

**Intoxication by drinking location: a web-based diary study in a New Zealand university
community**

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Abstract

Drinking to intoxication is a modifiable risk factor for various health, social, and legal problems. The objective was to estimate the relative risk of intoxication by type of drinking location. Participants were 1,614 university students (mean age 19.0 years) in residential halls who completed a web survey (67% response). Respondents reported their drinking for each day of the preceding week, in residential halls, pubs/bars/nightclubs, student flats/houses, and 'other' locations. An estimated blood alcohol concentration (EBAC) was computed and intoxication was defined as $EBAC > 0.08\%$. Pubs/bars/nightclubs accounted for 51% of all alcohol consumed, followed by residential halls (34%), student flats/houses (9%), and other locations (6%). Episodes resulting in intoxication comprised 61% of all drinking episodes in pubs/bars/nightclubs, 55% in student flats/houses, 53% in residential halls, and 37% in other locations. Multi-level analyses revealed positive associations between the first three location types (relative to 'other') and intoxication among women. Drinking in pubs/bars/nightclubs was associated with intoxication among men. Other significant predictors included hazardous drinking in the respondent's residential hall, pre-university drinking, and first-year status. Student intoxication is commonplace in licensed premises and residential halls. These environments are amenable to interventions to reduce the incidence of intoxication.

Key words: drinking, measurement, intoxication, college, web survey, diary

1. Introduction

Heavy episodic drinking is a significant health concern among college students in many countries. Though most of the college drinking literature is from North America, a recent international review suggests that the prevalence of heavy episodic drinking and a range of acute alcohol-related problems is similarly high in Europe, Australasia, and South America (Karam et al., 2007). First-year students are at particularly high risk of alcohol-related problems, given that their drinking appears to increase substantially upon matriculation and throughout their first year at university (Johnston et al., 2003; Kypri et al., 2002; O'Malley and Johnston, 2002; Sher and Rutledge, 2007). Notably, college students have a higher prevalence of hazardous drinking and alcohol use disorders than their non-student peers (Dawson et al., 2004; Kypri et al., 2005a; O'Malley and Johnston, 2002), suggesting that there may be something about the college environment which encourages or facilitates heavy drinking.

A large body of literature identifies a range of individual risk factors for heavy drinking in college, including male gender, age of initiation to drinking or heavy drinking (Hingson et al., 2002; Hingson et al., 2003) high school drinking pattern, family history, other substance use (Wechsler et al., 1995), and a range of psychological factors, such as impulsivity, negative emotional states, alcohol expectancies (Baer, 2002), and misperceptions about peer drinking norms (Kypri and Langley, 2003). Several social risk factors have also been identified, including membership of a fraternity or sorority (Larimer et al., 2000), self-selection into a heavy drinking social group (Sher and Rutledge, 2007), and living in a residential hall with heavy drinking peers (Kypri et al., 2002).

There is a small but growing US literature suggesting that certain types of drinking locations in college communities may increase risks for heavy drinking (Dowdall and Wechsler, 2002). For example, Clapp and colleagues found that in bars, the presence of other intoxicated persons and the playing of drinking games were associated with an increased volume of drinking

(Clapp et al., 2006b), while Usdan and colleagues found that drinking at private parties was more strongly associated with drink-driving than other types of drinking location (Usdan et al., 2005).

In the broader literature examining the role of locations, drinking in bars has been found to be associated with higher levels of consumption and alcohol-related problems than drinking in private settings (Single and Wortley, 1993). In approaches using multi-level modeling, the incidence of intoxication in bars has been shown to increase the risk and severity of aggression, beyond that associated with the intoxication levels of the individuals involved, i.e., there is an effect of the social milieu, which is more than the sum of the parts (Graham et al., 2006).

In a series of studies, we developed a web-based drinking diary instrument (Kypri and Gallagher, 2003; Kypri et al., 2004a; Kypri et al., 2005b) for the purpose of estimating blood alcohol concentrations (EBAC) for drinking episodes which occurred in the previous week, in a New Zealand university community. In this study, of students at 12 residential halls at a New Zealand university, we sought to (1) estimate the incidence of drinking to intoxication (defined as an EBAC >0.08%) in various drinking locations (e.g., public bars versus private settings), and (2) to determine whether the risk of intoxication at different locations varied by student characteristics such as first-year status, gender, ethnicity, and history of hazardous drinking.

