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Research paper

SmartStart: Results of a large point of entry study into preloading alcohol and associated behaviours

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ABSTRACT

Background: There is a growing trend of preloading with alcohol before entering entertainment districts. It is claimed that this occurs to save money and that preloading may be a good indicator of harmful drinking and risk taking behaviours more generally. No study has collected data from a large sample as the participants entered entertainment districts and measured blood alcohol concentration (BAC) levels and self-reported drinking and risk taking behaviours in a systematic way.

Methods: In this research, police and academics worked together to gauge the breadth and depth of preloading behaviours. In all, 3039 people completed a questionnaire and were breathalysed as they entered entertainment districts in Queensland, Australia. Of those, 2751 represented people from Brisbane and this data, collected every Thursday night to Sunday morning during the warm months, was analysed.

Results: More than 79% of people reported to preload and 71% returned a BAC greater than zero, both with little difference between the genders. Of preloaders, the mean BAC was 0.071, with 'to socialise with friends' being the primary reason given for preloading. Increasing preloading BAC was related to increasing risk taking and antisocial behaviours, as well as alcohol abuse and dependence. Older people entering entertainment districts had more accurate estimates of their BAC, yet 20% of our sample did not understand how the BAC system worked. Conducting the research was associated with a higher access rate to police and a lower arrest rate in the areas of data collection in comparison to the same nights 1 year earlier.

Conclusion: Preloading is widespread and involves moderate to heavy drinking in the Australian population visiting entertainment districts. Any interventions to curb drinking behaviours and reduce violence in night time entertainment districts need to involve approaches aimed at cultural phenomena, such as preloading behaviours.

Introduction

The harmful use of alcohol causes 3.3 million deaths per year worldwide (World Health Organisation [WHO], 2014). Mechanisms of harm from alcohol consumption include both short- and long-term harmful effects on organs, intoxication leading to accidents and violence, and chemical dependence preceding socio-economic and interpersonal damage. While the amount of alcohol consumed provides an indication of likely harm, there is evidence that the pattern of drinking is also related to type and severity of harm (Rehm et al., 2003). With heavy drinking defined as imbibing 60 g of pure alcohol in one sitting (equivalent to five or six drinks), dosage responses are associated with: increased risk of most cancers associated with any drinking (e.g., oesophageal, mouth, rectal, liver, and larynx; Corrao, Bagnardi, Zambon, & La Vecchia, 2004); epilepsy (Samokhvalov, Irving, Mohapatra, & Rehm, 2010); lower respiratory infections (Rehm, Baliunas, et al., 2010); cirrhosis of the liver (Rehm, Taylor et al., 2010); and preterm birth (Rehm et al., 2004). Likewise, harm from the behavioural consequences of drinking increases the risk of road injuries and fractures to the self (Corrao, Bagnardi, Zambon, & Arico, 1999) and increases self-injury and injury to others from violence (Cherpitel, 2007). In particular, it has been noted that the risk of injury to women is elevated with any alcohol consumption, but only for men following heavy drinking (>90 g; Stockwell et al., 2002), with current guidelines stating "the lifetime risk of hospitalisation from injury is about 1 in

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10 for men and 1 in 12 for women with a drinking pattern of four drinks on an occasion about once a week" (National Health Medical Research Council [NHMRC], 2009).

A growing trend in the western world has been preloading, where people consume alcohol, either individually or in groups, before venturing into town entertainment districts (Foster & Ferguson, 2014). Studies looking at people who reported to preload have found that they drink more alcohol over the course of the night (Paschall & Saltz, 2007) and are 2.5 times more likely to be involved in violent exchanges (Hughes, Anderson, Morleo, & Bellis, 2008). They also tend to have a higher blood alcohol concentration (BAC) than non-preloaders at any point during the night once in the entertainment district, and report engaging in this behaviour to save money from the cost of alcohol in pubs and clubs compared to take-away outlets (Miller, 2013). In European studies it is estimated that around 60% of people already in entertainment districts have preloaded (Hughes et al., 2011). This is of concern as intoxication before entering a licensed premise predicts violence as measured through emergency room attendances (Moore, Brennan, & Murphy, 2011) and appears to be a growing phenomenon irrespective of the trend for younger cohorts to drink less in general (Livingston et al., 2016).

Until now all preloading estimates have been acquired either by retrospective survey completion when not in the entertainment precincts or incidentally as part of a cross sectional survey of people at different times of the night. Without a reliable estimation of the degree, type and effects of preloading, before even entering the entertainment districts, it is not possible to plan for public health interventions or emergency services utilisation. Further, the reasons for preloading are unclear. In order to explore this issue further one would also need to look at what constitutes preloading. Preloading before entry into an entertainment district may include drinking at home, a friend's house, in the lobby bar of a hotel in which one is staying, and can even include drinking at a suburban pub/bar before "going into the city". This has not been systematically looked at before and needs further investigation, at the same time as measuring the estimated number of standard drinks (a drink containing 10 g of alcohol) people have had and their Blood or Breath Alcohol Concentration (BAC). Breath alcohol concentration is a quick and accurate proxy for blood alcohol concentration and relates to the number of grams of alcohol per 210 l of breath (equivalent to grams of alcohol per 100 mm of blood).

Miller (2013) conducted a multi-site mixed methods cross-sectional study in Australia, using short patron interviews and sessions of structured observations—all conducted near licensed venues in large cities (Melbourne, Geelong, Sydney, Perth and Wollongong) predominantly between the hours of 10 p.m. and 3 a.m. They asked to interview every 3rd person who passed them, irrespective of how long they had been in the entertainment district, and breathalyser tests were also given. Over 7000 participants were included, although it is not clear how many people refused to participate. It should also be noted that "patron interviews will not be conducted with people who are heavily intoxicated" (p. 72, Miller et al., 2013). This condition was obviously stipulated to satisfy ethical concerns regarding the safety of research assistants but is an obvious limitation to a study into the level of intoxication in entertainment precincts. They found a median BAC level of only .054% across the sites and across time of night.

