Internationally, WBIs have had marginally better success rates. For example, Neighbors, Larimer, and Lewis (2004) found that a WBI designed to correct misperceptions about social drinking norms and provide personalized feedback on consumption changed the perceptions of US students, such that they more accurately reflected the actual norms. Further, it slightly lowered consumption and alcohol-related problems and these effects were observed six months post-intervention. Similarly, Paschall, Antin, Ringwalt, and Saltz (2011) found that the use of an online intervention consisting of alcohol-related modules reduced alcohol consumption, hazardous drinking and alcohol-related harm in US students. Notably, those who displayed higher levels of interaction with the course content displayed the largest benefits. However, the effects of the WBI had dissipated at the subsequent follow-up six months later. Students who were more engaged with the WBI showed greater effects of the intervention. The authors suggested supplementing a WBI with another intervention to sustain the effects observed.

The efficacy of WBIs in changing student alcohol related behaviours and consequences is limited. While studies have demonstrated initial reductions in the level of consumption and the harms experienced, they typically fail to show any long-term effects. An explanation for this is that they are not in 'real-time'. In other words, they fail to consider the influence social context plays in student drinking (e.g. peer influence, access to alcohol, advertising, celebrations, etc.) (Connor, Kypri, Bell, & Cousins, 2011; Kypri, Bell, Hay, & Baxter, 2008; Larsen et al., 2009; Larsen et al., 2010; Sudhinaraset, Wigglesworth, & Takeuchi, 2016).

Ecological momentary interventions. Ecological Momentary Interventions have been proposed as a way for clinicians to deliver intervention information to patients in real time unlike

interventions conducted in clinical settings or WBIs. EMIs have been effective in reducing alcohol consumption and harms in young populations displaying hazardous drinking patterns (see Table 1 below). For example, Suffoletto et al. (2014) sampled 765 emerging adults (aged 17-25 years) who had been admitted to a US emergency department and who met the criteria for hazardous drinking. Participants were assigned into one of three conditions; EMA+EMI, EMA only, or control. Participants in the EMA+EMI completed text surveys about consumption intentions and behaviours on Thursdays and Sunday each week for three months. They also received tailored feedback regarding their alcohol consumption. Those in the EMA only condition (i.e. self-monitored drinking behaviours) reported consumption every Sunday for three months. The control condition did not receive any alcohol-related text messages. Participants who received both the EMI and EMA engaged in less binge drinking occasions, consumed less alcohol per occasion, and experienced less harm at the nine-month follow up than the those in the EMA only and control conditions.

The effectiveness of EMIs in reducing alcohol consumption in New Zealand student populations is unclear. For example, Riordan, Conner, et al. (2015) delivered EMIs to students during Orientation Week. The EMIs contained information regarding potential harms and health consequences of drinking. There was no difference in the level of consumption between males who received the EMI and those who did not. However, females who received the EMI consumed less alcohol. Riordan, Conner, Flett, and Scarf (2017) attempted to improve the effectiveness of this intervention by conducting focus groups to better tailor the EMI messages. Focus groups were conducted with both males and females to determine what EMI content would be the most likely to change drinking behaviour. Three conclusions regarding EMI content were generated from these discussions. First, the message should focus on the social implications of heavy alcohol use. Second, an informal tone was preferred. Finally, EMIs should be sent before consumption begins, and sent more than once.

Based on this feedback, Riordan, Conner, et al. (2017) adapted the EMI messages and recruited University of Otago students from two residential halls. Four EMIs were sent out throughout Orientation Week, and EMA messages assessed daily Orientation Week consumption and fortnightly academic semester consumption. Interestingly, the EMI was effective in reducing Orientation Week and semester consumption in students attending College A but not College B. Riordan, Conner, et al. (2017) note that there was a discrepancy between the levels of consumption between the two colleges at baseline. Baseline survey data showed that students from College B consumed markedly more than College A before attending university (14.7 vs 6.1 standard drinks, respectively) and during Orientation Week (37.2 vs 12.4 standard drinks, respectively). One explanation for not observing any effect in College B is that students in this college may have already established hazardous drinking patterns before attending university. As mentioned earlier, drinking behaviours remain mostly stable over time and strong interventions are required to change behaviours that have been established.

Table 1

Summary of ecological momentary intervention (EMI) studies

Author(s)	Participants	Sex	Mean age (SD)	Intervention	Control	Follow-up Assessment	Key Findings
(Bock et al., 2016)	US community college students who reported consuming 4 drinks within the past two weeks (n=60).	38.3% male (n=23) 61.7% female (n=37)	21.8 years old (3.0)	Texts sent on Thu, Fi, Sat and Sun nights over 6 weeks. Messages were facts about alcohol, consumption and harm reduction tactics, and alcohol related motivational messages.	Texts sent on Thu, Fi, Sat and Sun over 6 weeks. Texts were subscription and general motivational messages.	6 and 12 weeks after intervention	EMI reduced heavy drinking and harms, and higher resistance to drinking both 6 weeks and weeks 12 post intervention. High intervention retention rates.
(Riordan, Conner, et al., 2015)	First-year NZ university students (n=130).	45% male (n=58) 55% female (n=72)	21.8 years old (2.3)	Four texts sent through Orientation Week. Messages were social and long-term implications of drinking. EMA messages were sent throughout Orientation Week and once a week during the semester.	Received EMA messages through Orientation Week and throughout once a week during the semester.	Weekly EMA messages once throughout the semester.	EMI reduced alcohol consumption and harms in female but not male students.

(Riordan, Conner, et al., 2017)	First year NZ university students from 2 residential colleges (n=387).	Total 44% male (n=170) 56% female (n=217) College A 40% male (n=170) 60% female (n=217) College B 46% male (n=170) 54% female (n=217)	College A 18.4 years old (0.2) College B 18.4 years old (0.4)	Two texts sent through Orientation Week. Messages were social and long-term implications of drinking. EMA messages were sent throughout Orientation Week and once a fortnight during the semester.	Received EMA messages through Orientation Week and throughout once a fortnight during the semester.	Fortnightly EMA messages once throughout the semester.	At baseline, students from College A consumed more hazardously than College B. EMI reduced consumption in both males and females from college A, but not College B.
(Suffoletto et al., 2015)	Alcohol treatment non-seeking young recruited from a US emergency department. (n=765)	35% male (n=265) 65% female (n=500)	Feedback + Assessment 22.0 years old (2.0) Assessment Only 22.0 years old (2.0) Control 21.8 years old (2.1)	Two interventions; (1) EMA messages every Thu and Sun over the 12 weeks post admission to ED. Thu EMA messages assessed weekend drinking intentions and Sun EMA assessed consumption. EMI was feedback in response to EMAs. (2) EMA messages assessing weekly consumption.	Standard care/no alcohol weekly assessments.	3 months, 6 months, and 9 months following intervention.	Feedback is effective at reducing binge drinking, lowering consumption, and reducing harms at both the six and nine month follow-ups. EMA only condition did not reduce harm relative to controls.

Combining ecological momentary and web-based interventions. Attention has recently shifted to supplementing WBIs with EMIs. The rationale of a WBI with an EMI is that these interventions have been unable to produce long term effects in moderate drinkers when used separately. In theory, combining these techniques would create a more intensive intervention. Currently, only a few studies have investigated the effectiveness of pairing WBIs with EMIs. The earliest study combining the use of a WBI and EMI to reduce student alcohol consumption was conducted by Haug et al. (2013). A total of 477 Swiss students aged 15 to 25+ years old were recruited from seven vocational colleges (aka. trade schools). Vocational colleges are another form of post-secondary education (Tanggaard, 2007). Of the students recruited, 76% were eligible to receive the intervention. The remaining 24% were used as the no intervention control. During screening, students reported their typical consumption, binge drinking occasions, and alcohol-related harms from the previous month. From this, students were categorized into Non-Risk, Low-Risk, or High-Risk groups. A WBI provided personalized feedback on consumption as well as a comparison to their peers' consumption (i.e. social norms). EMI text messages focussed on an array of aspects related to healthy alcohol use as well as harms from heavy consumption. These messages were tailored to each risk group. All groups received motivational messages that focused on sensible drinking practices, resisting peer influence, and fitness. The Low-Risk group also received an extra fortnightly weekly message on their typical drinking day. These messages were regarding alcohol-related problems and reasons for reducing consumption. The High-Risk group received weekly messages covering all the content mentioned above, with the addition of information regarding counselling services as well as protective behavioural strategies to reduce their drinking. The High-Risk group received these additional messages on their typical drinking day. Follow-up assessments were conducted after the three month intervention. Haug et al. (2013) found that, across all participants who received the combined WBI+EMI intervention, there was a decrease

in the percentage of individuals engaging in binge drinking. Furthermore, these students showed a decrease in the average weekly consumption relative to the assessment only controls.

After their initial findings, Haug et al. (2017) conducted a more extensive WBI+EMI study. A total of 1,041 vocational students aged 16 to 19 years old were recruited. All students completed an online screening of alcohol use. The method of intervention replicated the Haug et al. (2013) study. The WBI component provided personalized feedback on consumption as well as information on consumption norms of their peers. Participants were then classified in to three groups based on the severity of their baseline alcohol use; Low-Risk, Medium-Risk, and High Risk. Participants received up to three EMI messages a week for a period of three months; Low-Risk drinkers received one, Medium-Risk drinkers received two, and High-Risk drinkers received three. The follow-up assessment was conducted six months after baseline (i.e. three months after the intervention ceased). Haug et al. (2017) noted that High-Risk drinkers who received the intervention reduced the number of binge drinking episodes, and lowered max volume of alcohol consumed during a drinking session relative to the assessment only controls. This general trend was observed for the Medium-Risk and Low Risk drinkers also, however the analyses used lacked power.

To date, Tahaney and Palfai (2017) have been the only researchers to examine the effectiveness a combined WBI+EMI intervention on undergraduate students alcohol consumption and harms. In this study, 113 US undergraduates who had engaged in at least one heavy episodic drinking during the previous month were recruited. Participants were randomly assigned into one of three conditions; (1) WBI+EMI condition, (2) WBI, or (3) assessment only. All completed baseline screening, after which the WBI component was delivered. This provided personalized feedback on drinking behaviours, alcohol-related information (e.g., drinking norms), adverse consequences, strategies to reduce drinking, and alternative non-alcohol related activities. Students in the WBI-EMI condition also received EMIs the month

following the WBI. In total, 12 EMIs were delivered across Thursdays, Fridays and Saturdays. The content of the EMIs matched the WBI. A follow-up assessment was then conducted at the end of the month. Students who received the WBI+EMI had lower weekend consumption than those who received the WBI only and assessment only control. Students in both the WBI-EMI and WBI only conditions were less likely to engage in heavy drinking episodes than the assessment only condition. However there was no observed difference in hazardous drinking between the two intervention groups. One possible explanation for this is that the EMI may sustain the effects of the WBI overtime rather than have an additive effect in reducing hazardous drinking. In this case, the follow-up assessment delivered at the end of the month may not have been long enough for the effects of the WBI to dissipate. Many studies looking at the efficacy of the WBIs on student alcohol use have shown effects lasting longer than a month (Kypri et al., 2013; Kypri et al., 2004; Kypri et al., 2014). As the WBI may have still been effective in reducing heavy episodic drinking at follow-up, and given that no new content was added, any sustained effect of the EMI would have been overlooked.