2. Methods

2.1 Setting

The setting of the study was residential halls at the University of Otago (18,000 students) in the New Zealand city of Dunedin (population 120,000). Otago students aged 17-24 years, have a hazardous drinking prevalence of 60-65% (Kypri et al., 2004b), which is more than twice that of their non-student peers nationally (Kypri et al., 2005a). Thirteen residential halls house approximately 2,700 predominantly first-year students, and drinking to intoxication is highly prevalent in most halls (Kypri et al., 2002). Previous research in a random sample of students

from the entire university (Kypri et al., 2005b) showed that students in residential halls (about 20% of the student population aged 17-29) had a higher prevalence of drinking to intoxication than those living in house share settings, which include 63% of the population (unadjusted odds ratios: 1.87 for women, 1.32 for men). It is therefore likely that the sample in this study would not be representative of the entire student population in terms of drinking behavior. This segment of the population was selected because of the opportunity to examine the possible influence of distinct drinking locations that are amenable to policy intervention, namely, licensed premises and residential halls. We excluded one of the 13 residential halls which caters for a highly heterogeneous mix of international students.

2.2 Procedures

In April 2004, all students from 12 halls (n=2,482) were invited by letter to participate in a web survey of their alcohol use, using a procedure that has been described in detail elsewhere (Kypri et al., 2004a; Kypri et al., 2005b). The questionnaire included a drinking locations diary, an instrument modified from a previous study (Kypri et al., 2005b), in which participants were asked to indicate at which of four locations they had consumed alcohol in the preceding seven days: (1) a pub, bar or nightclub, (2) a student flat or house, (3) a hall of residence, or (4) 'other locations', which they were asked to specify with free text. Upon submission of the page containing their responses to this question, for each location they had selected, respondents were presented with a retrospective diary asking them to indicate the number of standard drinks (defined as 10 g ethanol) consumed at the location on each of the last seven days, and the duration of each episode. This procedure was adopted to reduce the risk of satisficing (Krosnick, 1999), i.e., the tendency of some participants to take shortcuts to reduce their response burden. In the present case, respondents could not have known that their response concerning which location types

(maximum of four) they had used the previous week, would be followed by a diary for each location, thereby reducing the risk that alcohol consumption would go unreported.

Starting from the day prior to completion of the questionnaire, the day and date of each of the preceding seven days were automatically presented beside each diary response box in the questionnaire, to cue memory. A New Zealand standard drink contains 10 g ethanol. For comparison, a US standard drink contains 12 g ethanol, which is equivalent to 1.5 oz. of 80 proof liquor (40% alcohol by volume). Pictures of standard drinks were provided on the web pages as a guide, and examples were given of the number of drinks in typical drink containers, e.g., “a bottle of wine contains approximately 7.5 standard drinks” (i.e., 75 g ethanol). Elsewhere in the questionnaire, respondents were asked to enter their weight in kilograms or pounds for the purpose of estimating blood alcohol concentration (EBAC), the computation of which is described elsewhere (Kypri et al., 2005b). Respondents were also asked to complete the Alcohol Use Disorders Identification Test (AUDIT) (Saunders et al., 1993) for the year 2003, an indication of their propensity for hazardous drinking (AUDIT score ≥ 8) in the year preceding the study. The entire web questionnaire can be viewed at <http://ipru3.otago.ac.nz/hdpdemo/halls2004>.

We have previously argued for the importance of measuring drinking on a continuous scale, even if a binary measure (e.g., EBAC $>0.08\%$) is used for analytical purposes (Kypri et al., 2005b). Relative to a binary (e.g. 5+) measure, a continuous measure allows greater flexibility in the use of survey or observational data, for the analysis of alcohol consumption as an explanatory or outcome variable. In addition, we have argued that where possible, physical characteristics of the drinker (gender and weight) and duration of drinking episodes should be used to derive valid estimates of impairment or intoxication.

The survey also included basic demographic questions (e.g., age, gender, ethnicity, and academic class status) that were included as covariates in analyses. These background characteristics, along with students' past-year hazardous drinking level, their propensity for going

to drinking locations, and hazardous drinking prevalence in their residential halls, were considered as selection factors that may act as confounds. Controlling for such factors minimizes the probability that observed relationships between drinking location types and student intoxication are attributable to pre-existing factors.

