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Research Article

Factors affecting blood alcohol concentration (BAC) estimation and drinking intention during voluntary breath testing (VBT): a cross-sectional study

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In this article
Abstract
Introduction
Methods
Results
Discussion
Conclusion
Supplemental material
Disclosure statement

Abstract

This study aimed to assess the accuracy and factors influencing blood alcohol concentration self-estimation during voluntary breath testing. It also aimed to assess whether intended drinking behaviour changed after reviewing blood alcohol concentration and factors influencing this. A total of 462 Australian music festival patrons aged 18–40 years completed a survey exploring factors likely to affect estimation accuracy and provided an estimation of their blood alcohol concentration. A breathalyser reading was taken and participants were asked whether reviewing this reading changed their drinking intentions. Most respondents (58.4%) were accurate within 0.02% range, while 11.4% underestimated and 29.1% overestimated. Machine-read blood alcohol concentration was the most significant estimation accuracy predictor. Reviewing their readings changed the intention to drink in one-third of participants, indicating that voluntary breath testing may influence future drinking behaviour. Underestimation was associated with intention to drink less, whilst completing the survey earlier and <1 h since last drink was associated with intention to drink more.

Keywords: Blood alcohol concentration (BAC) | voluntary breath testing (VBT) | music festival | driving | estimation | drinking

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Introduction

Heavy consumption of alcohol is a common behaviour at music festivals in Australia and worldwide (Feltmann et al., 2019; Fernando et al., 2018; Mohr et al., 2018). High levels of alcohol consumption are associated with a variety of adverse physical and social health effects including alcohol poisoning, unintentional injuries, violent behaviour, and drink driving (Carbia et al., 2017; Courtney & Polich, 2009; Feltmann et al., 2019; Scott & Kaner, 2014). Many festivals are located in rural and regional areas which can necessitate patrons using private vehicles to get home, increasing the risk of drink-driving. Additionally, the young age of festival patrons (average 22.39 years in one study [Hughes et al., 2019]) exacerbates this risk, as younger people are more likely to hold a provisional or learner license. Furthermore, young people are disproportionately represented in deaths related to drink-driving in Australia (Centre for Road Safety, Transport for NSW, 2017).

Various public health promotion programs worldwide have aimed to reduce harmful drinking and its consequences (Kelly-Weeder et al., 2011). Australian drink-driving laws require a Blood Alcohol Concentration (BAC) of 0.00% for provisional and learner drivers and below 0.05% for those with a full license. Random breath testing (RBT) is conducted by police to enforce these laws and provide a deterrent against drink-driving (Centre for Road Safety, Transport for NSW, 2017). Individuals may self-estimate their BAC to determine whether they are legally safe to drive, both on the day of drinking and the day after (Fernando et al., 2018). Accurate estimation is thus important to avoid adverse legal, physical, and psychosocial consequences.

However, self-estimation of BAC has been found to be generally inaccurate (Aston & Liguori, 2013; Cameron et al., 2018; Clapp et al., 2006, 2009; Grant et al., 2012; Kraus et al., 2005; Lansky et al., 1978; Mundt & Perrine, 1993; Rossheim et al., 2018). Clapp et al. (2006) interviewed US college students after drinking sessions and developed a method of classifying self-estimation accuracy, with accurate being classed as within 0.02% of their estimate, overestimate being >0.02% over their estimate, and underestimate being classed as >0.02% under their estimate.

It has been demonstrated that blood alcohol is overestimated at lower concentrations and underestimated at higher concentrations (Cameron et al., 2018; Grant et al., 2012; Mundt & Perrine, 1993). Furthermore, several individuals and environmental factors that influence BAC estimation have been identified including gender (Clapp et al., 2009; Grant et al., 2012; Thombs et al., 2003), total drinking time (Clapp et al., 2006, 2009; Kraus et al., 2005), food availability, large party size and rowdy behaviour in party environments (Clapp et al., 2006), type of alcoholic beverage (Rossheim et al., 2018), alcohol tolerance (Lansky et al., 1978) and personality traits including anxiety (Aston & Liguori, 2013). Importantly, the underestimation of BAC is associated with risky driving after drinking (Beirness, 1987; Laude & Fillmore, 2016).