The Present Study

The aim of the study is to test the effect of a combined WBI and EMI intervention among incoming first-year students in New Zealand. The primary hypothesis was that participants in the WBI+EMI+EMA condition would consume significantly less alcohol during the academic year than participants in the EMA+WBI and EMA groups. Secondary hypotheses were that, when compared to those in the EMA+WBI and EMA groups, participants in the WBI+EMI+EMA group would report experiencing fewer negative alcohol-related consequences and report lower AUDIT scores throughout the academic year.

Method

Design

The study was a three-arm randomised control trial. Participants were randomised into either a WBI+EMI condition, a WBI-only condition, or an assessment-only control (EMA). The WBI was administered prior to the start of Orientation Week. The EMIs were delivered in 2 phases: 8 messages over 4 days during Orientation Week and 6 fortnightly messages during Semester 1. Participants completed surveys at baseline (pre-university) and after their first (~4 months) and second semesters (~8 months). This research was approved by the University of Otago Human Ethics Committee New Zealand. Participants were presented with the information sheet and consent form at the start of the online survey.
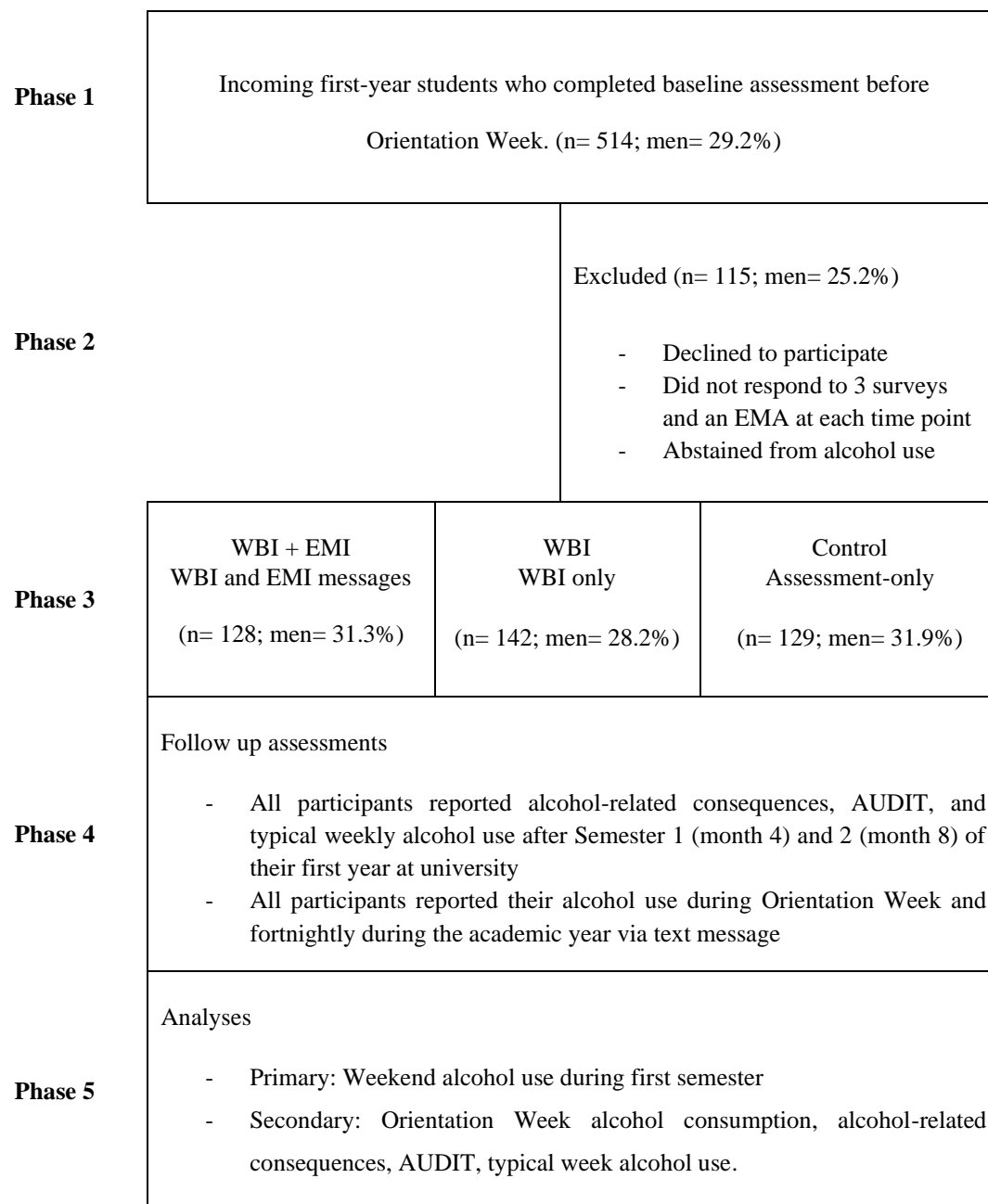
Phase 1	Incoming first-year students who completed baseline assessment before Orientation Week. (n= 514; men= 29.2%)		

Phase 2	Excluded (n= 115; men= 25.2%) - Declined to participate - Did not respond to 3 surveys and an EMA at each time point - Abstained from alcohol use		

Phase 3	WBI + EMI WBI and EMI messages (n= 128; men= 31.3%)	WBI WBI only (n= 142; men= 28.2%)	Control Assessment-only (n= 129; men= 31.9%)

Phase 4	Follow up assessments - All participants reported alcohol-related consequences, AUDIT, and typical weekly alcohol use after Semester 1 (month 4) and 2 (month 8) of their first year at university - All participants reported their alcohol use during Orientation Week and fortnightly during the academic year via text message		

Phase 5	Analyses - Primary: Weekend alcohol use during first semester - Secondary: Orientation Week alcohol consumption, alcohol-related consequences, AUDIT, typical week alcohol use.		

Figure 2. Attrition diagram illustrating flow of events. AUDIT: Alcohol Use Disorder Identification Test; EMI: ecological momentary intervention; WBI: Web-based intervention.

Participants and Procedures

All incoming students who were beginning their first-year at university, aged 17 to 22 years old, and living in any of the five residential colleges at the University of Otago were invited to take part (n=1405). The invitation email was be sent out from each of the residential

colleges to their incoming cohorts. The initial email invitation was sent four weeks before the first day of Orientation Week, with a follow-up reminder two weeks before the beginning of Orientation Week. Residential colleges also invited students to take part by posting on their respective Facebook pages. Participants were offered NZ $100 remuneration for taking part in the study.

Participants who were interested in taking part were directed to a secure webpage with information about the study and consent forms. Participants were excluded if they declined to participate throughout the academic year or did not provide a mobile number. After completing the baseline survey (which included a definition of a New Zealand standard drink), those who provided a mobile phone number were then be randomised into one of the three conditions. Participants randomised into the WBI+EMI and the WBI condition automatically received personalized feedback (i.e., the WBI) based on their answers on the baseline questionnaire. Participants randomised into the control group did not receive feedback.

Participants randomised in the WBI+EMI condition, but not those in the WBI condition or control group, received EMIs throughout the year (see Figure 2 above). Participants in all conditions were asked to report their weekend alcohol use fortnightly throughout each semester via Ecological Momentary Assessments (EMAs) and completed brief surveys at the send of the first and second semester. Participants were paid $50 after completing each survey.

Assessment and Outcome Measures

The primary outcome measure was weekend alcohol use during first semester, which was reported via fortnightly EMAs. Secondary outcomes included alcohol-related consequences and AUDIT scores.

Measures

Academic year weekend alcohol use. Academic year weekend alcohol use (Riordan, Conner, et al., 2017; Riordan, Scarf, et al., 2015) was assessed by fortnightly EMAs ("How many drinks did you have Thurs, Fri, Sat? Send reply like this: 1,5,0." see Table 2). This procedure has been used in prior studies with good compliance (75% completed four or more of the seven academic year reports in the pilot study) (Hoeppner et al., 2012; Riordan, Scarf, et al., 2015).

Table 2

Schedule of text messages for each group during Semester 1

	Semester 1						
Week	1	3	5	7	9	11	13
Control	EMA	EMA	EMA	EMA	EMA	EMA	OLS
WBI	EMA	EMA	EMA	EMA	EMA	EMA	OLS
WBI+EMI	EMI EMA	EMI EMA	EMI EMA	EMI EMA	EMI EMA	EMI EMA	OLS

EMA: Ecological momentary assessment.
OLS: Online survey.
WBI: Web-based intervention.
EMI: Ecological momentary intervention.

Table 3

Schedule of text messages for each group during Semester 2

	Semester 2						
Week	1	3	5	7	9	11	13
Control	EMA	EMA	EMA	EMA	EMA	EMA	OLS
WBI	EMA	EMA	EMA	EMA	EMA	EMA	OLS
WBI+EMI	EMA	EMA	EMA	EMA	EMA	EMA	OLS

EMA: Ecological momentary assessment.
OLS: Online survey.

Orientation Week alcohol use. Orientation Week alcohol use (Riordan, Conner, et al., 2017; Riordan, Scarf, et al., 2015) was assessed by two text messages during Orientation Week. One message was sent on the Thursday of Orientation Week at 2:00 PM ("How many drinks did you have Mon, Tues, Wed? Send reply like this: 1,5,0") and the second was sent on Sunday at 2 PM ("How many drinks did you have Thurs, Fri, Sat? Send reply like this: 1,5,0"). This procedure has been used in prior studies with good compliance (75% completed both reports) (Hoeppner et al., 2012; Riordan, Scarf, et al., 2015).

Negative alcohol-related consequences (B-YAACQ). The number of negative alcohol-related consequences (Kahler, Strong, & Read, 2005) experienced was assessed by the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ). The B-YAACQ is composed of a list of 24 alcohol consequences and participants simply answer yes or no as to whether they have experienced each consequence in the past 30 days. The B-YAACQ was administered at baseline and after semester 1 and 2 (~4 and ~8 months).

The Alcohol Use Disorder Identification Test (AUDIT). (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993). The AUDIT is composed of 10 questions and provides an effective screening tool for identifying likely alcohol use disorders (Bohn et al., 1995). The AUDIT was administered at baseline and after semester 1 and 2 (~4 and ~8 months).

Typical week alcohol use. Number of drinks consumed during a typical week was measured retrospectively using a modified version of a timeline follow-back procedure (Sobell, Sobell, Litten, & Allen, 1992). Participants were be asked to "Think of a typical week in the last 3 months for you. Think of what you did, where you lived, what your weekly activities were. Try to accurately remember how much alcohol you typically drank." Typical week drinking was administered at baseline and after semester 1 and 2 (~4 and ~8 months).