The author reports that the major reason for preloading (provided by 67% of respondents) was to save money, with only 8.5% relating their preloading to socialisation and 13.9% 'for fun'. However, besides the sampling bias, this data appears to have been acquired retrospectively, once the majority of respondents had already gained access to the entertainment districts and had begun to pay higher prices in the clubs. Such retrospective reasoning by the participants requires replication if the high-street price of alcohol is to be used as the preferred method to combat preloading behaviours. It was also claimed that 23% of the entire sample had consumed energy drinks during the night at some point and that, of the 67% of males and 62% of females who preload, 26% had consumed energy drinks (Miller, 2013). In effect, they found that approximately 19% of preloaders directly mixed their drinks with alcohol. However, the definition of what counted as an energy drink is unclear and it seems that this may have included caffeinated drinks such as cola. Further, it appears that these data are, as outlined above, retrospective reports by non-inebriated patrons already drinking in the entertainment district. Without using a sample of participants entirely composed of those who are still attempting to enter the city entertainment districts, we are unclear whether these figures are the product of participants' retrospective meaning-making, which is influenced by extraneous factors and questioning strategy. We are interested whether these figures hold when people are interviewed before they have entered the entertainment districts and also includes those obviously inebriated. Further, we are unclear whether intoxication increases during preloading when energy drinks are used as mixers, as has been argued from meta-analyses (Verster, Benson, Johnson, & Scholey, 2016). This is not to say that the energy drinks increase theeffects of alcohol, but rather that people who mix energy drinks with their alcohol tend to consume more alcohol compared to those who do not mix energy drinks. That said, it has also been suggested (Verster et al., 2016) that those who mix energy drinks with their alcohol drink less alcohol than when those same people are not mixing energy drinks. In effect they argue for a volumetric reason for why energy drink users have higher alcohol readings: people can get more inebriated (and quicker) when they drink spirits.

In the current study we conducted the first specific investigation into the prevalence of preloading before entry to city entertainment precincts. We aimed to assess blood alcohol concentration in people on arrival in the entertainment precincts, analysed by time of arrival, their subjective perspective on how inebriated they felt, why they preloaded, their use of energy drinks, and dependence and impairment ratings. We also aimed to gauge risk taking behaviours such as prevalence of being in fights and casual sexual encounters, and prevalence of harm as measured through next day memory loss and likelihood of dependence through the concern of friends. We wanted to have an unbiased sample, assessing people obviously intoxicated, and thus included police into the study design. We also gauged the effect of our study by looking at arrest rates in close proximity to our data collection points in comparison to the previous year arrest rates. As an operational outcome of the research was to increase positive engagement by the police with members of the public, we also collected data on calls to the police for assistance over the two year period up until 1st January 2015.

Method

Participants & procedure

All study procedures were cleared by the Griffith University Human Research Ethics Committee (ref: PSY/71/14/HREC). Participants were 2751 people entering the entertainment districts of Brisbane on a Thursday, Friday or Saturday night. For comparison with a holiday destination and a regional area, further participants were obtained from the 'party zone' of the Gold Coast (n = 137; Collected over three nights from Thursday the 5th to Saturday the 7th February 2015) and the mining town of Mackay (n = 151, Collected over two nights from Friday the 12th to Saturday the 13th December 2014), resulting in 3039 participants from Queensland, Australia. Demographics and results are presented in Table 1.

Table 1
Demographics and results of the SmartStart project.

	Brisbane	Gold Coast	Mackay	All
Age x̄ (SD; N)	22.20 (5.01; 2745)	24.11 (5.97; 136)	28.74 (8.64; 151)	22.61 (5.49; 3032)
Min–Max	16–59	17–51	17 –55	16–59
Gender % (N)				
Male	53.69 (1477)	51.83 (71)	47.68 (72)	53.31 (1620)
Female	46.31 (1274)	48.18 (66)	52.32 (79)	46.69 (1419)
Night of week % (N)				
Thursday	35.70 (982)	24.82 (34)	–	33.43 (1016)
Friday	30.35 (835)	36.50 (50)	29.80 (45)	30.60 (930)
Saturday	33.95 (934)	38.69 (53)	70.20 (106)	35.97 (1093)
Time of night x̄	22.47 p.m.	22.44 p.m.	22.13 p.m.	22.45 p.m.
(SD; median)	(47.4 min; 22.37 p.m.)	(50.4 min; 22.42 p.m.)	(67.2 min; 22.30 p.m.)	(49.2 min; 22.37 p.m.)
Transport to town % (N)				
Train	48.21 (1038)	2.94 (4)	0	44.36 (1042)
Car	21.92 (472)	26.47 (36)	40.00 (24)	22.65 (532)
Bus	5.95 (128)	3.68 (5)	0	5.66 (133)
Taxi	16.40 (353)	38.24 (52)	50 (30)	18.52 (435)
Walked	5.71 (123)	22.79(31)	5 (3)	6.68 (157)
Other	1.81 (39)	5.88 (8)	5 (3)	2.13 (50)
Self-reported alcohol [f]preloading % (N)				
All—yes/no	79.72/20.28 (1726/439)	83.94/16.06 (115/22)	78.33/21.67 (47/13)	79.93/20.07 (1888/474)
Males—yes/no	79.59/20.41 (885/227)	85.92/14.09 (61/10)	73.91/26.09 (17/6)	79.85/20.15 (963/243)
Females—yes/no	79.87/20.13 (841/212)	81.82/18.18 (54/12)	81.08/18.92 (30/7)	80.02/19.98 (925/231)
People with a BAC > 0%; % (N)				
All—yes/no	71.29/28.71 (1952/786)	81.62/18.38 (111/25)	87.33/12.67 (131/19)	72.69/27.31 (2209/830)
Males—yes/no	74.75/25.25 (1098/371)	85.71/14.29 (60/10)	88.89/11.11 (64/8)	75.85/24.15 (1222/389)
Females—yes/no	67.30/32.70 (854/415)	77.27/22.73 (51/15)	85.90/14.10 (67/11)	68.79/31.21 (972/441)
% (N) people with a BAC > 0% by time of night				
<10 p.m.	66.3 (419)	84.85 (28)	78.85 (41)	68.06 (488)
10.00 p.m.–10.59 p.m.	69.72 (792)	67.93 (36)	95.56 (43)	70.58 (871)
11.00 p.m.–11.59 p.m.	76.37 (640)	95.75 (45)	87.76 (43)	77.94 (728)
12.00 a.m.–12.59am	76.52 (101)	66.67 (2)	100 (4)	76.98 (107)
[a]Last drink how long ago? x̄ (SD; median; N)				
All	33.06 (28.56; 30; 1590)	20.17 (18.82; 15; 97)	13.13 (6.48; 10; 40)	31.87 (28.08; 25, 1727)
Males	32.55 (29.53; 30; 812)	20.12 (20.66; 15; 51)	16.20 (8.74; 15; 15)	31.55 (29.06; 25; 878)
Females	33.58 (27.52; 30; 778)	20.22 (16.77; 15; 46)	11.28 (3.78; 10; 25)	32.20 (27.05; 30; 849)
[b]Length of session x̄ (SD; median, N)				
All	100.34 (104.75; 60; 1399)	115.18 (119.05; 90; 112)	165.79 (139.76; 140; 43)	103.22 (107.45; 60; 1554)
Males	115.78 (120.56; 90; 700)	123.28 (129.17; 90; 58)	227.19 (193.51; 180; 16)	118.65 (123.91; 90; 774)
Females	84.87 (83.33; 60; 699)	106.48 (107.66; 90; 54)	129.41 (79.08; 120; 27)	87.91 (85.50; 60; 780)
[c]Number of drinks x̄ (SD; median, N)				
All	5.56 (3.66; 5; 2202)	6.66 (3.70; 6; 113)	8.16 (4.76; 7; 134)	5.74 (3.78; 5; 2449)
Males	6.51 (4.11; 6; 1196)	7.88 (4.17; 7.5; 60)	10.42 (5.50; 10; 64)	6.76 (4.28; 6; 1320)
Females	4.41 (2.61; 4; 1006)	5.26 (2.43; 5; 53)	6.10 (2.65; 6; 70)	4.55 (2.64; 4; 1129)
If [f]preloaded, where (if only one place)? % (N)				
My house	44.63 (540)	30.11 (28)	36.67 (11)	43.44 (579)
Friends house	30.83 (373)	23.66 (22)	16.67 (5)	30.01 (400)
Suburban pub	9.92 (120)	15.05 (14)	13.33 (4)	10.35 (138)
Hotel/motel/hostel	6.53 (79)	25.81 (24)	20 (6)	8.18 (109)
Train station	1.07 (13)	2.15 (2)	0 (0)	1.13 (15)
Carpark	1.07 (13)	0 (0)	0 (0)	0.98 (13)
Other	5.95 (72)	3.23 (3)	13.33 (4)	5.93 (79)
[d]Guessed BAC of self-reported preloaders x̄ (SD; median, N)				
All	.068 (.053; .06; 1360)	.075 (.049; .07; 91)	.072 (.046; .08; 42)	.069 (.053; .06; 1493)
Males	.071 (.054; .07; 714)	.072 (.038; .065; 52)	.109; (.047; 0.1; 14)	.072 (.053; .07; 780)
Females	.065 (.052; .05; 646)	.079 (.062; .07; 39)	.054 (.033; .05; 28)	.065 (.052; .05; 713)
[e]Preloaders unable to guess BAC % (N)				
All	21.21 (366)	20.87 (24)	10.64 (5)	20.92 (395)
Males	19.32 (171)	14.75 (9)	17.65 (3)	19.00 (183)
Females	23.19 (195)	27.78 (15)	6.67 (2)	22.92 (212)
BAC of those self-reporting to preload x̄ (SD; median, N)				
All	.058 (.047; .053; 1714)	.076 (.047; .07; 115)	.071 (.051; .057; 46)	.06 (.048; .054; 1875)
Males	.062 (.048; .058; 878)	.081 (.049; .075; 61)	.087 (.058; .084; 17)	.064 (.048; .059; 956)