2.3 Response to the survey

Complete questionnaires were submitted by 1,594 residents (64% of the eligible population), while a further 67 residents (3%) submitted partially complete questionnaires which met a pre-determined minimum data requirement of a complete AUDIT and the drinking locations diary, giving a total response of 67% (N=1,661). The response rate was significantly higher for women (n=1,029, 70%) than men (n=632, 62%; $\chi^2=17.2$, df=1, $p<0.001$), but did not differ significantly by ethnicity (New Zealand European 67%, all other ethnicities 66%; $\chi^2=0.6$, df=1, $p=0.58$). Of the 1,661 respondents, 1,614 (97%) provided complete data for all study variables (62% female, 78% New Zealand European, mean age = 19.0, SD=1.0, age range: 17-24, 79% first-year students). “New Zealand European” is the official term for a person with European ancestry.

3. Results

Descriptive person-level analyses were conducted to examine alcohol use and the prevalence of hazardous drinking in the past 12 months, and alcohol use in the past seven days, in different locations (Table 1). Results in Table 1 indicate, for example, that 54.5% of students drank in pubs/bars/nightclubs in the past 7 days and that the majority of students went to 1 or 2 drinking locations in the past 7 days.

<Table 1>

Drinking location diary data were used to estimate the total volume of alcohol (i.e., number of standard drinks) consumed by all students who reported any drinking in the past seven days, and the volume of alcohol consumed in different locations (e.g., pubs/bars/nightclubs, residential halls). Respondents consumed 21,675 standard drinks in the 7-day sampling period, of which 11,098 (51.2%) were consumed in pubs/bars/nightclubs, 7,421 (34.2%) in residential halls, 1,950 (9%) in student flats/houses, and 1,188 (5.5%) in ‘other’ locations. There were a total of 3,701 drinking location episodes among drinkers.

Based on EBACs computed for each drinking location and episode, we calculated the percentages of all location episodes with $EBAC > .08\%$ for all locations combined, and separately, for each location type. Location episodes were defined as periods of time, on a given day, in which alcohol was consumed at one of the four types of location. Table 2 presents proportions of all location episodes which resulted in EBACs of more than 0.08%, by location type and gender. In contrast to Table 1, it summarizes data at the level of the location episode, rather than the person. For example, 60.6% of all location episodes in pubs/bars/nightclubs resulted in EBACs of $>0.08\%$. It should be noted that one person could contribute more than one location episode to the summary. Proportions were highest for episodes which occurred in pubs, followed by residential halls, student flats/houses, and other locations. Percentages of location episodes with $EBAC > .08\%$ were generally higher for men than women. A similar pattern was observed for binge drinking, which was strongly associated with the incidence of $EBAC > .08$ (Chi square = 2823.9, $df=1$, $p < 0.001$). Of 2,049 location episodes, 1,549 (76%) involved binge drinking (>4 drinks for women, >6 drinks for men; $\chi^2=2098.5$, $df=1$, $p < .001$).

<Table 2>

We conducted a multi-level analysis based on location episodes and drinking location (level 1), student characteristics (level 2), and residential hall drinking norm (level 3), to estimate the relative risk (or likelihood) of intoxication at different types of location, controlling for potential confounding variables, including: (1) students' first-year status, gender, ethnicity, prior hazardous drinking, and average number of drinking locations; and (2) hazardous drinking prevalence at the residential hall, which has previously been found to be independently related to individual drinking levels (Kypri et al., 2002). Multi-level modeling is appropriate when observations are nested within individuals (e.g., multiple drinking location episodes per student) or when individuals are nested within groups (e.g., students living in residential halls), to model effects at multiple levels and adjust for variance that is attributable to clustering (i.e., non-independence) of observations (Raudenbush et al., 2004). The relative risk of intoxication is represented by odds ratios (ORs), which represent the likelihood of intoxication in locations such as pubs or residential halls relative to 'other' locations. ORs also represent risk of intoxication in subgroups of students defined by behavioral and sociodemographic characteristics (e.g., men versus women). We also examined possible moderating effects of student characteristics (first year status, gender, ethnicity, prior hazardous drinking) to determine whether the risk of intoxication at each location type may vary by these characteristics. HLM version 6.02 software was used for this analysis (Raudenbush et al., 2004), producing unbiased parameter estimates by adjusting for the clustering of observations within each level of analysis.