Intervention components

Web-Based Intervention. The WBI provided personalized normative feedback based on the amount of alcohol participants reported consuming during a typical week. The feedback was specific to the University of Otago, participant's gender, and their year at university. These specific norms were derived from the Daily Life Study, which was a large study that surveyed around 2000 full time students from the University of Otago (~10% of the university population) (Riordan, Conner, Thrul, et al., 2018; Riordan, Flett, Hunter, Scarf, & Conner, 2018). The feedback included tailored graphics and text information regarding (1) the number of drinks consumed in the past week compared to a typical first-year student of the same gender, (2) the financial cost of drinking, (3) the number of calories consumed, (4) the number of negative alcohol-related consequences experienced in the past 3 months compared to a first-year student of the same gender. Participants also received feedback on their AUDIT score, feedback on their heaviest drinking session (estimated peak Blood Alcohol Content (BAC) and the effects of consuming alcohol at that level), and were suggested protective behavioural strategies.

Ecological Momentary Intervention. The EMI consisted of text messages delivered during Orientation Week and periodically throughout academic year. Content included information about protective behavioural strategies, social consequences of drinking, and campus-based social norms, matched to the occasion, as follows. The Orientation Week messages was be sent on the nights during Orientation Week historically associated with the most drinking (the first year toga party, on nights with music concerts, and the Saturday of Orientation Week). The specific content and timing of the messages was based on feedback from surveys (Riordan, Conner, et al., 2015), focus groups (Riordan, Conner, et al., 2017), and in-situ interviews with students outside Orientation Week events (Riordan, Conner, Flett, et al., 2018). On days during Orientation Week with social events, participants received one

message at 2:00 PM reminding them of a protective behavioural strategy mentioned in the WBI (e.g., "Toga party tonight! If you are planning to have a few drinks, remember to eat. Food=energy! Eating is not cheating"). They then received one message timed to when they start drinking at 7:00 PM reminding them of the social consequences of alcohol (e.g., "Remember, don't be a dick! Your drinking can affect your mates"; Table 4 contains the complete list of Orientation Week texts).

Table 4

Schedule of Orientation Week EMI text messages with content type

EMI Number	Delivery Time	Message	Type
1	Wednesday 2:00pm	Toga party tonight! If you are planning to have a few drinks, remember to eat. Food=energy! Eating is not cheating.	PBS
2	Wednesday 6:45pm	These could be your friends for the year. Make sure your drinking doesnt ruin everyones night.	SC
3	Thursday 3:00pm	Chase and Status! Remember to smash water when drinking. Subbing water while you drink will decrease hangover symptoms. OWeek is a loong week.	PBS
4	Thursday 7:00pm	On it? Remember to look after your friends if you are drinking!	SC
5	Friday 2:00pm	Rugby tonight! You've made it this far. If you're drinking tonight, set a limit that works and stick to it!	PBS
6	Friday 6:30pm	Think about your friends if you are drinking. Don't be the story everyone tells tomorrow.	SC
7	Saturday 2:00pm	OWeek Saturday! If you're having a wet one tonight, drink slowly. Alc can hit you like a ton of bricks!	PBS
8	Saturday 6:45pm	*Remember, don't be a dick! Your drinking can affect your mates.*	SC

PBS: Protective behavioural strategy.
SC: Social consequence.

During the academic year, students received a social norm message fortnightly tailored to their gender reminding them of some of the information presented during the WBI (e.g., "Hope you had a great OWeek! The typical female scarfie drinks no more than 6 drinks per week. OWeek is a one off, now the year begins") (see the complete list of text messages in Table 5).

Table 5

Schedule of Semester 1 EMI text messages for males and females

Academic Week	Text (Males)	Text (Females)
1	Hope you had a great OWeek! The typical male scarfie drinks no more than 11 drinks per week. OWeek is a one off, but now the year begins!	Hope you had a great OWeek! The typical female scarfie drinks no more than 6 drinks per week. OWeek is a one off, now the year begins!
3	Drinks can set you back! The average scarfie male drinks about 11 drinks per week, that is $1144-5720 a year, OR 2-10 round trips to Raro!	Drinks can set you back! The average scarfie male drinks about 11 drinks per week, that is $1144-5720 a year, OR 2-10 round trips to Raro!
5	Remember, drinks contain empty calories. The average male scarfie drinks no more than 11 drinks a week, that is about 2.3 sticks of butter.	Remember, drinks contain empty calories. The average female scarfie drinks no more than 6 drinks a week, that is about 1.3 sticks of butter.
7	Hope your break is going well! During this half of the semester the typical male scarfie drinks no more than 8.6 drinks a week.	Hope your break is going well! During this half of the semester the typical female scarfie drinks no more than 4.2 drinks a week.
9	This time of year, male scarfies typically drink no more than 8.6 drinks per week. That is about $894-4472 a year, OR 9-45 HUBs text books!	This time of year, female scarfies drink no more than 4.2 drinks per week. That is about $437-2184 per year, OR 4-21 HUBs text books!
11	This time of year, male scarfies drink no more than 8.6 drinks per week. That is about 1462 extra calories OR a cup of bacon fat!	This time of year, female scarfies drink no more than 4.2 drinks per week. That is about 714 extra calories OR half a cup of bacon fat

Results

Participant Demographics

In total 514 (150 males, 364 females) incoming university students started the baseline survey. Of these, 504 (147 males, 357 females) consented to take part in the study. Students were included in the analysis if they completed all three surveys (i.e. baseline, semester 1 and semester 2 follow-up surveys), and replied to at least one EMA during each time point (i.e. Orientation Week, Semester 1, Re-Orientation Week, and Semester 2). A total of 418 participants (126 males, 292 females) were included the analysis. Participants were aged from 17-22 years old (M =18.01 years old, SD = 0.718). The sample size recruited from each college varied; of the 418 participants 29.7% (n = 124) were recruited from College A, 11.0% (n = 46) were recruited from College B, 13.9% (n = 58) from College C, 25.4% (n = 106) from College D, 17.0% (n = 71) from College E, and the remaining 3.1% (n = 13) were from other forms of accommodation. In total, 78.7% (n = 329) were New Zealand European, 6.0% (n = 25) of the sample was Asian, 3.3% (n = 14) were European, 3.1% (n = 13) were Indian, 1.2% (n = 5) were Middle-Eastern/Latin-American/African, 0.2% (n = 1) were Pacific Islanders, and 2.6% (n = 11) identified with another ethnicity.

Preliminary Analyses

Response rate. As noted above, the first EMA was sent on the Thursday of Orientation Week. The first academic-year message was sent at the end of the first academic week and EMAs were then sent fortnightly for the remainder of the semester. In semester two, an EMA was sent at the end of Re-Orientation Week and then fortnightly for the remainder of the semester. With respect to response rates, the average response rate for male respondents across all 13 EMAs was 89.27% and for female respondents was 92.85%. As shown in Figure 3, there

was a decrease in the percentage responding to the EMAs over the course of the year for both males and female respondents, with the trend appearing slightly stronger for males than females. Nonetheless, for both males and females, the response rate remained high across the duration of the study; for males the response rate did not fall below 82.99% (122 out of 147), and for females the response rate did not fall below 87.68% (313 out of 357). In subsequent analyses, any variations in the sample size is due to participants missing questions.
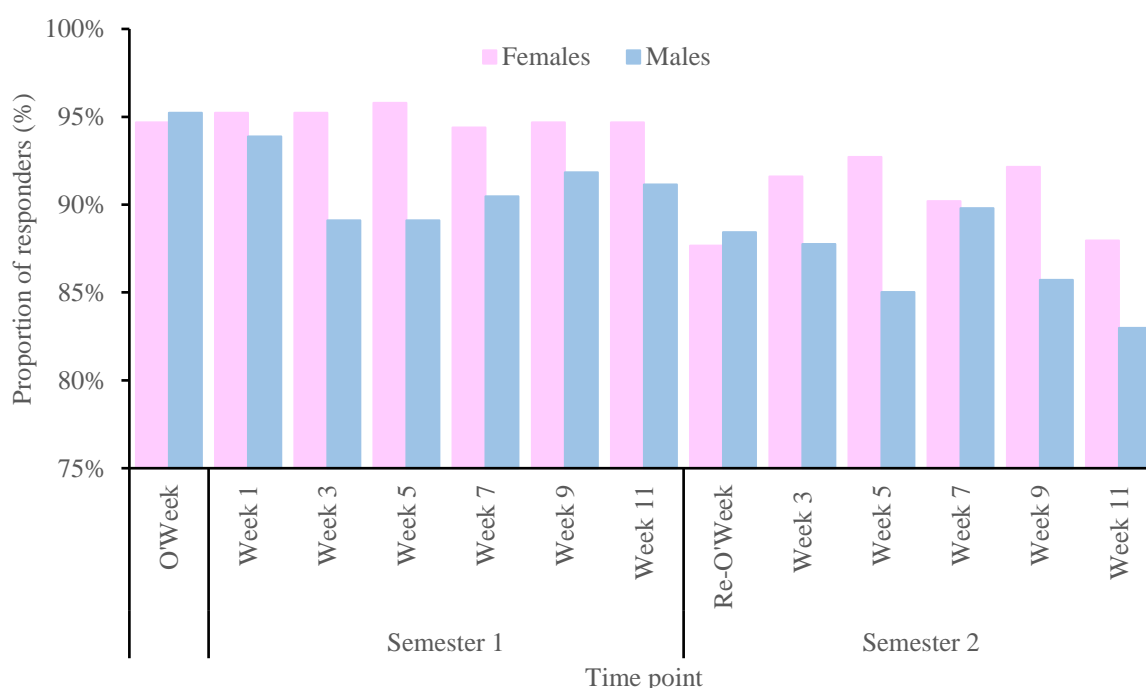
Figure 3. Percentage of students who responded to each EMAs. Note that the x-axis depicts the weeks on which the EMAs were delivered.