In an Australian cross-sectional study, Fernando et al. (2018) found that 41% of music festival participants changed their intention to drive after using a breathalyser to determine their BAC. They also found an association between an increase in the number of passengers in the car and a change in intention to drive.

This study provides a number of contributions to the literature, with the primary aim of this study being to add to the assessment of the accuracy of and factors affecting BAC self-estimation during voluntary breath testing (VBT) among Australian festival patrons. While the main aim of VBT is to inform patrons whether they are safe to drive or not, we hypothesised that informing patrons of their BAC also has an impact on their intended drinking behaviours. Our second aim was therefore to determine whether self-reported intended drinking behaviour changed after reviewing one's BAC, and what factors influenced changes in drinking intention. To the best of our knowledge, this is an area that has not been previously studied in the existing literature.

Methods

Design and setting of study

A cross-sectional study was conducted at a large three-day outdoor music festival in regional New South Wales, Australia, which was attended by more than 30,000 people, in collaboration with STEER, a not-for-profit organisation (www.steerproject.org.au). STEER performs free voluntary breath testing at community events and major music festivals, to positively change behaviours of those intending to drink and drive by increasing awareness of BAC (Preston, 2018). Ethics approval was received from the Human Research Ethics Committee Western Sydney University (H11327).

Participants and materials

Festival patrons who approached the STEER stall were asked to participate in the study. The STEER stall included an onsite breathalyser and information pamphlets about drink driving. Eligibility criteria were being aged between 18–40 years and having consumed alcohol in the past 24 h but not within the past 10 minutes. Drinking alcohol within 10 minutes before breath testing can cause BAC readings to be artificially inflated (Fessler et al., 2008). The lower age limit of 18 years old was chosen as it is the legal drinking age in Australia (Department of Industry Liquor and Gaming, 2020). The upper age limit of 40 years old was based on previous research at music festivals to enable comparison (Fernando et al., 2018).

When potential respondents approached the STEER stall with the aim of self-administering a breath test, they were asked if they would like to participate in a survey involving voluntary breath testing and estimation of blood alcohol concentration. A participant information sheet was provided and verbal consent for participation was then gained. The number of potential respondents that declined to participate in the survey after receiving information about the study was recorded.

Data collection

Procedures

Participants completed a self-administered paper survey. To assist with an accurate recall of a number of standard drinks in the last 24 h, participants were provided with a Standard Drinks Guide developed by the Australian National Health and Medical Research Council (National Health and Medical Research Council, 2009).

Upon completion of the first part of the survey, participants were directed by a trained STEER volunteer to a wall-mounted breathalyser (Alcolizer WM5). The Alcolizer WM5 can detect a BAC range of 0.000–0.500 g/100 ml at an absolute accuracy of better than ±0.005 g/100 ml (BAC) (Alcolizer Technology, 2016).

The participants then self-administered their breath tests with assistance when required from STEER volunteers and recorded their machine-read BAC level (mBAC). Participants were then asked to complete the remainder of the survey.

After completion of the survey, participants were advised about their mBAC levels and other transportation options to encourage safe driving behaviour and given information on the STEER project's goals and initiatives.

To deter festival patrons from drinking excessively to 'achieve a high score,' the wall-mounted machine results were limited to a BAC level of 0.1%. If participants blew above this range, the machines would display a reading of >0.1%. Participants who blew above 0.1% were therefore recorded to have a BAC in the range of >0.1% rather than an exact reading. Many participants were not familiar with the scale used to estimate BAC, and so were told that the legal driving limit for full license drivers was 0.05% and zero for other drivers by STEER volunteers and also directed to posters displaying the legal limit to ensure participants were aware of their legal limits. We applied the principles outlined by Aldridge et al. (Aldridge & Charles, 2008) to guide our interaction with intoxicated research participants to conduct the survey ethically. These included actions such as not surveying individuals who were overtly severely intoxicated and taking extra time to ensure participants understood the purpose of our project and what participation would entail.