Table 1 (*Continued*)

	Brisbane	Gold Coast	Mackay	All
Females	.055 (.047; .048; 836)	.07 (.044; .065; 54)	.061 (.045; .056; 29)	.056 (.046; .049; 919)
BAC of those with a BAC > 0% $\bar{x}$ (SD; median, N)				
All	.071 (.043; .064; 1952)	.08 (.044; .075; 111)	.083 (.05; .076; 131)	.072 (.044; .066; 2194)
Males	.073 (.044; .067; 1098)	.084 (.047; .078; 60)	.094 (.048; .09; 64)	.074 (.045; .067; 1222)
Females	.068 (.042; .062; 854)	.074 (.04; .068; 51)	.072 (.05; .062; 67)	.069 (.043; .063; 972)
BAC of those with a BAC > 0% by time of night $\bar{x}$ (SD; median, N)				
<10 p.m.	.066 (.043; .058; 419)	.078 (.052; .07; 28)	.077 (.05; .066; 41)	.067 (.044; .06; 488)
10.00 p.m.–10.59 p.m.	.067 (.043; .058; 792)	.079 (.042; .076; 36)	.089 (.05; .085; 43)	.069 (.043; .06; 871)
11.00 p.m.–11.59 p.m.	.077 (.044; .074; 640)	.082 (.042; .082; 45)	.08 (.044; .067; 43)	.078 (.044; .074; 728)
12.00 a.m.–12.59 a.m.	.079 (.042; .073; 101)	.053 (.014; .053; 2)	.105 (.103; .082; 4)	.079 (.045; .07; 107)
Reported energy drink usage % (N)				
All	9.84 (213)	16.79 (23)	6.67 (4)	10.16 (240)
Males	9.53 (106)	23.94 (17)	8.7 (2)	10.37 (125)
Females	10.16 (107)	9.09 (6)	5.41 (2)	9.95 (115)
[f]Preloaders mixing energy drinks % (N)				
All	11.65 (201)	20 (23)	8.51 (4)	12.08 (228)
Males	11.07 (98)	28.87 (17)	11.77 (2)	12.15 (117)
Females	12.25 (103)	11.11 (6)	6.67 (2)	12 (111)
BAC of those with a BAC > 0% reporting to mix energy drinks $\bar{x}$ (SD; median; N)				
All	.076 (.045; .071; 178)	.065 (.04; .054; 23)	.061 (.052; .052; 4)	.075 (.045; .068; 205)
Males	.086 (.047; .084; 86)	.07 (.044; .054; 17)	.08 (.07; .08; 2)	.083 (.047; .079; 105)
Females	.068 (.041; .06; 92)	.052 (.025; .054; 6)	.042 (.044; .042; 2)	.066 (.04; .06; 100)
BAC of those with a BAC > 0% reporting to not mix energy drinks $\bar{x}$ (SD; median; N)				
All	.069 (.043; .063; 1,315)	.083 (.044; .083; 88)	.074 (.049; .058; 42)	.07 (.043; .064; 1445)
Males	.07 (.043; .065; 709)	.09 (.047; .088; 43)	.086 (.057; .07; 16)	.072 (.044; .066; 768)
Females	.067 (.043; .061; 606)	.077 (.041; .075; 45)	.067 (.042; .058; 26)	.068 (.042; .063; 677)

Note. Not all participants were asked every question; data percentages rounded.
[a] = Set to a minimum of 5 min and a maximum of 240 min before testing.
[b] = Length of drinking session, set to minimum of 1 min and maximum of 12 h.
[c] = Set to a minimum of 1 and maximum of 30.
[d] = Set to a maximum of 0.3.
[e] = Stated they were unable to understand the system or gave an answer greater than a BAC of 0.3%.
[f] = People reported to preload, irrespective of BAC.