Consumption. The proportion of non-drinkers at each time point is displayed in Figure 4. As shown, a large proportion of students choose not to drink at each time point and this was true for both males and females. It is important to note, however, that a smaller proportion of males than females choose not to drink. To calculate consumption rates we focused on the students who reported consuming alcohol at one or more time points.
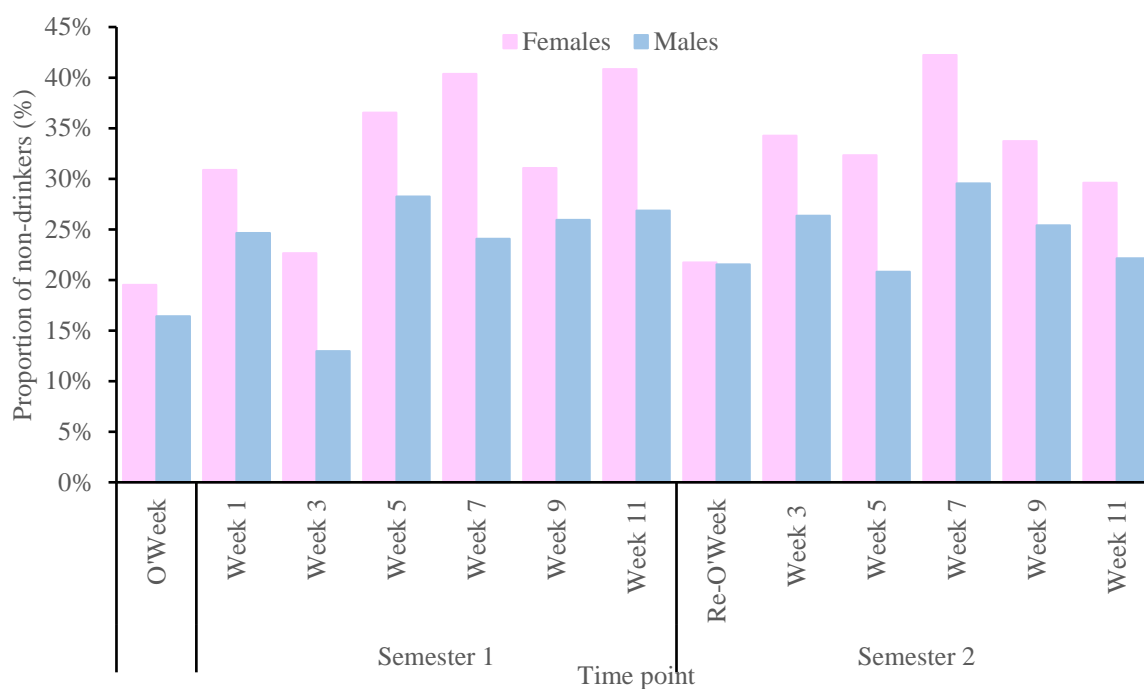
Figure 4. The percentage of male and female respondents who reported consuming no alcohol on average for each EMA. Note that the x-axis depicts the weeks on which the EMAs were delivered.

As shown in Figure 5, males reported higher weekend consumption than females across all time points. Weekend alcohol consumption was highest for both genders during Orientation Week and Re-Orientation Week. Specifically, males reported consuming an average of 25.6 standard drinks during Orientation Week and 27.2 standard drinks during Re-Orientation Week. Similarly, females reported consuming an average of 16.3 standard drinks during Orientation Week and 15.8 standard drinks during Re-Orientation Week. For both genders, weekend consumption was similar for both semesters. Average weekend consumption for males was 19.1 standard drinks ($SD = 2.65$) in Semester 1 and 18.9 ($SD = 1.10$) standard drinks in Semester 2. For females, average weekend consumption was 11.2 ($SD = 1.44$) standard drinks in Semester 1 and 10.7 ($SD = 0.81$) standard drinks in Semester 2.
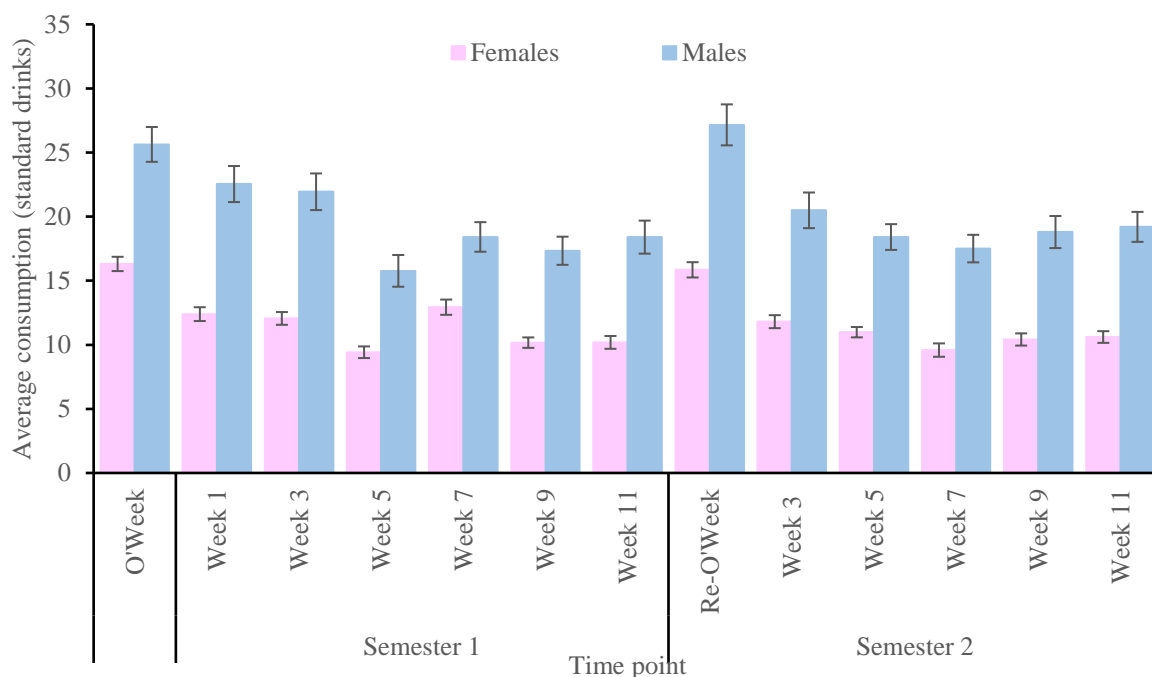
Figure 5. The average weekend consumption for males and females for each EMA. Note that the x-axis depicts the time that EMAs were delivered.

Proportion of hazardous drinkers. AUDIT scores were collected for each participant at three different time points throughout the study (pre-university/baseline, follow-up survey 1/Semester 1, and follow-up survey 2/Semester 2). An AUDIT score of 8 or higher is indicative of hazardous drinking. The proportion of females engaging in hazardous drinking increased gradually over the course of the study with 50.7% (140 out of 276) engaging in hazardous drinking pre-university, 62.6% (174 out of 278) during Semester 1, and 69.4% (193 out of 278) during Semester 2. For males, 66.1% (80 out of 121) engaged in hazardous drinking pre-university and an equal proportion of males engaged in hazardous drinkers during Semester 1 and Semester 2 (76.9%, or 93 out of 121). Figure 6 below shows the percentage of males and females who drank hazardously at each time point.
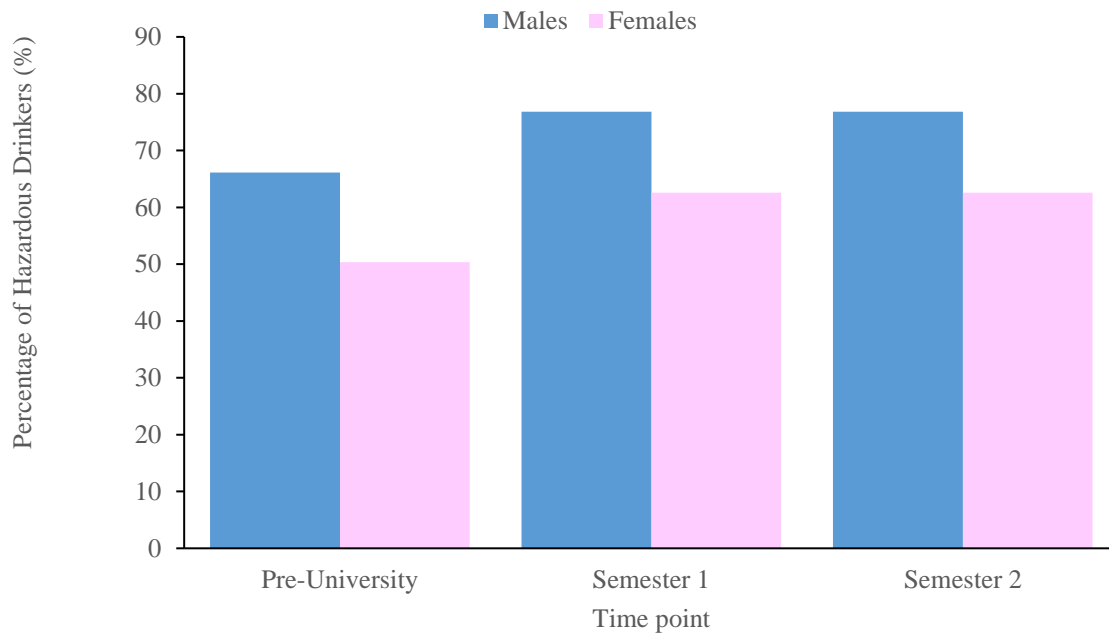
Figure 6. The percentage of males and females who consumed hazardously at each time point.

Average hazardous drinking. A two-factor repeated measures ANOVA with Time as a within subjects factor and Gender as the between subject factors revealed a main effect of Time, $F(1.736, 690.117) = 62.237$, p < 0.001, reflecting the increase in hazardous drinking across the year. In addition, there was a main effect for Gender, $F(1, 395) = 10.786$, $p < 0.001$, reflecting the higher levels of hazardous drinking in males relative to females ($M = 11.678$, $SD = 5.587$, and $M = 9.685$, $SD = 5.499$, respectively). There was no interaction effect of Time and Gender, $F(1.736, 690.117) = 0.247$, p < 0.750. Figure 7 below shows the average AUDIT score for males and females for each time point.
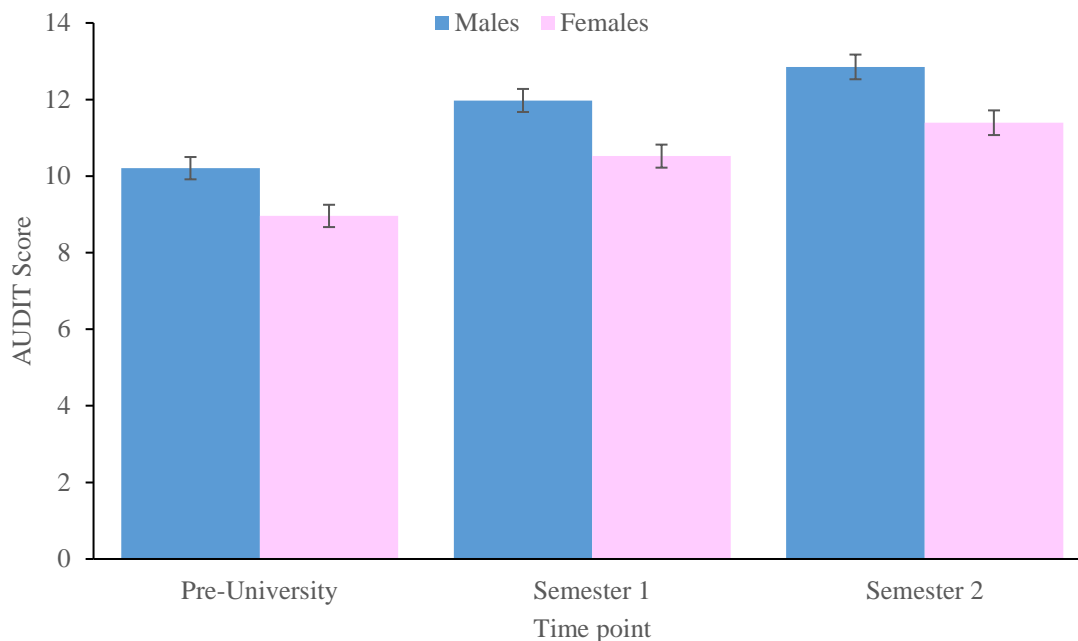
Figure 7. Average pre-university, semester 1 and semester 2 AUDIT scores for males and females.