As indicated in Table 3, associations between each location type and EBAC $>.08$ were positive and stronger for women than men. Relative to 'other' locations (e.g., restaurants), drinking in a residential hall, pub/bar/nightclub, and flat/house was associated with a greater likelihood of drinking to intoxication among women, while only drinking in a pub/bar/nightclub was associated with EBAC $>.08$ among men. The gender-specific odds ratios (ORs) were different at the .05 level for residential hall and flat/house, while the gender-specific ORs for

pub/bar/nightclub were different at the .10 level. Of the other explanatory variables, a greater than average prevalence of hazardous drinking in residential halls, prior hazardous drinking by students, and being a first-year student (relative to more senior status) were positively associated with drinking to intoxication. These analyses were repeated with a more conventional binary measure of heavy episodic or “binge” drinking (>4 drinks for women, >6 drinks for men, based on the standard drink size and recommended upper limit for drinking in New Zealand) during each location episode, as the dependent variable, and results were very similar to those reported in Table 3.

<Table 3>

3. Discussion

Two thirds of respondents from residential halls reported drinking during the preceding seven days, and 55% of the drinking location episodes resulted in intoxication (EBAC>.08%). During the seven days preceding the survey, approximately half of all the alcohol was consumed in pubs/bars/clubs, a third in residential halls, with the balance in student flats and other locations. Pubs/bars/clubs were the locations with the highest odds of drinking to intoxication, controlling for a range of possible selection effects: gender, year of study, ethnicity, and drinking status in the previous year.

Strengths of the study include the use of a measure of drinking in the preceding year (the AUDIT) in multivariate models of drinking to intoxication. Given the likely tendency of students to have chosen locations which suited their drinking predispositions (i.e., they were not randomly allocated to drinking location types), inclusion of this measure in multivariate statistical models probably diminished the possibility that observed differences in the incidence of drinking to intoxication by location are due simply to self-selection effects. Our findings identify the type of location where drinking to intoxication is most likely to occur, which has implications for liquor law enforcement. In addition, the use of an EBAC >.08% as indicative of intoxication,

corresponds with visible signs of impairment (Schuckit, 2000), and epidemiological evidence showing a marked increase in traffic crash risk for drivers with BACs of .08% relative to lower levels (Zador et al., 2000).

In a previous study in this population group, non-response error was estimated by (1) comparing respondents with non-respondents in their demographic characteristics and (2) by comparing drinking data for early versus late respondents (Kypri et al., 2004b). Evidence suggestive of non-response bias was found: non-respondents were more often male than female (as in the present study), and persons submitting a late response tended to be heavier drinkers than those who submitted an early response, however, the inferred effects on prevalence or consumption estimates were small (Kypri et al., 2004b). It was concluded that intensive (and therefore costly) follow-up procedures were not warranted, and a response rate of 65-70% was predicted for a web survey in this population, utilizing a pre-notice letter, e-mail invitation and two or three reminder e-mails. The rate attained in the present study (67%) was in the predicted range. Consumption and hazardous drinking prevalence are therefore likely to be only slightly underestimated.

In their comparison of quantity-frequency, graduated frequency, and drinking yesterday measures, Stockwell and colleagues concluded: “Recent recall methods encourage fuller reporting of volumes plus more accurate estimates of unrecorded consumption and the proportion of total alcohol consumption that places drinkers at risk of harm. However, they do not capture longer-term drinking patterns. It is recommended that both recent recall and measures of longer-term drinking patterns are included in national surveys” (p.1024) (Stockwell et al., 2004). The drinking locations diary, with a reference period of 7 days, imposes a lesser response burden than the graduated frequency approach and circumvents the problem of relying on respondents to work out for themselves what represents their usual drinking volumes. Supplemented with quantity-frequency questions, e.g., items 1 and 2 of the AUDIT (Saunders et al., 1993), one can

obtain more accurate estimates of recent consumption, including information on patterns, and an approximation of overall volume, which can be used for comparison with most epidemiological studies.

The location-specific measures presented in this paper introduce a policy-relevant dimension which is absent from typical measurement approaches. For example, knowing how much respondents drink in licensed premises, versus at home, gives insight into the role of such outlets in drinking to intoxication and in public places, and could be used to assess the efficacy of liquor law enforcement, which is typically focused on licensed premises. Such a measurement approach directs researchers and policy-makers toward settings in which there is an opportunity to modify availability and promotion of alcohol, or demand for it.

The study has a number of limitations. First, estimated BACs, while superior to *per se* binge drinking measures (e.g., the 5+ definition), suffer from the same biases as all self-report measures, i.e., possible limitations of recall, socially desirable response, and the interpretation of standard drink measures. There is evidence that the estimation is good for BACs up to .08% but less accurate at higher levels (Carey and Hustad, 2002). This may be due in part to the tendency of respondents to round up or down when recalling high levels of consumption. This may have occurred in the present study: in the frequency distributions of drinks per episode, reports of 12, 20, and 24 were more common than reports of 13, 21, and 23 drinks respectively.