With Brisbane participants representing 90.52% of the data, and there being natural differences in the demographics between the locations (e.g., the Gold Coast sample is older than the Brisbane sample and the Mackay sample is older than the Gold Coast sample, $p < .001$), the Brisbane cohort will be used for quantitative analysis. Participants were recruited on Thursday, Friday, and Saturday nights from 21st August 2014 until 27th February 2015. One weekend (14th–16th November 2015) was avoided due to the G20 Heads of Government Summit in Brisbane and a break was taken over the unrepresentative Christmas period from 20th December 2014 until 8th January 2015. Locations where data was collected included train stations and bus stations leading to the Brisbane CBD and Fortitude Valley entertainment districts, outside major nightclubs and bars where people alighted taxis, and on walkways which led to the entertainment districts. Two researchers were accompanied by two police officers and people were asked to partake in the research survey, if they had the time. Both the researchers and the police asked people to take part, with positive community engagement being a main aim of the police. While every fourth person, or group of people, was approached and asked to take part when the researcher was free, we asked every person following a refusal. Refusals were rare as the researchers guaranteed anonymity and offered free BAC readings. The first week's data collection included only 22 refusals out of 150 participants asked (14.67% refusals) and the data collection rates for all other weeks in comparison to this figure were unremarkable to the notice of the researchers. Time of data acquisition ran from 8.50 p.m. to 12.59 a.m., with a mean time of data collection being 22.47 p.m. (sd = 47.4 min; between 10.30 p.m. and 11.30 p.m. was also the busiest time in the researchers' opinion). The entertainment districts were predominantly empty before this time and after 12.30 a.m. most passers-by had already been drinking within the entertainment districts. We found that if one member of a group of people volunteered to take part in the survey we needed to keep their companions engaged. If they were willing to also do a survey and we had an iPad/Tablet available then we would give them the survey to complete. However, as nearly everyone wanted to be breathalysed, we also had a very short questionnaire that asked minimal questions and then we breathalysed them. In this instance we held the iPad while they tapped their answers. The short questionnaire asked only their gender, age, what they think they will blow, and how many standard drinks they have had. This was conducted for the Brisbane sample only (n = 586). The only exclusion criteria to the study was if people had already been drinking in the entertainment district. If they had, they were still offered a free breathalyser test (which most people wanted and we saw as a public service) but they were not included in the data collection.

During completion of the survey the researcher did not look at the answers they gave, but stood next to the participant answering any questions that arose. The Police, whilst helping to engage people at the beginning, withdrew during survey completion so that they could not see the answers given on the iPad/Tablet. This was important because some of the questions related to illegal behaviour and we wanted to ensure participant confidentiality and also not place the Police in a compromised position.

Participants were given a business card which directed people to a website for the information sheet and they were also given an

identification number on the card. If, at a later date, any participant wished they had not taken part in the research they could contact the research team through the website and request that their data be removed and destroyed. Only one participant contacted us, and this was to obtain a copy of the final results when they were available.

We had a bank of researchers that were selected for work based upon availability. We found that a combination of a male and female researcher worked well, but also had no acts of violence directed towards us and had no problem with putting two male or two female researchers on together. The primary author was asked whether he was an undercover policeman a number of times, but the University identification and younger researchers seemed to allay suspicions. Further, as we followed where the crowds were entering the entertainment districts (e.g., if the trains were empty we went to the bus stop, taxi drop-off points, pavement thoroughfare or tram stop) we were filmed multiple times by television crews. Many people saw these television programmes and this acted as further assurance that we were a University research team and not trying to 'trap' people into giving information about illegal behaviour that would then be used by the police. The police presence actually worked to attract attention, with many patrons reporting that this was the first time they had "actually spoken to a cop who wasn't telling me what to do or staring at me".

Materials and assessment devices

We used iPad and Android tablets to collect data in real time using QuickTapSurvey (TabbleDabble, 2014). Questions related to drinking alcohol before entering the entertainment district, use of energy drinks, experiences of antisocial behaviour during past nights in the town, impairment from and dependence of drinking, risky sexual practices in the past, body self-image, and use of non-prescribed steroids and 'party drugs'. This paper, however, only focuses on the alcohol, risk and harm aspects of the survey.

Participants were also asked to guess their BAC before being breathalysed, having first been given an anchor point by being told that the drink-driving limit in Australia is a blood alcohol concentration of 0.05%. To breathalyse people we used the Alcolizer LE5. This breathalyser uses an electro-chemical fuel cell (platinum) which was recalibrated twice during the data collection. This state-of-the-art device is used by law enforcement agencies throughout Australia and South East Asia, is Australia Standard 3547 certified, with an accuracy of greater than 0.005 at 0.100 BAC g/100 ml.

We obtained data on calls for assistance and arrest rates from the Queensland Police Service in the areas where the researchers attended during the research. We also obtained these data for the same areas and on the same dates for a year earlier in order to compare any possible negative or positive effects from the research.

Approach to analysis

The data was obtained by exporting the responses from QuickTapSurvey to an excel spreadsheet and then importing the spreadsheet to Statistica (version 13) and changing data type according to the question. After data cleaning we approached the analysis in order of what we saw as the most important goals of the research: To log the frequency and intensity of preloading as people entered the entertainment districts; how this preloading changes across the night; correlates of preloading associated with possible harm; people's ability to guess their own BAC reading to understand whether government legislation was understood at a gross level; presence of people preloading with energy drinks (which did not include cola drinks) and whether this population were more or less inebriated than those who did not use energy drinks; why people reported to preload in the first place; and a clarification of whether preloading intensity differs depending upon the definition of preloading. We checked for methodological covariates before analysis. Those who completed the short questionnaire had, on average, a significantly ($p < .05$) higher BAC than those who completed the long questionnaire—but only if you include BAC's of zero. Obviously, the person/driver in the group who was completely sober was more likely to agree to do the long questionnaire while we gave the short questionnaire to his/her (usually more inebriated) friends. If you exclude BACs of zero then there is no significant difference between the two forms of data gathering and so the data have been presented broken down by BAC (greater than zero and including zero).

Results

Preloading specifics & BAC

The majority of our sample arrived in the entertainment districts by train, car, and taxi, at the median time of 10.37 p.m. Of the 79.72% who self-reported to preload, the average BAC was 0.058 ($sd = 0.047$). Of the 71.29% who entered the entertainment districts with a BAC reading above zero, the average BAC was 0.071 ($sd = 0.043$). There was a significant difference in male and female rates, with males being more likely to have a positive BAC, although this effect only accounted for an exceedingly small 0.67% of the variance in the relationship ($\chi^2(2738) = 18.45$, $p < .001$; Phi = 0.082). When giving a positive reading, males were slightly more likely to have a larger BAC (*Hedges' g* = .12, *95% CI* .026, .21). The maximum preloaded blood alcohol concentration % (BAC) obtained from any participant was 0.258 (a single 32 year old male arriving at 8.50 p.m. by taxi from home, hoping to enter a city bar on a Thursday night).