Outcome measures

The following data from respondents were collected: demographics, transportation methods, alcohol use, previous experience with RBT and VBT, and eating and sleeping behaviours (see Supplementary Appendix 1). Demographics included age in years, gender (male/female/other), height, weight, and maximum level of education attained (Year 10/High School Certificate/Trade Certificate or Diploma or Professional/undergraduate degree/Postgraduate degree. Participants were also asked: How are you planning on getting to your accommodation tonight? Response options included: Walking, Public or festival transport, Taxi/ride sharing service, Private car, or other.

The validated survey instrument AUDIT-C (Alcohol Use Disorders Identification Test – Consumption) was used to identify hazardous drinking (Frank et al., 2008). The score ranges between 0 and 12. Hazardous drinking scores for men are ≥4 and for females are ≥3 (Frank et al., 2008).

Confidence in estimating BAC was developed specifically for this study using a scale from 0–10, with 0–3 recorded as low-level confidence, 4–6 recorded as medium level confidence, and 7–10 recorded as high-level confidence. These categories were chosen with the aim to reduce categories, ease of interpretation, and to allow for a relatively equal distribution across confidence level. The other survey questions were based on findings regarding potential factors influencing BAC and BAC estimation in previous studies (Clapp et al., 2006; Fernando et al., 2018; Grant et al., 2012).

BAC measures

Participants were asked to estimate their BAC (eBAC) on the paper survey and also to record their mBAC.

Data management

Similar to Clapp et al. (2006), an accuracy BAC measure (aBAC) was created as follows: accuracy BAC equals estimated self-reported BAC level (eBAC) minus machine-read BAC level (mBAC). aBAC estimates were further classified into 3 categories, according to Clapp et al.'s model (Clapp et al., 2006) for clarity:

1. Accurate estimates (within 0.02% of the mBAC value)
2. Underestimates (>0.02% under mBAC value)
3. Overestimates (>0.02% over mBAC value)

Statistical analysis

Primary outcome – BAC accuracy (aBAC)

We examined the relationship between factors and aBAC using *t*-test and ANOVA for categorical factors and Pearson's correlation for continuous factors. We then entered factors that were significantly associated ($p < 0.1$) with aBAC in bivariate analyses into a multiple regression model using the stepwise method with aBAC as our continuous dependent variable. Main effects were included. The following variables were coded as 1 = yes, 0 = no: previous RBT experience, confidence ratings in their ability to estimate their BAC levels between 7 and 10 (versus ratings below 7), and intention to drive in the next 24 h. mBAC was measured in units of BAC and time from last drink to test was measured in hours.

We evaluated the effects of the predictors on aBAC firstly by finding which variables had a significant effect on it and these variables' coefficients/betas (see Table 2). To enable an easy understanding of the effects of different variables on BAC estimation accuracy and their real-world implications, when adjusted for other variables, we used the model's findings to illustrate the values of aBAC under common scenarios. The following variables and categories within them were used to predict aBAC under specified conditions: intention to drive (yes versus no), RBT experience (yes versus no), and machine-read BAC levels (0.0%, 0.05%, 0.10% units of BAC).

Secondary outcome – drinking intention

We examined the relationship between factors and intention to drink using ANOVA for categorical variables and Pearson's Chi-square test for categorical variables. We then entered factors that were significantly associated ($p < 0.1$) with drinking intention in bivariate analyses into a multinomial multiple logistic regression model using the stepwise method. As drinking intention was a three-category variable, the model compared 'drink less' to 'no change' as well as 'drink more' to 'no change.' Main effects were included. Survey time was coded as 4–8pm versus after 8pm (reference category). Time since last drink was coded as less than 1 h, 1–2 h, versus more than 2 h (reference category). The accuracy of BAC was classified into underestimate, overestimate versus accurate (reference category). Results are reported as adjusted odds ratios (AOR). Analyses were performed using IBM SPSS software (version 25).

Results

Study population characteristics

Of the people approached, 83.7% (494/590) completed the survey. We excluded respondents who did not record their mBAC or who had drunk alcohol within 10 minutes of their BAC reading ($n = 32$), resulting in 462 respondents. The characteristics of the study population are outlined in Table 1.

Table 1. Characteristics of study population.