Proportion of respondents who reported harm. B-YAACQ scores were collected at four time points (pre-university/baseline, Orientation Week, follow-up survey 1/Semester 1, and follow-up survey 2/Semester 2). The proportion of students who reported experiencing harm remained high and relatively stable across the study. In absolute terms, for both males and females, harms were lowest during Orientation Week (for males = 80.99%, or 98 out of 121, and for females = 75.00%, or 207 out of 276). It is important to note, however, that B-YAACQ scores for Orientation Week reflect harms experienced during a single week whereas B-YAACQ scores for all other time points reflect harms during a 3-month period. Thus, the fact students experience a level of harm during 1 week (i.e., Orientation Week) that is comparable to a 3-month period during the academic year is cause for concern. Figure 8 below displays the proportion of males and females who reported experiencing harm at each time point.
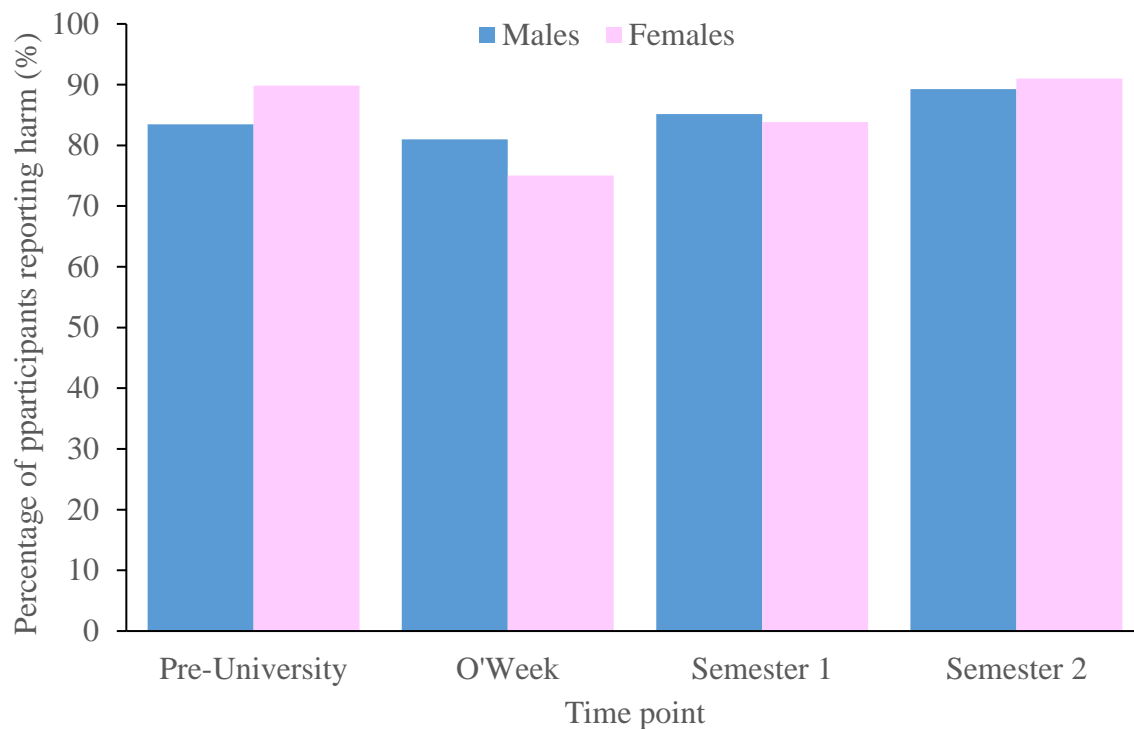
Figure 8. Percentage of males and females who reported experiencing harm pre-university, during orientation week, semester 1, and semester 2.

Types of Harms. Next, the proportion of participants who reported experiencing each harm was calculated for each time point (see Table 6 and Table 7 below). The greatest proportions of harm experienced by each item tended to be during Semester 2 (i.e. the highest proportion of harm experienced for 16 of the 24 items was observed for this time point for males and 17 of the 24 items for females). Interestingly, the proportions of harm experienced during semester 2 most closely resembled those pre-university. Similarly, the number of B-YAACQ harms reported during Orientation Week resembled that of Semester 1. Given that the proportions of the harms reported during Orientation Week nearly reached those of examining harms over three-month periods, this indicates that the risk of experiencing adverse outcomes during that week is higher.

The most commonly reported harm was hangovers, which was consistent across all time points for females, and for Orientation Week, Semester 1 and Semester 2 for males. A

larger proportion of students reported feeling embarrassed and sick because of their drinking. These harms are considered mildly severe, however, they may precede more severe harms (Kahler, Strong and Read, 2005). Approximately half of the participants reported feeling tired as a result of their Orientation Week consumption (males = 50.4%, and females = 48.2%). This is considered a moderately severe harm. Interestingly, the prevalence of two items regarded as most severe ('quality of work suffered', and 'neglected obligations') was twice that during semester 2 relative to pre-university for both males and females.

Table 6

Proportion of Males Reporting B-YAACQ Items (Harms)

	Time point			
Item	Pre-University	Orientation Week	Semester 1	Semester 2
While drinking, I have said or done embarrassing things.	69.4%	40.5%	57.0%	66.9%
I have had a hangover the morning after I had been drinking.	66.9%	54.5%	61.2%	74.2%[a]
I have felt very sick to my stomach or thrown up after drinking.	19.8%	14.9%	14.0%	26.4%
I often have ended up drinking on nights when I had planned not to drink.	15.7%	13.2%	12.5%	23.1%
I have taken foolish risks when I have been drinking.	62.8%	33.9%	45.5%[a]	64.5%
I have passed out from drinking.	14.0%	5.8%	29.8%	36.4%
I have found that I needed larger amounts of alcohol to feel any effect, or that I could no longer get high or drunk on the amount that used to get me high or drunk.	38.8%	18.2%	28.1%	43.0%
When drinking, I have done impulsive things that I regretted later.	7.4%	6.6%	9.1%	15.7%
I've not been able to remember large stretches of time while drinking heavily.	14.9%	5.0%	10.7%	23.1%
I have driven a car when I knew I had too much to drink to drive safely.	6.6%	0.0%	4.1%	4.1%
I have not gone to work or missed classes at school because of drinking, a hangover, or illness caused by drinking.	27.3%	28.9%	32.2%	41.3%
My drinking has gotten me into sexual situations I later regretted.	25.6%	10.7%	20.7%	28.1%
I have often found it difficult to limit how much I drink.	10.7%	5.0%	5.8%	8.3%
I have become very rude, obnoxious or insulting after drinking.	19.8%	8.3%	11.7%[a]	17.5%[a]
I have woken up in an unexpected place after heavy drinking.	33.1%	30.6%	33.1%	43.8%
I have felt badly about myself because of my drinking.	41.7%[a]	21.5%	27.3%	36.4%
I have had less energy or felt tired because of my drinking.	7.4%	4.1%	7.5%[a]	10.7%
The quality of my work or schoolwork has suffered because of my drinking.	29.8%	28.9%	35.5%	39.7%
I have spent too much time drinking.	19.0%	12.4%	16.5%	14.9%
I have neglected my obligations to family, work, or school because of drinking.	17.4%	11.6%	13.2%	24.8%

My drinking has created problems between myself and my boyfriend/girlfriend/spouse, parents, or other near relatives.	47.1%	50.4%	40.8%[a]	47.1%
I have been overweight because of drinking.	5.0%	1.7%	3.3%	4.1%
My physical appearance has been harmed by my drinking.	11.6%	6.6%	15.8%[a]	20.0%[a]
I have felt like I needed a drink after I'd gotten up (that is, before breakfast).	6.7%[a]	3.3%	10.7%	14.2%[a]

Based on males who reported alcohol use (N=121).
[a]N=120

Table 7

Proportion of Females Reporting B-YAACQ Items (Harms)

	Time point			
Item	Pre-University[c]	Orientation Week[c]	Semester 1	Semester 2
While drinking, I have said or done embarrassing things.	70.3%	40.2%	59.4%	76.9%[d]
I have had a hangover the morning after I had been drinking.	70.5%[b]	50.4%	67.6%	78.8%
I have felt very sick to my stomach or thrown up after drinking.	13.0%	13.8%	16.2%	21.2%
I often have ended up drinking on nights when I had planned not to drink.	12.8%[a]	12.0%	15.5%[d]	20.6%[d]
I have taken foolish risks when I have been drinking.	54.3%	23.0%[a]	51.4%	59.6%[d]
I have passed out from drinking.	5.8%	3.6%	28.8%	35.4%[d]
I have found that I needed larger amounts of alcohol to feel any effect, or that I could no longer get high or drunk on the amount that used to get me high or drunk.	26.4%	17.4%	21.6%	29.9%
When drinking, I have done impulsive things that I regretted later.	8.7%	9.1%	12.2%	16.9%
I've not been able to remember large stretches of time while drinking heavily.	23.9%	13.8%[b]	26.6%	31.0%[d]
I have driven a car when I knew I had too much to drink to drive safely.	4.7%	1.1%	1.8%	1.8%
I have not gone to work or missed classes at school because of drinking, a hangover, or illness caused by drinking.	37.0%	33.0%	42.4%	50.4%
My drinking has gotten me into sexual situations I later regretted.	19.2%	7.2%	18.0%	20.5%
I have often found it difficult to limit how much I drink.	6.2%	9.4%	11.9%	12.3%[d]

I have become very rude, obnoxious or insulting after drinking.	10.5%	5.1%	8.6%	7.9%
I have woken up in an unexpected place after heavy drinking.	23.2%	32.1%[a]	35.3%	39.1%
I have felt badly about myself because of my drinking.	40.6%	23.6%	32.7%	39.6%[c]
I have had less energy or felt tired because of my drinking.	8.3%	7.2%	8.0%[c]	11.9%
The quality of my work or schoolwork has suffered because of my drinking.	21.0%	27.2%	32.4%	29.5%
I have spent too much time drinking.	21.4%	11.6%	18.0%	16.9%
I have neglected my obligations to family, work, or school because of drinking.	10.9%	5.8%	9.0%	19.1%
My drinking has created problems between myself and my boyfriend/girlfriend/spouse, parents, or other near relatives.	54.3%	48.2%	51.1%	53.2%
I have been overweight because of drinking.	2.2%	3.3%	0.7%	2.2%
My physical appearance has been harmed by my drinking.	7.6%	7.2%	17.4%[c]	16.7%[c]
I have felt like I needed a drink after I'd gotten up (that is, before breakfast).	5.1%[a]	4.0%	7.2%[d]	13.4%[c]

Based on females who reported alcohol use (*N*=278).
[a]*N*=274
[b]*N*=275
[c]*N*=276
[d]*N*=277

Intervention Analyses

Participants who did not consume at any of the time points were excluded from these analyses (n = 19; men = 26.3%). As drinking was relatively stable across each semester for both genders, the total weekend consumption was averaged across all EMAs for each semester. This gave single estimates for the average consumption on a typical Semester 1 weekend and a typical Semester 2 weekend.