BAC over the night

Surprisingly, there was only a small to moderate effect on the BAC level of preloaders by time of night that their reading was taken. People scoring above a zero BAC level went, on average, from 0.066 ($sd = 0.043$, $n = 419$) before 10 p.m. to 0.079 ($sd = 0.042$, $n = 101$) between 12 a.m. and 1 a.m. (*Hedges' g* = 0.3, *95% CI* .09, .52). Overall, there was a small correlation between BAC (if greater than zero) and time of night that the data was collected ($r = .12$), representing a shared variance of only 1.44%. This is demonstrated in Fig. 1.

BAC and indicators of harm

In relation to harm and risky behaviour (see Table 2), whether someone had ever been assaulted, or had assaulted someone else, was related to BAC. Those with larger BACs were more likely to report to have ever been punched/slapped/kicked by someone else or to have done this to someone else ($F(1,2147) = 8.69$, $p = .003$, partial $\eta^2 = .004$; See Fig. 2). As one would expect, there was an effect for gender, with men more likely to report having been involved in such behaviour ($F(1,2147) = 8.13$, $p = .004$, partial $\eta^2 = .004$). In effect, the larger people's BAC on entering the entertainment districts, the more frequently they reported to have been involved in assaults (either being hit or hitting other people). Likewise, the higher people's BAC, the more they reported to have woken up with strangers after a night out ($F(4,2140) = 3.3$, $p = .01$, partial $\eta^2 = .006$). A larger percentage of men (47.01%), compared to women (21.87%), reported waking up with a stranger at least once. This difference was particularly noticeable with those who

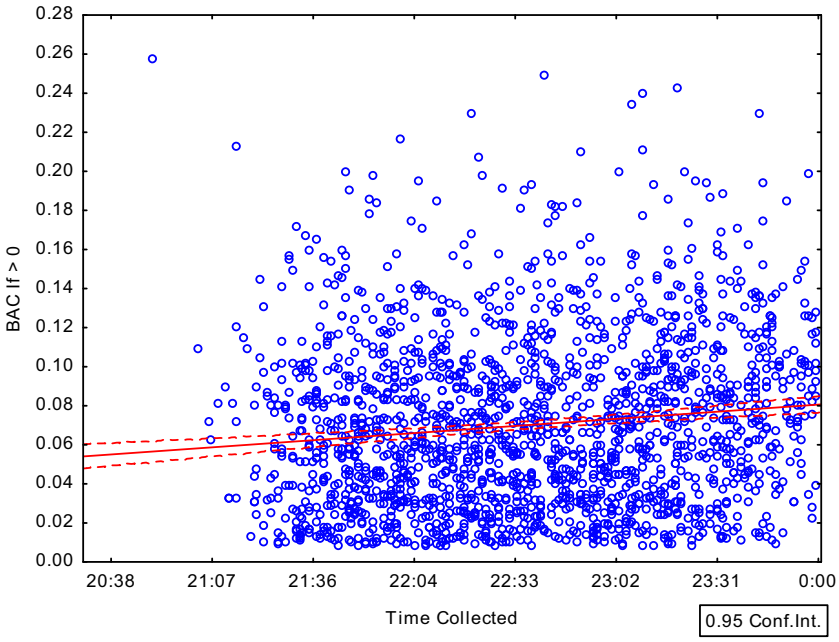

Fig. 1. Relationship between time of night and BAC (if greater than zero) up to midnight.

admitted this had happened "a few times" and this difference between the genders was statistically significant, with gender explaining approximately 8% of the variance in how people responded ($\chi^2(N = 2{,}150; df = 4) = 173.91, p < .001; Phi = 0.28$). There was no interaction of gender and BAC with promiscuous behaviour.

There was a significant relationship between people's preloading BAC and the frequency with which they had woken up and not remembered the night before ($F(4{,}2142) = 11.44$, $p < .001$, partial $\eta^2 = .021$). There was similarly an interaction with gender, with higher preloading BACs in women being associated more with

Table 2
Antisocial, risk and dependence related activities in relation to preloading BAC in Brisbane.

	All $\bar{x}$ (SD; median; N)	Males $\bar{x}$ (SD; median; N)	Females $\bar{x}$ (SD; median; N)
Have been punched/slapped/kicked by someone in town			
Never	.046 (.047; .035; 1616)	.049 (.048; .038; 745)	.044 (.046; .032; 871)
Once	.05 (.047; .04; 253)	.057 (.048; .053; 165)	.038 (.042; .023; 88)
A few times	.058 (.053; .05; 220)	.06 (.054; .05; 151)	.054 (.052; .047; 69)
Frequently	.06 (.053; .054; 43)	.057 (.05; .054; 31)	.068 (.063; .065; 12)
Nearly always	.079 (.058; .089; 19)	.065 (.043; .077; 11)	.098 (.072; .098; 8)
Have punched/slapped/kicked someone in town			
Never	.046 (.047; .033; 1783)	.048 (.048; .037; 864)	.043 (.046; .03; 919)
Once	.058 (.052; .048; 188)	.066 (.055; .06; 112)	.047 (.045; .035; 76)
A few times	.063 (.052; .055; 148)	.064 (.052; .055; 108)	.06 (.05; .055; 40)
Frequently	.067 (.04; .075; 13)	.064 (.046; .075; 9)	.072 (.029; .068; 4)
Nearly always	.08 (.055; .094; 19)	.069 (.041; .089; 11)	.094 (.071; .098; 8)
Woken-up with a stranger after night in town			
Never	.046 (.047; .033; 1467)	.049 (.049; .037; 620)	.043 (.046; .03; 847)
Once	.053 (.049; .046; 192)	.058 (.049; .058; 112)	.047 (.049; .033; 80)
A few times	.052 (.047; .045; 351)	.052 (.047; .047; 275)	.05 (.046; .045; 76)
Frequently	.062 (.056; .058; 95)	.065 (.057; .061; 70)	.052 (.054; .033; 25)
Nearly always	.063 (.057; .054; 45)	.055 (.052; .056; 25)	.072 (.063; .051; 20)
Woken to not remember the night before			
Never	.042 (.048; .024; 973)	.043 (.048; .029; 462)	.041 (.048; .02; 511)
Once	.05 (.046; .043; 351)	.06 (.048; .053; 158)	.042 (.042; .041; 193)
A few times	.053 (.048; .048; 599)	.057 (.05; .057; 344)	.048 (.045; .041; 255)
Frequently	.062 (.054; .056; 156)	.063 (.054; .057; 96)	.061 (.054; .055; 60)
Nearly always	.061 (.047; .059; 73)	.048 (.042; .041; 44)	.081 (.049; .074; 29)
People you know suggest you have a problem with alcohol			
Never	.045 (.047; .033; 1358)	.048 (.049; .037; 635)	.041 (.045; .028; 723)
A Little	.053 (.049; .044; 268)	.056 (.051; .045; 164)	.048 (.046; .036; 104)
Sometimes	.061 (.048; .055; 96)	.064 (.044; .063; 59)	.057 (.053; .045; 37)
A lot	.041 (.046; .027; 31)	.042 (.045; .032; 12)	.04 (.048; .027; 19)
Always	.088 (.061; .088; 30)	.088 (.063; .089; 15)	.089 (.062; .08; 15)