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The mean age was 23.91 (SD = 4.92). The Audit-C screening questionnaire classified 87.6% as high-risk drinkers. Almost 2/3 (61.0%) intended to drive in the next 24 h. More people reported previous experience with random breath testing (74.3%) compared with voluntary breath testing (46.3%).

The mean eBAC was 0.039 (SD = 0.032) (negatively skewed) and the mean mBAC was 0.030 (SD = 0.028) (negatively skewed), giving a mean aBAC of 0.010 (SD = 0.030) (normally distributed, but 0 inflated). After reviewing their mBAC, around 2/3 (62.9%) of participants did not intend to change their drinking behaviour, while 16.6% reported planning to drink less and 20.5% to drink more.

Accuracy of BAC estimation

To determine the accuracy of BAC estimation, we excluded respondents who recorded an eBAC greater than 0.4% (the lethal limit), as we deemed these estimates invalid ($n = 48$). We also excluded respondents who recorded greater than or equal to 0.1% mBAC on the STEER breath testing machines as we were unable to record their exact mBAC reading ($n = 52$). This resulted in the inclusion of 394 participants.

A moderate correlation between eBAC and mBAC (df(393), $r = 0.530$, $p = <0.001$) was found. More than half of respondents (58.4%) were classed as accurate while 11.4% underestimated their BAC and 29.1% overestimated their BAC.

Of the 186 participants that held a full licence and intended to drive in the next 24 h 18.8% (35/186) blew over 0.05%. Of these 35 participants, approximately one third (34.3%, $n = 12$) estimated under 0.05%. Of the 57 participants that held a provisional licence and intended to drive in the next 24 h 43.9% (25/57) blew over 0.00 (the legal limit in Australia). Of these 25 participants, only one estimated 0.00 (the mBAC recorded was 0.01).

Factors influencing aBAC

A significant multiple regression equation was found ($F(5, 376) = 21.250$, $p < 0.001$, $r^2 = 0.223$) and is outlined in Table 2.

Table 2. Multiple regression model predicting accuracy of blood alcohol concentration (aBAC)*.

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Results of the multiple linear regression indicated that there was a significant association between aBAC and mBAC ($p < 0.001$), intention to drive ($p = 0.001$), time from last drink to test in hours ($p = 0.002$), confidence to accurately estimate BAC levels (between 7–10 versus levels lower than 7) ($p = 0.009$), and previous RBT experience ($p < 0.037$). The values of multiple scenarios were predicted using the regression coefficients and are outlined in Table 3.

Table 3. Predicted aBAC under certain conditions.

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For the majority of the scenarios, aBAC was within the accurate range (aBAC ± 0.02%). There were six scenarios that returned an overestimate, and three that returned an underestimate. For those which resulted in underestimates, mBAC was 0.1 in all scenarios. For those which resulted in overestimates, mBAC was 0.00 in all scenarios.

Factors associated with change in drinking intention after reviewing mBAC

The results of the multinomial multiple logistic regression model are outlined in Table 4.

Table 4. Multinomial logistic regression model for intention to drink after reviewing mBAC.

Download CSV Display Table

Using a range of scenarios, our model indicated that among respondents who accurately estimated their BAC, were surveyed after 8pm and two or more hours after their last drink, only 6.6% planned to drink more than before their VBT. Those who were surveyed between 4–8pm and who had had their last drink <1 h before the survey were much more likely to plan to drink more after the VBT, with 44.6%, 41.3%, and 60.5% of accurate estimators, under-estimators, and over-estimators respectively planning to drink more after VBT. Significantly more under estimators intended to drink less after VBT. While 43.9% of under estimators whose last drink was >2 h prior to survey intended to drink less, only 12.2% of over estimators whose last drink was 1–2 h pre-survey, intended to drink less.

Discussion

The results of this study indicate that misperceptions of BAC is likely improved at lower levels of BAC, and that mBAC has the most significant effect on misperceptions of BAC. These data also show that undergoing VBT is likely to influence intended drinking behaviours, which to our knowledge has not been described in the literature prior to this study. We showed that misperception of BAC is associated with a change in intended drinking behaviour, as well as drinking pattern (time to last drink) and time of the survey.