Baseline Consumption. To test for any differences in baseline consumption between groups, a one-way ANOVA was conducted with Intervention as the between subjects factor and pre-university weekend consumption as the dependent variable. No group differences in baseline consumption were observed, $F(2, 398) = 1.115$, $p = 0.329$. However, it appears that males in who received the EMI+WBI condition tended to drink less than those who received the EMA+WBI and EMA at baseline.

Weekend Consumption. A mixed model ANOVA with time as a within-subjects factor, and gender and intervention type as between subjects' factors, was conducted. There was a main effect of Time, $F(3.232, 1270.159) = 98.055$, $p < 0.001$, reflecting the fact students consumed more alcohol during Orientation Week and Re-Orientation Week when compared to weekend consumption pre-university and during Semester 1 and Semester 2. Additionally, there was a main effect of Gender, $F(1,393) = 68.489$, $p < 0.001$, reflecting the fact that males consumed more alcohol than females. Unfortunately, there was no main effect of Intervention type, $F(2, 393) = 2.562$, $p = 0.081$. Also, there was no two-way interaction between Time and Intervention ($F(6.464, 1270.159) = 0.810$, $p = 0.570$), or Gender and Intervention ($F(2, 393) = 2.395$, $p = 0.092$). There was an interaction effect of Time and Gender, ($F(3.232, 1270.159) = 3.718$, $p = 0.009$), but no three-way interaction between Time, Gender and Intervention, $F(6.464, 1270.159) =$

1.191, $p = 0.307$. Figures 9 and 10 show the average weekend consumption across the

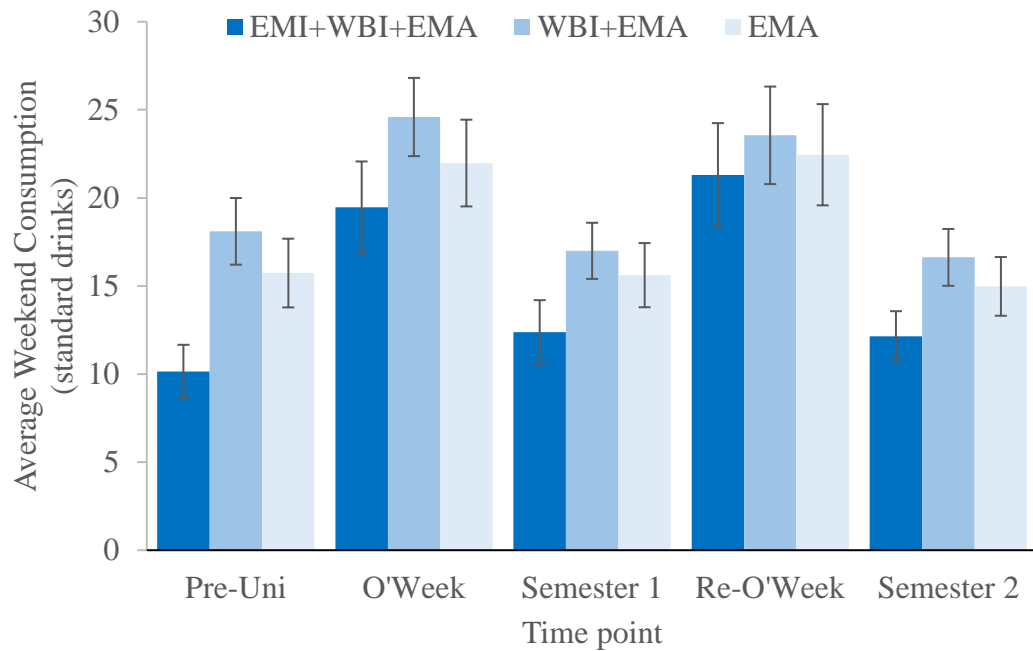academic year for males and females, by intervention type.

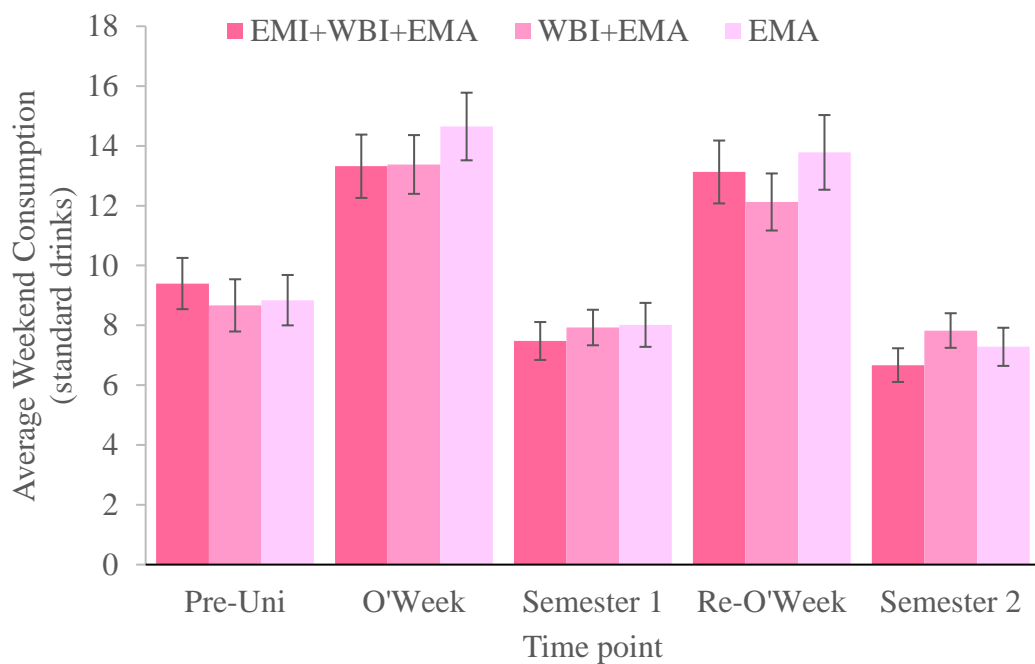*Figure 9.* Average weekend consumption across the academic year for males in each intervention condition.

Figure 10. Average weekend consumption across the academic year for females in each intervention condition.

Baseline B-YAACQ data. To test for any differences in baseline harms between groups, a one-way ANOVA was conducted with Intervention as the between subjects factor, and pre-university weekend consumption as the dependent variable. No group differences in the number of B-YAACQ harms reported were observed, $F(2, 396) = 0.467$, $p = 0.627$.

Average B-YAACQ scores over time. The total possible score for the B-YAACQ is 24 (i.e., a maximum of 24 harms). A repeated measures ANOVA with Time as a within subjects factor and Intervention and Gender as between subjects factors revealed no main effect of Gender, $F(1, 389) = 0.063$, $p = 0.802$, reflecting the fact males and females experienced a similar number of harms. There was a main effect of Time, $F(2.715, 1056.146) = 76.967$, $p < 0.01$, reflecting the fact the number of harms experienced during Orientation Week ($M = 4.132$, $SD = 3.958$) was lower than that of other time periods. A main effect of Intervention was observed, $F(2, 389) = 3.413$, $p = 0.034$. Post-hoc pair-wise comparisons revealed that participants who received the EMI+WBI ($M = 5.157$, $SD = 4.137$) reported one less harm than those in the EMA+WBI condition ($M = 6.253$, $SD = 4.163$), $p = 0.041$. There was no difference in number of harms reported by participants who received the EMA ($M = 5.465$, $SD = 4.057$) and the number reported by either of the intervention groups, $p > 0.05$. There were no two-way interactions of Time and Intervention, $F(6, 1056.146) = 0.1.138$, $p = 0.338$, or Gender and Intervention, $F(2, 389) = 1.442$, $p = 0.238$, or Time and Gender, although this was approaching significance, $F(2.715, 1056.146) = 2.634$, $p = 0.054$. Lastly, there was no three-way interaction of Time, Intervention, and Gender, $F(6, 1056.146) = 0.608$, $p = 0.724$. Figures 11 and 12 show the average B-YAACQ scores for males and females for each time point.
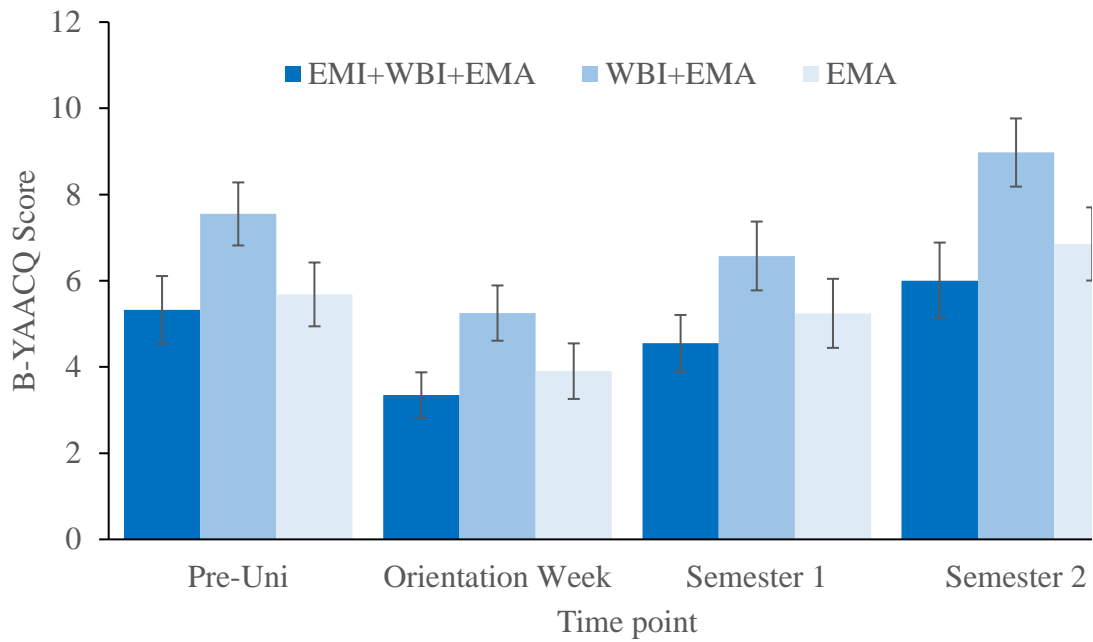
Figure 11. The average pre-university, orientation week, semester 1 and semester 2 B-YAACQ scores for males in each condition (EMA+WBI+EMI, EMA+WBI, and EMA).
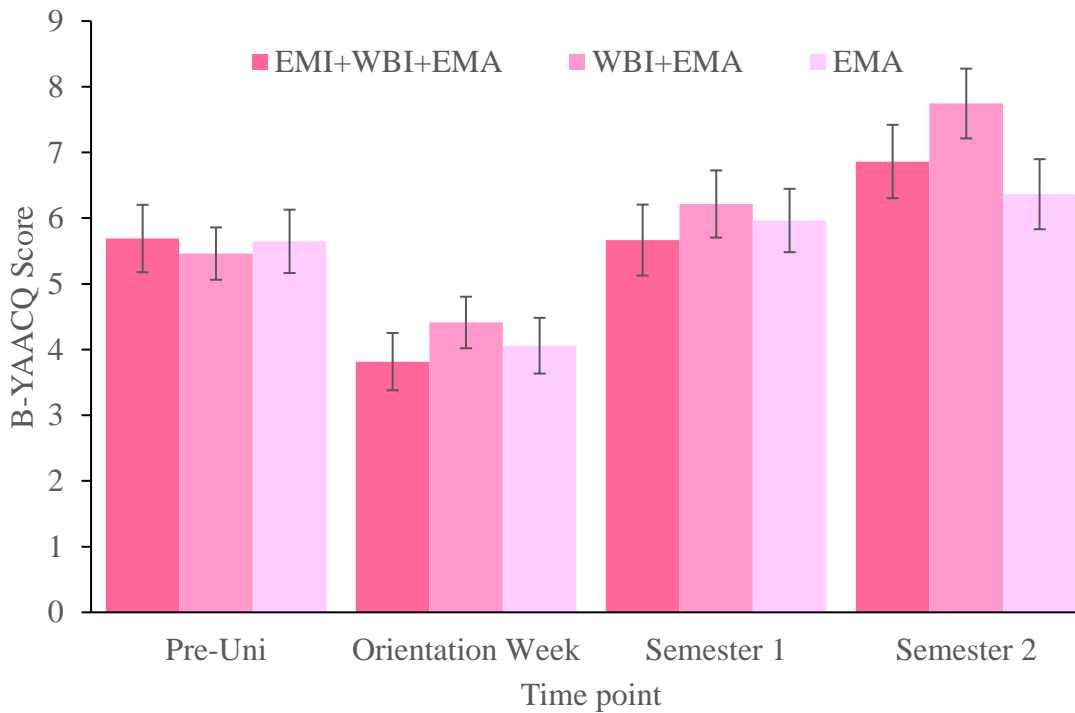