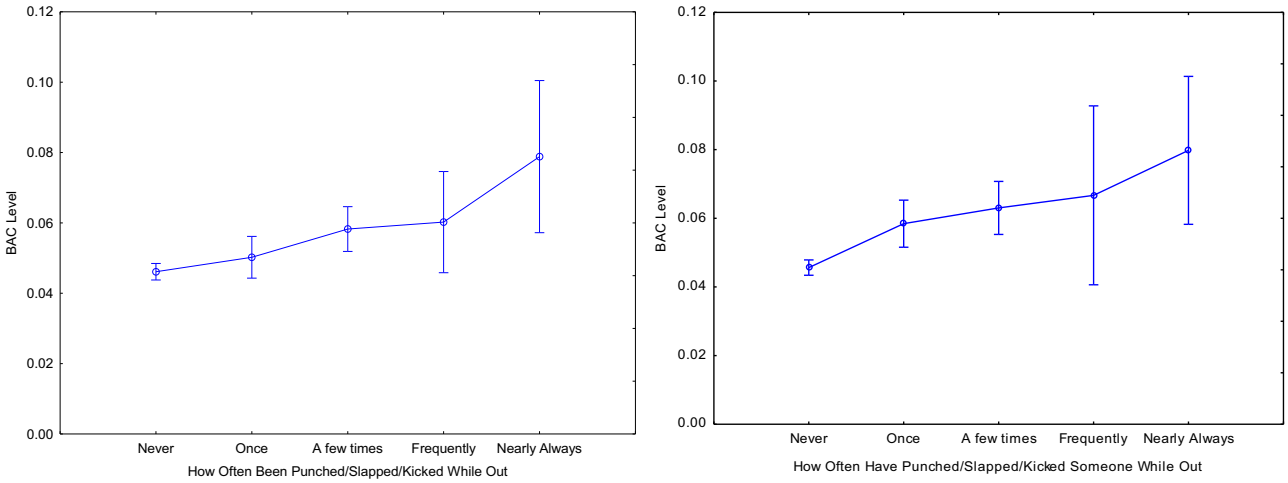

Fig. 2. Reported antisocial behaviour experiences as a function of preloading BAC (with 95% confidence intervals).

self-rated memory loss following nights out than in men ($F(4,2142) = 4.97$, $p < .001$, partial $\eta^2 = .009$). Also related to harm/dependence, the higher people's BAC the more likely they were to report that others had told them that they had a problem with alcohol ($F(4,1773) = 9.01$, $p < .001$, partial $\eta^2 = .02$). There was no difference between males and females in this profile.

Self-estimated BAC

Guessed BAC was compared to actual BAC, for those reporting to preload, and demonstrated a moderate correlation (r = .39; 15.21% shared variance). The difference between real and guessed BAC, for those who reported to preload, appears to show more variability the younger the participant. In effect, the youngest participants appeared to wildly over- or under-estimate their BAC level compared to older participants, evidencing a funnel plot relationship, as shown in Fig. 3. More than 20% of our sample was unable to even guess their BAC, having no knowledge of the blood alcohol concentration system (as used by the police to arrest drivers under the influence of alcohol). Comparing the ages of those that could and could not understand the system (i.e., said "I don't understand the system and can't guess" or did guess and guessed a BAC of over .3% – more than anyone in our trial – and had a difference between their real BAC and guessed BAC of more that ±.1, and also had a real BAC greater than 0) showed a significant result ($F(1,1947) = 4.16$, $p < .042$, partial $\eta^2 = .002$). Those who did not understand the BAC system were younger than those who did, using the current definition.

Energy drink usage during preloading

Only 9.84% of our sample reported to have used energy drinks. Of those who preloaded, this represents only 11.65% mixing their alcohol with energy drinks (see Table 1). This is a significantly lower number than in Miller (2013) study ($p < .001$). Those who did mix energy drinks scored a significantly higher BAC than those who did not mix energy drinks, although this only accounted for

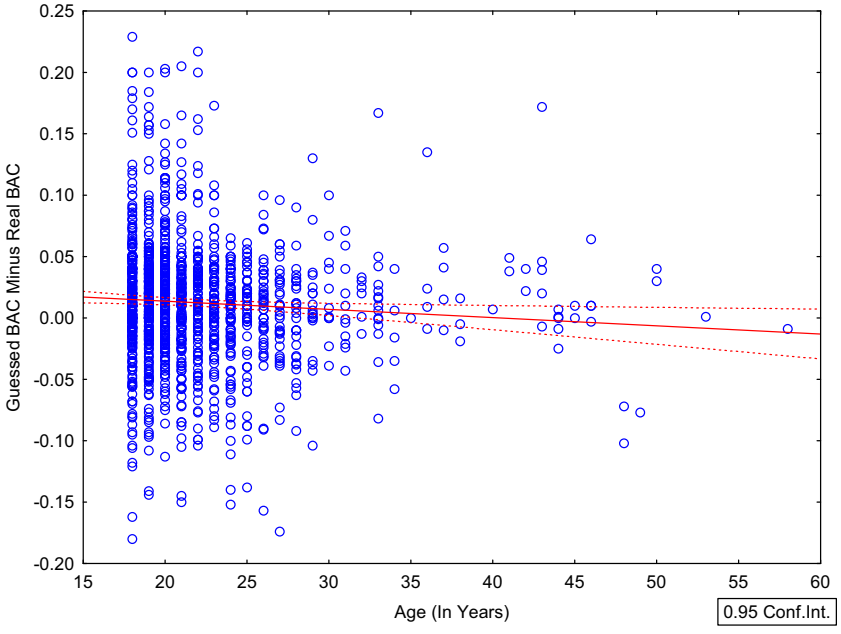

Fig. 3. Difference between guessed and real BAC in preloaders, as a function of age.