Study population characteristics

Our survey captured a young study population in line with other field studies on BAC estimation, with Clapp et al. in 2006 having a mean age of 20.1 (SD = 2.1) years and the Fernando et al. study having 18–21 year olds make up 58% of their study population versus 41% in our study (Clapp et al., 2006; Fernando, 2018). Field studies on BAC self-estimation appear to capture more male than female participants, with 56.4% male in Grant et al., 60% in Fernando et al. and 63.5% in Clapp et al., which is in line with our slight majority of males of 54% (Centre for Road Safety, Transport for NSW, 2017; Clapp et al., 2006; Grant et al., 2012; Fernando et al., 2018). High risk drinking as measured by the Audit-C screening questionnaire was prevalent and very similar in our study population to the Fernando et al. study (Median [min., max.]: 7 [2, 12] versus 6 [1, 12]) (Fernando et al., 2018). High-risk drinking behaviours appear to be prevalent in other field study populations on BAC self-estimation – for example, in the US Grant et al. study, participants reported 6.57 (SD = 4.67) binge episodes in males and 4.20 (SD = 3.97) binge episodes in females in the past month (Grant et al., 2012). In our study, 76.2% had a full driver's license compared to only 51% in the study by Fernando et al. (2018). Participants in our study also had a higher proportion of people that intended to drive in the next 24 h compared to the study by Fernando et al. (2018): 61% versus 45%.

Factors affecting aBAC

The majority of respondents (58.4%) were accurate within ±0.02% units of BAC. The proportion of accurate estimates is higher than the 24% found by Clapp et al. in their 2006 study of college students in the United States (Clapp et al., 2006), and the 28.4% found in their replication in 2009 (Clapp et al., 2009). This may be explained by the comparatively low range of BAC values of our study population. Other studies did not define accurate estimation within a range, using exact values instead (Beirness, 1987; Cameron et al., 2018; Grant et al., 2012; Kraus et al., 2005).

mBAC was the most significant predictor of estimation accuracy. Using Clapp et al.'s definition of an accurate estimate as aBAC within ±0.02, we found that the most accurate estimation occurred at mBAC = 0.05 in our modelled scenarios. Additionally, we found that there was a considerable bias at the extreme ends of mBAC with overestimation more common at mBAC = 0.00 and underestimation more common at mBAC = 0.1.

Our finding that BAC is overestimated at lower levels of BAC is in line with previous studies (Cameron et al., 2018; Grant et al., 2012; Laude & Fillmore, 2016; Thombs et al., 2003; Wicki et al., 2000). However, the upper limit of the range that BAC is overestimated at appears to vary across multiple studies. In the New Zealand field study surveying participants on the streets of a university town over 5 nights, Cameron et al. found that on average people with an mBAC less than 0.07 overestimated their BAC (Cameron et al., 2018). Similarly, in their study of American college students who had consumed alcohol, Grant et al. found that people with an mBAC up to 0.08% slightly overestimated their BAC (Grant et al., 2012). However, some studies have found that BAC can also be overestimated at higher levels. Over their 15-week field study of American college students returning to their residence halls late at night, Thombs et al. found that those with an mBAC up to 0.14% tended to overestimate their BAC (Thombs et al., 2003). Similarly, in their study conducted on Swiss soldiers on a night of drinking, Wicki et al. (2000) found that BAC was always overestimated by those with an mBAC up to 0.15%. These varying study populations may partly explain why there are differences in the levels of BAC that are overestimated.

Our modelled scenarios are more in line with Grant et al. and Cameron et al. where mBAC of 0.05% resulted in accurate estimation. This lower value may be explained by our study population, as VBT is designed to inform patrons whether they are legally safe to drive and therefore participants that use VBT may be more cautious in their self-estimation than the general population. It may also be explained by the restraint that respondents with an mBAC >0.1% were excluded from our study. The finding that mBAC set at 0.05% (the legal driving limit) in the modelled scenarios resulted in the most accurate aBAC is reassuring from a public health perspective. However, of the full licence drivers that blew over 0.05 (the legal limit), approximately one third estimated their BAC to be under the legal limit. Furthermore, for three study participants that were classed as accurate according to the Clapp categorization method (±0.02%), they underestimated their BAC as being under the legal limit (0.05) while their mBAC reading was in fact over. This is a limitation of this method of categorization when BAC is around 0.05. This finding highlights the need for further public education around the relationship between alcohol intake and BAC, and the need for care when self-estimating BAC around 0.05.