Figure 12. The average pre-university, orientation week, semester 1 and semester 2 B-YAACQ scores for females in each condition (EMA+WBI+EMI, EMA+WBI, and EMA).

Discussion

This study investigated the effectiveness of a paired WBI and EMI in reducing student alcohol consumption and related harms. To determine this, weekend consumption, hazardous drinking, and alcohol-related consequences were observed across an academic year. Comparisons of these measures between EMA+WBI+EMI, EMA+WBI, and EMA groups were used to examine if the paired intervention was more effective than the WBI alone. It was hypothesised that participants in the EMA+WBI+EMI condition would consume significantly fewer drinks during weekends throughout the academic year when compared to those in the EMA+WBI and EMA conditions. Secondly, it was hypothesised that, when compared to those in the EMA+WBI and EMA conditions, participants in the EMA+WBI+EMI group would experience fewer negative alcohol-related consequences, and report lower AUDIT scores throughout the academic year. Unfortunately, there was no difference in weekend consumption at any time point throughout the academic year between any of the groups. Therefore, the first hypothesis was not supported. With regard to the second hypotheses, there was no difference in AUDIT scores between intervention groups throughout the academic year. Participants in the EMA+WBI+EMI condition did report experiencing one less harm on average than those in the WBI condition. However, as the EMA+WBI+EMI was not superior to the EMA condition, the second hypothesis was also not supported.

Weekend Alcohol Consumption

With regard to weekend consumption throughout the academic year, students who received the EMA+WBI+EMI condition did not consume less than students in the WBI and EMI conditions. This was observed for both semesters. It was theorized that pairing a WBI with an EMI would strengthen and sustain the effects of the WBI. As

WBIs are brief, one-off interventions, arguments against their effectiveness are largely based on the fact that the individual needs to remember the intervention to apply it to real life. Furthermore, they do not account for contextual factors, such as injunctive norms, present during the drinking occasions (Heron & Smyth, 2010; Larsen et al., 2009; Larsen et al., 2010; Strano, Cuomo, & Venable, 2004). Given this, the additional use of an EMI has been suggested as a way to minimize participants forgetting WBI content, and account for social factors which influence the behaviour. However, in the current study, neither the EMA+WBI+EMI nor the EMA+WBI had an effect above the assessment only control at any time point. This is unusual, as personalized feedback, correcting misconceptions about social norms, and providing protective behavioural strategies have produced short-term effects in WBI and EMI studies (Haug et al., 2017; Haug et al., 2013; Palfai, Winter, Lu, Rosenbloom, & Saitz, 2014; Tahaney & Palfai, 2017). While EMIs have the potential to be more sensitive to social factors, when used on a large scale as in the current study, the social factors only apply to large-scale common events (e.g., Orientation Week). Interestingly, the WBI was not effective in reducing consumption at either follow-up period (three or six months) relative to the assessment-only control. This is inconsistent with past research on the effectiveness of WBIs in New Zealand student populations which have shown small, short-term effects. For instance, Kypri et al (2004) found an initial reduction in student consumption following a WBI. However, after six months any differences had disappeared. In a later study, Kypri et al (2014) found that students who received a WBI initially consumed less on a typical weekend than controls, however, these effects had also disappeared five months later. Failure to engage with the WBI in the current study could explain this difference. For instance, in both the Kypri et al (2004) and Kypri et al (2014) studies, the screening immediately prior to intervention was short (less than 5 minutes and 10 to 15 minutes, respectively). Whereas in the current

study, the initial screening took 40 minutes to complete on average. More effort is required to maintain attention while completing long surveys (Meade & Craig, 2012). Given that the WBI was delivered immediately afterwards, it is possible that the participants failed to pay attention to the intervention content.

It is likely that the social pressure to drink prevented any effects of intervention being observed. As students gain autonomy from their parents, they begin to rely more on their peer groups (Schnyders, Rainey, & McGlothlin, 2018). Indeed, the transition to university is characterized by many stressful changes, such as a change in residence, social groups, and increased autonomy. Adopting the behaviours of other students may ease the transition (Stel & Vonk, 2010). Tao, Dong, Pratt, Hunsberger, and Pancer (2000) noted that a sense of social support at university is correlated with better social adjustment. Interestingly, a study by (Carter-Sowell, Chen, & Williams, 2008) also found that students who felt excluded had heightened levels of social compliance. Given this, an innate drive to be accepted by other students may be motivating first year university students to adopt student drinking norms.

It is important to note that within each college, only a small fraction of participants are receiving either intervention. Therefore, one driving factor could be a fear of missing out (FoMO) (Riordan, Flett, et al., 2018). This phenomena is driven by the need to feel connected, and has been described as a sense of anxiety as the result of being left out from a rewarding experience (Riordan, Cody, et al., 2018). Riordan, Flett, et al. (2018) found that New Zealand students who report experiencing higher levels of FoMO are more likely to experience alcohol-related harms. Further, in one of their experiments, they noted that these individuals were more likely to engage in heavier alcohol consumption. Given that students tend to hold positive attitudes toward alcohol (McMillan & Conner, 2003) and that many Orientation Week events and weekends are

characterised by their peers drinking, the immediate feelings of FoMO may supersede any effects of interventions.

Given that students are strongly influenced by social factors, it is also possible that a desire to be seen as favourable by the researchers influenced their consumption reports. Social desirability bias refers to when participants respond in a manner that is considered socially desirable rather than their true behaviours (Fisher, 1993; Van de Mortel, 2008). Here, an individual will tend to overestimate their positive characteristics and underestimate negative qualities to appear favourable. This differs from the earlier stated social norms influence, whereby an individual behaves in ways considered normal by their social group. The difference lies in the fact that the behaviour is acted (i.e. high consumption), however, the response will be what they believe the researchers desires (i.e. lower consumption). The drive to be socially accepted is especially salient during emerging adulthood, therefore, it is likely that they too would want to be seen as favourable by the experimenters. In this case, underestimated reports of the level of consumption would be expected. This may also skew the number of non-drinkers such that it would appear more are abstaining from drinking.

In an attempt to reduce this, the participants were informed they would remain anonymous. However, social desirability bias has been demonstrated in recent University of Otago events. During the 2019 Orientation Week, the students association introduced a new initiative which offered free drug checks to students so they could test the safety of the drugs before using them (McPhee, 2019). There were no negative repercussions for taking part, however, only 61 students turned up, with one student stating they were "worried about it turning out [to be] an undercover narc tent" (O'Mannin, 2019). The initiative was developed by an association affiliated with the University of Otago, and

therefore concerns around the consequences may have discouraged students from taking part. Given that the University has concerns about student consumption (Kypri, Maclennan, Cousins, & Connor, 2018), and that there is a desire to act in a socially favourable way to avoid negative consequences, it is possible that consumption was underreported in the current study. This would produce an underestimate, with students reporting what they believe to be desirable rather than true. Any effect of intervention may be concealed by an underestimate.

A final explanation for these findings could be that answering the questions about alcohol use could have acted as an intervention. For example, participants in the assessment condition may have reflected on their own consumption behaviours when completing the surveys, or when reporting how much they had consumed. The fact that they are being made aware of their drinking may then cause them to reduce their consumption. For example, McCambridge and Kypri (2011) noted that students appear to alter their alcohol behaviours as a results of being queried about them. Therefore in the current study, it may be that any participants who completed the surveys and EMAs may have been made aware of their drinking when answering the questions, and altered their consumption, improving alcohol-related outcomes.

Hazardous Drinking

The results found that males consume more hazardously than females, and that both genders drink more hazardously across the academic year. An explanation for this could be that the University Halls of Residence could insulate student drinking culture. Specifically, the Halls of residence are concentrated areas of students, where peer influence may have a stronger impact over consumption behaviour, such that their behaviours would resemble others in their hall (Kypri & Langley, 2003; Lewis & Neighbors, 2004). In support of this, (Kypri, Langley, McGee, Saunders, & Williams,

2002) found that the culture within the University of Otago halls of residences predict consumption behaviours.