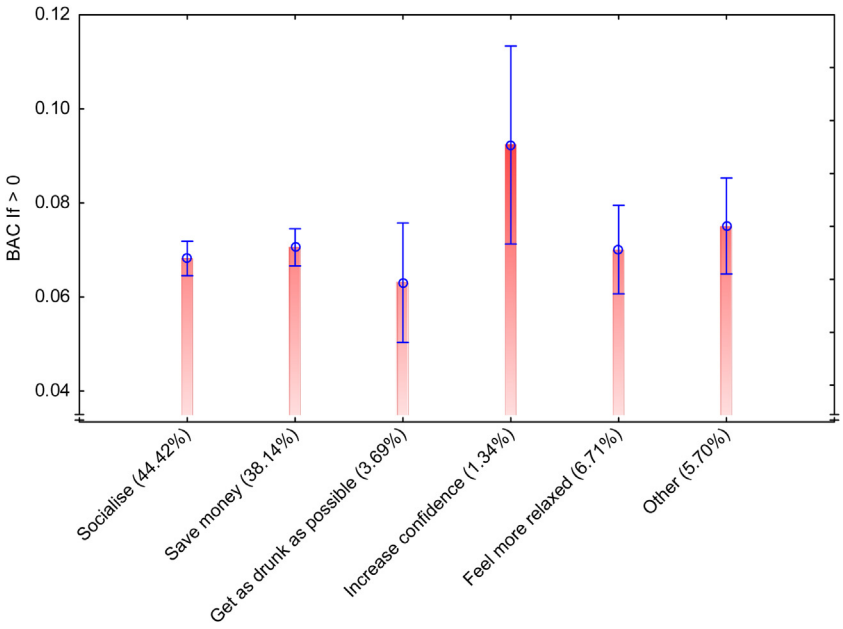

Fig. 4. Primary reason for preloading if BAC greater than zero (95% confidence intervals; N = 1193).

0.4% of the variance in BAC ($F(1, 1712) = 6.37$, $p = .012$, partial $\eta^2 = .004$).

Reasons for preloading

Reasons for preloading are demonstrated in Fig. 4. People could select more than one option as their reasons for preloading, but we present here the results for the majority who only picked one reason (the myriad possible combinations of 6 primary reasons led to 79 combinations being entered). The major reason given for preloading was 'to socialise with friends', with 'to save money' coming a close second. Significantly more people selected 'to socialise' than 'to save money' ($p < .002$). When plotted against alcohol reading, it is unsurprising that the small number of respondents who reported to be drinking to self-medicate a lack of confidence scored highest on BAC. There were no differences between the genders on their reasons for preloading. Including answers in all given combinations of reasons (79 of them), 'to socialise' was included in the answers of 49.54% of the participants and 'to save money' was included in 44.12% of them. This still represents a significant elevation of 'to socialise' over 'to save money' ($p < .02$).

Types of preloading & BAC

Of those reporting to preload, the majority of males and females drank at home, a friend's house, or at a local suburban pub before entering the main city entertainment districts. It could be argued either way that preloading should or should not include drinking at a suburban pub before entering the entertainment district. To clarify whether this had an effect on our results we analysed by preloading location. For those people who reported one main location for preloading (a minority preloaded at multiple locations), there was no significant difference in the BAC of people drinking in a suburban pub and the two predominant preloading categories of those drinking at home ($t(556) = .99$, $p = .32$) and those drinking at a friend's house ($t(431) = 1.72$, $p = .09$). The BAC of people, broken down by preloading location, is presented in Fig. 5. Naturally, with proximity to the testing sites, those few people preloading at car parks have the highest BAC, followed by those preloading in hotels and hostels.

Research & arrest rate correlates

In relation to the possible effects of the research, we obtained arrest/charge rates on the nights we collected data in each entertainment district and also obtained the number of logged calls for assistance made to the police. Table 3 contains the tabulation for arrest rates for personal crime compared to calls for assistance, and also the tabulation of public order offences against calls for assistance. We obtained the same data from the same nights and locations for the previous year. Calls for assistance increased during our data collection from 219 in 2013/14 to 288 in 2014/15. At the same time, and in comparison, there was a significant decrease in personal crime ($\chi^2(N = 935, df = 1) = 9.05$, $p = .001$, $Phi = 0.098$) and public order offences ($\chi^2(N = 982, df = 1) = 3.45$, $p = .03$, $Phi = 0.06$).

Vacation & regional areas

As one would expect with smaller samples, there was slightly more variation in our data from a regional area and from a holiday destination. The BAC of preloaders from Mackay ($\bar{x} = 0.083$), and particularly the males (BAC = 0.094), was very high on average. This older demographic (mean age of 29 years, compared to 22 years in Brisbane) was also much more likely to understand the BAC system, have had a longer drinking session before entering town, and to have had their last drink a shorter time ago. The Gold Coast data was midway between Brisbane and Mackay data on most indices, except they were more likely to have mixed energy drinks with their alcohol (17%). The Gold Coast holiday destination

Table 3
Arrest rates and calls for assistance before and during the research.

	2013/14	2014/15	Totals
Personal crime	21	7	28
Calls for assistance	419	488	907
Totals	440	495	935
Public order	43	32	75
Calls for assistance	419	488	907
Totals	462	520	982

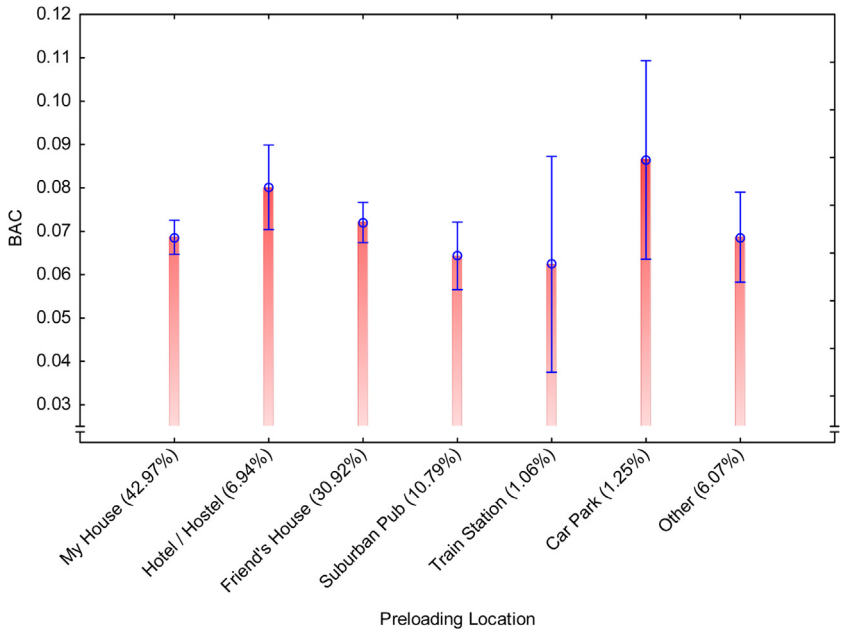

Fig. 5. Blood alcohol concentration levels of those who selected one location for their preloading (95% confidence intervals; N = 1038).

sample had higher rates of preloading and was higher on BAC recordings than in Brisbane generally.