Conversely, for provisional drivers, it is reassuring that 96% of participants correctly predicted their BAC was over 0.00. This finding is likely due to the tendency to overestimate rather than underestimate BAC at low levels as discussed above. It also reflects the importance of maintaining a drivers' licence for young provisional drivers in the context of strict enforcement of driving under the influence of alcohol in NSW for provisional drivers.

Underestimates in the modelled scenarios occurred only when mBAC = 0.1. This is consistent with studies finding that underestimation occurs at higher BAC levels. Cameron et al. found that the 'switching point' at which their participants moved from overestimating to underestimating their BAC was BAC 0.1 (Cameron et al., 2018). Similarly, Thombs et al. found that participants with a BAC above 0.09 tended to underestimate (Thombs et al., 2003). Conversely, in Kraus et al.'s field study of American college students walking on campus late at night, where participants had an average BAC of 0.09, the overall trend was an overestimation (Kraus et al., 2005). In this study, BAC ranged from 0 to approximately 0.21 and it was not specified whether under or overestimation occurred at different levels within this range.

In our scenarios, the group that performed the worst at a BAC of 0.1 were those with high confidence, RBT experience, and intention to drive, with an

underestimation of costs. This is a concerning finding as drivers with high confidence and high experience may have been expected to perform the best at this mBAC level. This finding may be due to overconfidence resulting in further carelessness regarding the monitoring of alcohol consumption. This attitude may be associated with personality traits, which were not assessed in this study, such as sensation seeking (Zuckerman, 2007). It is likely that the beneficial effects of confidence in estimation and RBT experience at low levels of BAC are reduced as BAC increases. This finding may also be explained in part by the fact that the intention to drive had an extended time period (any time in the next 24h), so it is likely that some drivers were intending to drive at much later time periods after their BAC would have decreased.

Change in drinking intention

This study found that approximately one-third of participants changed their intention to consume more or less alcohol after reviewing their BAC. Although the primary intention of VBT is to inform patrons whether they are safe to drive or not, this finding shows that VBT also influences intended drinking behaviours at music festivals.

Our study found that when people were informed of their mBAC, underestimation was associated with the intention to drink less. This is likely due to drivers who were more intoxicated than intended and/or who perceived and increased need for restraint amongst the participants who intended to drive later that night. This finding suggests that VBT may have a protective role at music festivals.

However, the potential harms of voluntary breath testing need to be further investigated. In the state of American college students, Carey et al. (2012) hypothesised that when people are not informed of their BAC, overestimation at the BAC levels may positively reduce drinking due to a misunderstanding of being more intoxicated than in actuality, and wanting to self-regulate their drinking so as not become overly intoxicated. In line with this hypothesis, a greater proportion (26.8%) of overestimating VBT participants, compared with intended to drink more once they were informed of their BAC. In our scenarios, a significant association was also found between overestimation and intention to drink more, and anecdotally some participants reported that reviewing a low BAC reading gave them a reason to drink more. This is a potential deleterious consequence of VBT that should be further investigated by controlled studies to better investigate the relationships between misperception of BAC, VBT, and drinking behaviours. We recommend that STEER volunteers and those administering VBT tailor their advice to underestimators and advise them not to increase drinking more than they planned, following the discovery that their BAC was lower than what they thought. In addition, this finding is linked to the notion of 'determined drunkenness,' where drinkers have a target level of intoxication that they are aiming to reach, often as a specific aim of weekend drinking. If drinkers are below their intended level, they will endeavour to drink more (Measham, 2006). Furthermore, misperception of BAC and intended drinking behaviours is also linked to the concept of alcohol course expectancies (Blume & Gutos, 2015), where participants may have held certain positive alcohol outcome expectancies attached to specific values on the BAC scale. Further research would be useful to elucidate whether the relationship between misperception of BAC, VBT, and intended drinking behaviour changes depending on specific BAC values.