Alcohol-Related Harms

An interesting result was that students who received the EMA+WBI+EMI experienced one less type of harm across all time points than those in the EMA+WBI condition. There was no difference between both interventions and the assessment only group. It is important to note that the EMI component included protective behavioural strategies. This was not included in the WBI content. However, as those in the EMA condition also did not receive protective behavioural strategies, it is unlikely that this explains why the EMA+WBI+EMI performed better than the EMA+WBI in reducing the types of harms experienced. Considering that the difference was minimal, it is likely due to a feature of group differences as a result of random assortment. Approximately 80% of students reported experiencing at least one alcohol-related harm in the past 3 months when questioned at baseline/survey 1, and at the end of Semester 1/survey 2, and Semester 2/survey 3. Alarmingly, the percentage of students reporting harm during Orientation Week matched this. This partially supports the findings of Merrill et al. (2017) who noted that students are at highest risk of experiencing harms in the first weeks of tertiary study.

Somewhat surprisingly, students reported experiencing the most types of harms during semester 2. This is inconsistent with the findings from Merrill et al. (2017) who argued that the relationship between consumption and harm gets weaker over time. The researchers suggested that students develop protective behavioural strategies over the year which prevent them from experiencing alcohol-related harms. However, literature has also identified a number of risk taking behaviours which peak during emerging adulthood, leading to an increased risk of harm (Arnett, 2000). Such risks include

substance use, unprotected sex, and risky driving. A reason why this peak in risky behaviours is observed during this life stage could be in part due to an increased sense of autonomy or independence over oneself, as well as a result of identity exploration. It is possible that students risk taking results in more alcohol related problems. Different types of harms experienced may reflect identity exploration and normal development.

Drinking Trajectories

While the efficacy of the interventions in the current study were inconsistent with previous research, the general drinking trajectories of participants in the study largely mirrored that of past literature. Higher levels of consumption were observed during both of the orientation weekends, than during semester 1 and 2. This was consistent with the findings of Greenbaum et al. (2005) and Tremblay et al. (2010), who proposed that event-specific drinking which occurs during these time points, as well as the low academic demand reinforce heavy consumption during these periods. Orientation Weeks are comprised of events designed to welcome students into the semesters. These events tend to be characterized by heavy drinking (Riordan, Conner, Flett, et al., 2018; Riordan, Scarf, et al., 2015). Given that consumption was especially heavy during these periods for all groups, it indicates that event-specific drinking occasions may act as time-outs from normal consumption behaviour. It is possible that concerns about alcohol use and outcomes may be less important during these periods. However, one-off hazardous occasions can have serious implications (Riordan et al., 2016), as indicated by the high number of harms reported during the Orientation Weeks in the current study. Other dates associated with event-specific alcohol use include New Year's Eve, St Patricks Day, Halloween, and Christmas (Del Boca et al., 2004; Greenbaum et al., 2005; Tremblay et al., 2010). None of these public holidays coincided with days or weeks participants were

asked to report on. Therefore we are unable to observe whether event-specific drinking occurred during these public holidays.

Consistent with the findings of Del Boca et al. (2004), the current study found that the proportion of non-drinkers varied across weeks. The authors also noted that there is variability in the amount consumed between weeks. However, of those who drank in the current study, the amount consumed during the weekends remained relatively stable throughout the semesters (see Figure 5). This could be due in part to the holidays that fall during the US academic calendar. Holidays associated with the heaviest drinking (i.e. Christmas, New Years, Spring Break and Halloween) fall outside the New Zealand academic calendar, or during exam season (i.e. Halloween). When reporting "*typical* pre-university weekend consumption" it is likely that these occasions of event-specific drinking were concealed by the average. Furthermore, the current study focussed only on weekend reports as Thursday to Saturdays are consistently recognized as days of heightened student alcohol consumption (Del Boca et al., 2004; Tremblay et al., 2010; Wood et al., 2007). As Del Boca et al. (2004) measured daily consumption (i.e. Monday through Sunday) they would have observed more event-specific drinking occasions, which would have produced more variance in the level of consumption across the weeks. This could explain the differences observed between the current study and the findings by Del Boca et al. (2004).

Of note, weekend semester drinking did not differ from pre-university weekend consumption. This is intriguing and may indicate that drinking patterns develop during secondary school. Riordan, Scarf, et al. (2015) noted that Orientation Week appears to be a gateway for academic year drinking, such that those who consume more during Orientation Week tend to consume more during the academic year. However, as no differences were observed between pre-university weekend consumption and that of

either semester in the current study, it may be that alcohol patterns are established prior to attending university. As the use of WBIs have been effective in preventing the onset of consumption, it is possible that earlier intervention may subsequently improve student alcohol behaviours (Palfai et al., 2014).

Strengths and Limitations

A strength of the study is that this is one of the first to examine the effectiveness of a paired intervention on alcohol consumption in student populations, and the first to do so in a New Zealand student population. As the literature focussing on the combined use of WBIs and EMIs are still in preliminary stages, it cannot be fully understood how paired WBI+EMIs work (Haug et al., 2017; Haug et al., 2013; Tahaney & Palfai, 2017). It was proposed earlier that the use of EMIs in conjunction may strengthen and sustain the effects of a WBI. This is because EMIs are in real-time, which may account for contextual factors, such as peer influence that effect student behaviours. Further, they allow the intervention to take place with close temporal proximity to the drinking occasion.

Another strength of this study is that it was large scale, longitudinal, and had regular assessments (EMAs). Previous studies assessing the effectiveness of interventions in University of Otago student population have found benefits from interventions limited to members in one residential hall but not others (Riordan, Conner, et al., 2017), and females but not males (Riordan, Conner, et al., 2015). Ideally, an intervention should be beneficial for the majority of first-year students. Given that there was a large number of participants sampled from a range of residential halls, this allowed for a more diverse range of students to be sampled. Had any effect of interaction been observed, it would indicate that this effect be generalizable to first-year students. Furthermore, as it was longitudinal in design, it was able to account for variations in

student drinking trajectories across the year. Regular assessments allowed any fluctuations in consumption to be observed.

Empirical research has identified non-response bias as a challenging factor facing surveys and assessments and this is a potential limitation in the present study. Non-response bias refers to the phenomenon in which individuals who share a common characteristic may be less likely to respond to the survey. For example, Damian and Ben like to go to the pub, whereas Kenny and Kelly prefer to go to the bakery. When asked about their alcohol-related behaviours, Damian and Ben may not respond because they believe they drink too much, while Kenny and Kelly may be more willing to report their drinking behaviours as they feel less shame about their drinking.

This non-response bias has been previously observed in New Zealand student samples. For example, Kypri, Samaranayaka, Connor, Langley, and Maclennan (2011) recruited 3283 undergraduates from five New Zealand tertiary institutions. Participants completed a survey that assessed alcohol and tobacco use, diet, physical activity and body mass index. Participants were classified as either an early-responder or a late-responder. Late-responders acted as a proxy for non-responders. The results found that late-responders had a 47.1% likelihood of having had engaged in frequent binge drinking occasions. In contrast to this, early responders only had a 38.3% likelihood of having engaged in binge drinking behaviours. The authors use the continuum of resistance model, proposed by (Lin & Schaeffer, 1995), to explain this finding. The model states that the longer it takes an individual to respond, the less willing they are to disclose the information. An earlier study conducted by (Kypri et al., 2004) showed similar findings. In this study, undergraduates who responded late to the survey also reported consuming larger amounts of alcohol, more binge drinking occasions, and more alcohol-related harm. It is important to note that these studies are grounded in the assumption that non-

responders share similar characteristics as late responders. Non-response bias was also observed in Haug et al. (2013), where it was noted that participants who dropped out of the study engaged in more risky drinking occasions. With respect to the current study, those who did not respond to the EMAs or follow-up surveys may have also consumed larger amounts of alcohol. If this were the case, then it would likely follow that they would experience more alcohol-related harm.

Another limitation of the study is that the B-YAACQ may not accurately reflect the *amount* of alcohol-related harm that is experienced. Unfortunately, this measure only provides an indication of range of harms students experience, rather than the number of times each harm occurs (Kahler et al., 2005). Given this, it is possible that students are using protective behavioural strategies and experiencing harms less frequently over time. However, the new types of alcohol-related harms obscure this. Nonetheless, the use of the B-YAACQ has given an insight into the patterns of alcohol-related harms across an academic year. To give further insight into the amount of harm experienced, the College Alcohol Problems Scale - Revised (CAPS-r) could be used (Maddock, Laforge, Rossi, & O'Hare, 2001). This measures eight personal and social harms (i.e. four from each domain) that university students experience as a results of alcohol use. However, it is important to consider that this measure covers less aspects of harm than the B-YAACQ. It could be supplemented by asking students to report how many times in the past three months each B-YAACQ harm was experienced.

Implications and Future Research

An implication from this study is that combined EMA+WBI+EMIs appear to not be an effective way to improve alcohol behaviours in first-year university students. There has been growing research on the effectiveness of these interventions separately, however, the results have shown limited success (Cronce, Bittinger, Liu, & Kilmer,

2014). Much of the literature examining these interventions in New Zealand student populations have shown even smaller effects (Kypri et al., 2013; Kypri et al., 2004; Kypri, Stephenson, et al., 2005; Kypri et al., 2014). When used together, these have also shown limited success (Haug et al., 2017; Haug et al., 2013; Tahaney & Palfai, 2017).

While these interventions are designed taking into account the social influence of peers they fail to consider wider societal/cultural differences that may affect student consumption. Researchers also need to consider the role that societal factors have over student drinking behaviour when designing interventions. For example, New Zealand alcohol studies have largely grounded in findings that have emerged from the US. These tend to ignore societal differences, such legal minimum purchasing age (i.e. New Zealand = 18 versus US = 21 years old) and calendar events coinciding with the academic year (Del Boca et al., 2004; Greenbaum et al., 2005; Karam, Kypri, & Salamoun, 2007; Riordan et al., 2016). Lastly, the current study found that pre-university consumption mirrored that of Semester 1 and 2, which suggests that drinking behaviours are starting at a younger age. Therefore researchers should consider intervening during secondary school before these behaviours develop.

Conclusion

In conclusion, the current study investigated the effectiveness of a combined EMA+WBI+EMI in reducing alcohol consumption and harm in first-year university students. The results showed the EMA+WBI+EMI was not effective in reducing weekend alcohol consumption during Orientation Weeks and during academic semesters. Further, it did not reduce the number of alcohol related harms nor hazardous drinking scores relative to the assessment only controls. Interestingly, the level of consumption pre-university did not differ from weekend consumption of either semester, which may suggest heavy drinking patterns are developing prior to the transition to university. The

study is in agreement with previous literature which has shown heightened levels of consumption during Orientation Week. While we were unsuccessful in improving heavy drinking in university students, we propose that future research examines the effectiveness of these interventions during secondary schooling before drinking patterns are established.

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