Discussion

In this research we evaluated the extent of, and reasons for, alcohol preloading in a large sample, utilising direct measurements at point-of-entry to entertainment districts. We also evaluated the relationship of preloading with other alcohol-related behaviours, and self-reported harm and dependence indicators. We found that greater than 71% of people had a BAC greater than zero and 80% claimed to have drunk any alcohol before arriving in the city. This figure is much larger than previous estimates in research which did not specifically focus on preloaders before they entered city pubs (Hughes et al., 2011; Miller, 2013) or had heavy intoxication as an exclusion criteria to being part of their study (Miller et al., 2013). The mean BAC of those registering greater than zero (i.e., 71% of the people) was 0.071. This BAC is above the legal driving limit in many countries (e.g., Australia, France, Germany, and Scotland) and approaching a level similar to that used in experimental laboratory settings to represent a moderate dose of alcohol in order to enable impairment measurements (Fillmore & Vogel-Sprott, 1998; Marczinski, Harrison, & Fillmore, 2008).

Time of night had only a small effect on increasing people's preloading BAC, arguing against a strong determinant of opportunity to drink being associated with higher inebriation. Males had significantly higher BAC levels, but it should be noted that this effect was small and female preloaders displayed a very similar mean BAC of 0.068. These results are consistent with North American survey data (White et al., 2015) which suggest that the drinking habits of men and women are becoming more similar.

The vast majority of preloaders drank at home or at a friend's home, and the drinking session before leaving for the entertainment districts was over an hour and a half. People who preloaded at suburban pubs before entering the entertainment districts were similarly inebriated as those preloading at houses. The relatively large number of people preloading in hotels and hostels had the second highest BAC as a group. This is consistent with an undocumented trend in Brisbane for youth to hire and share cheap apartments in the city centre, avoiding taxi fares home and allowing independence from parents. It is also consistent with a trend for young, affluent workers in the mining industry to spend weekends in state capitals—hiring hotel suites and partying with friends and acquaintances.

Contrary, and significantly different, to previous research, the primary reason for preloading was 'to socialise'. This difference with past research (e.g., Miller, 2013) is marked and requires further clarification. We are concerned that, while price of alcohol is a factor in preloading, it is not the only, or even primary, factor. We are concerned that a price-point approach to alcohol may not be the only or best approach. Alcohol is readily brewed/mixed at home and virtual prohibition through price-point approaches may have unexpected consequences. Reducing preloading through social means, such as encouraging people into the city earlier or the provision of alcometers in pubs and clubs to allow entry, may be an effective first step to manage a growing preloading culture.

Consistent with a recent meta-analysis (Verster et al., 2016), people who had consumed alcohol mixed with energy drinks had a significantly higher BAC than those who had not mixed alcohol with energy drinks. However, and inconsistent with past research (Miller, 2013), only 9.84% of people, on average, used energy drinks, and 11.65% of preloaders mixed energy drinks. This difference between our sample and that of Millers is both significant and noteworthy. We believe that it is possible that previous studies do not have a representative sample of people entering the entertainment district or/and include all caffeinated drinks in their definition of what constitutes an energy drink.

There was a direct relationship for harm and dependence self-report data on the one hand and BAC level on the other. The higher people's BAC from preloading, the more likely they were to report having been involved in fights, had higher promiscuity, to have had amnesia the following day, and to have been told they had a drinking problem by other people. As such, more extreme preloading behaviours may be a good reason to suspect that dependence, impairment, and general harm is being done from alcohol intake. Many of the people who we assessed were heavily intoxicated at the time of assessment and this may have affected

their ratings. We believe that such a large sample may go some way in overcoming this problem.

In order to explain the high BAC correlation with risky and antisocial behaviours, it is tempting to argue that people who are heavier drinkers get into more trouble generally, and people who are heavier drinkers tend to preload more. However, this has not been tested in the field. Considering the ubiquity of preloading in those entering the entertainment districts, we have pause for concern that this would reflect in the other direction: that those who preload and have a higher BAC, are heavier drinkers generally.

Somewhat troubling were the more than 21% of people who did not even understand how the BAC system worked and were unable to even attempt to guess their level in relation to the driving limit for alcohol content in Australia. Related to this, the difference between guessed BAC and real BAC appears to be moderated by age, with older participants generally being more accurate in their estimations. This has never before been tested and suggests that drinking experience, and/or advertising campaigns from previous years, have been more successful in educating people regarding alcohol levels and impairment.

This research is the first study in the peer reviewed literature to focus entirely on preloaders, utilise a very large sample selected across many weekends, to include city and regional areas, and to include police into the data gathering process. The research was also associated with a positive effect on community violence in that it decreased, compared to the year before, wherever the researchers were collecting data. However, without a control condition on the nights of data collection this may reflect other practices and initiatives from the Queensland Police. It is possible, however, that the inclusion of police into the research protocol may also have diminished barriers between the public and police, with more approaches being made to police for help during the night at an earlier point in the offence pathway, leading to fewer arrests. This requires a targeted study to clarify the reasons for the current results. Likewise, a further study to assess the impact of police on the veracity of answers given by participants in the survey is under way. That said, an individual's BAC reading could not be impacted by the police presence.

Different European countries appear to have similar preloading norms (Hughes et al., 2011) but it may be argued that a limitation of the current study is that this is data from only one State in Australia, as opposed to across multiple States or, indeed, multiple countries. However, this research allows for a methodology that can be replicated and a baseline for international comparisons from a major capital city in a westernised country where preloading was assessed at point of entry, irrespective of inebriation, rather than as a retrospective estimate from people not heavily inebriated. As such, it represents the largest study so far on preloading behaviours, with direct implications for policy approaches to reducing harms associated with high alcohol intake. The results are alarming in the ubiquity and degree of preloading. We hold concerns for legislative procedures designed to affect drinking norms which do not directly address the underlying cultural aspects of drinking behaviours, of which preloading is but one example.

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Alcolizer Technology provided consumables for testing and calibrated the breathalysers.

Conflict of interest

None.

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