The finding that completing the survey earlier in the night was associated with the intention to drink more was likely due to participants wanting their drinking to coincide with the main events of the festival occurring later in the evening. Additionally, completing the survey earlier means they may still have had enough time to continue drinking and allow their BAC to reduce to a reasonable level before leaving the festival. This may also explain the finding that a shorter time since last drink (<15 hrs) was associated with an increased likelihood of drinking more after reviewing BAC. Those who had their last drink less than an hour prior survey were probably more likely to have been in the midst of their drinking session when compared to those who had their last drink over 24 ago. Together these findings suggest that VBT may be more useful later at night when the festival environment has quietened and participants are more likely to be finished with drinking alcohol and planning their return home.

Strengths

To our knowledge, this is the first study that investigated the relationship between VBT and drinking intention. A high response rate was achieved. Our anonymous survey design aimed to reduce potential response bias. The questions used for the survey to gauge drinking behaviours were part of a validated instrument, AUDIT-C (Frank et al., 2008). Our survey utilised both subjective measures including self-reported intention to drive, drive and confidence in BAC estimation, and objective measures including machine measured BAC. Additionally, during the data collection phase it was deemed that many respondents were very unsure of how to estimate their BAC. Informing the study participants of the legal limit (0.05) likely improved the accuracy of our study participants' BAC estimates.

Limitations

There were several limitations to this study. Firstly, our analysis was restricted to respondents who recorded a BAC of 0.1 or below. As people are more likely to underestimate their BAC as their BAC becomes higher, our population may have been skewed towards overestimation of BAC. The results of this study are generalisable to people intoxicated above this level. Secondly, selection bias may have been present because participants showed initiative to approach the STEER stall to check their BAC and complete the survey, which may have led to a more responsible, conscientious study population. Thirdly, people were motivated when they were completing the survey which may decrease the reliability of the results. The methodology of informing respondents of the legal limit is consistent with multiple previous studies (Cameron et al., 2018; Clapp et al., 2006; Grant et al., 2012; Lansky et al., 1978; Rossheim et al., 2018). Furthermore, this study did not enquire about or control for illicit drug use. However, previous studies have demonstrated that drug use at music festivals is high (Day et al., 2018) and that Australian festival attendees were much more likely than their same-age counterparts in the general population to have reported ever using illicit drugs and current usage of illicit drugs (Jenkinson et al., 2014). This could have adversely influenced BAC estimation accuracy. Also, this study was not designed to assess voluntary breath testing as an intervention to reduce drinking behaviours. Associations between factors and change in drinking behaviors cannot be calculated. Due to the fact that the intention to drive had an extended time period (any time in the next 24 h), it is likely that some drivers were intending to drive at much later time periods when their BAC was lower and potentially 0.00. Lastly, The Cage classification categories do not take into account the special cases around the legal limit of 0.05 where a participant may underestimate their BAC as being under the legal limit while in reality being over the limit, but still be classed as accurate because the correct estimate was within 0.02 of their actual BAC. However, in this study population, the occurrence of this was very rare – only 3 cases out of 394 valid study participants, or less than 2 cases, the study participants estimated their BAC to be 0.04 while they recorded an mBAC of 0.051, 0.057, and 0.057 respectively. We therefore acknowledge the concerns that a 0.02 difference could have a very real implication for driving over the limit but it rarely happens in practice.

Conclusion

Most participants accurately estimated their BAC (within ±0.02). VBT changed intention to drink in one-third of participants. Intentions to drink more after VBT were concerning but intentions to drink less were encouraging, indicating that VBT may have an effect on drinking behaviour, and could potentially be utilised further as a harm reduction tool in festival environments. Further research should be conducted on VBT as an intervention in relation to drinking intentions.

Supplemental material

Factors affecting blood alcohol concentration (BAC) estimation and drinking intention during voluntary breath testing (VBT): a cross-sectional study

Disclosure statement

Philip Preston is the coordinator of STEER Project. Part of his role is to organise, conduct, and report on voluntary breath testing at major music festivals and community events. The authors declare that they have no further competing interests.

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