An important recent study, comparing self-report with breath alcohol measures in college students at parties near their university campus, showed that EBACs were poorly correlated with BACs estimated from breath alcohol (Clapp et al., 2006a). Furthermore, the authors found that “environmental variables, including party size, rowdy behavior, having food present, and observing many intoxicated partygoers, were also associated with [errors in EBACs]” (p.620). This suggests the possibility that in the present study, error in estimation of the volume of alcohol consumed and the duration of the drinking episode, may have been differential by location type,

which would have biased the results. Given that obtaining breath alcohol measures for the purposes of epidemiological or intervention studies is usually impracticable, further research is needed to identify the sources of error and means of improving BAC estimates from self report.

Another limitation of this study is the potential constraint on the generalizability of the findings to other university populations. Participants were recruited from residential halls at a single university in New Zealand. The extent to which the observed relationships would be present in other campuses in New Zealand, or in other countries, is unknown. In Dunedin, there are many licensed premises within walking distance of residential halls, alcohol consumption is permitted to varying degrees in residential halls (Maclennan 2005), and in New Zealand the minimum legal purchase age for alcohol is 18 years (there is no 'drinking age' as such). It would be surprising if alcohol consumption, risk behaviors, and patterns of harm were not different in places where access to alcohol was more restricted. Furthermore, the relative importance of licensed premises may be different in the wider student population, the majority of whom reside in private accommodation, without parental or other supervision.

The findings raise a number of questions which could be addressed in further research. Like their counterparts in many parts of the world, the hall administrators who facilitated this study wish to reduce the extent of drinking to intoxication and related harms among residents (Maclennan, 2005). Indeed, all consider it a priority, but they differ in their views on how to accomplish that end. Some have adopted policies in accordance with the broader alcohol policy literature (Babor et al., 2003), which suggests restricting the availability of alcohol is a key to reducing problems. Others argue for a *laissez faire* approach, in which sensible drinking is modeled to residents, and antisocial behavior (rather than drinking *per se*) is censured. Some proponents of the *laissez faire* approach argue that restricting drinking in the students' place of residence could force students to drink in less safe settings and thereby produce more harm than would occur in an unregulated environment (Maclennan, 2005).

Using measures of policy and controlling for selection effects, it may be possible to discover whether restrictive or *laissez-faire* approaches are associated with the incidence of drinking to intoxication in, versus out, of the residential hall, and secondly, whether more or less harm is associated with each policy type. Notably, women reported a greater proportion of their drinking in halls than did men, so a secondary question is whether the effects of restrictive policy differ by gender.

New Zealand, like most countries, has a law — the Sale of Liquor Act (1989) — which prohibits pubs, bars and clubs from admitting intoxicated persons to the premises, from serving patrons to the point of intoxication, and from allowing intoxicated persons to remain on the premises. Given such laws, and the findings of this study: that half of all alcohol consumed was in pubs/bars/clubs and that the odds of intoxication were highest for drinking in this type of location, there is clearly a need to more closely examine the enforcement of liquor laws.

There are limitations to current liquor laws which make the prevention of alcohol-related harm difficult to effect. A noteworthy feature of the Sale of Liquor Act is the lack of a definition of ‘intoxication’. This may make it difficult for licensees to comply with the law, for police to collect suitable evidence, and for a prosecution to be effected when a case is brought to court. A recent paper proposed that there be a statutory maximum BAC for drinking in public places, taken to include pubs, bars, and clubs (Hawks, 2006). Such a law would have far reaching implications which need careful consideration. A law prohibiting public drunkenness (also not defined) was repealed in New Zealand in 1982. Reintroducing such a law, with an appropriate BAC specified, would probably assist in the management of alcohol use and its effects in public space. It would also introduce the possibility of enhancing the societal management of public disorder, with the benefit of several decades experience in measuring BAC for evidential purposes in the road traffic area.

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Table 1. Summary of student drinking behavior

	Total (N=1614) %	Women (n=1006) %	Men (n=608) %
Drank alcohol in the previous year	87.7	88.3	87.4
Hazardous drinking in the previous year (AUDIT > 8)	46.5	43.2	52.0
Drank alcohol in the preceding 7 days at:			
Any location	66.7	63.9	71.5
Pub/bar/nightclub	54.5	49.7	62.3
Student flat/house	17.6	15.0	21.9
Hall of residence	52.6	49.6	57.6
Other locations ¹	13.6	11.4	17.1
Mean number of location types per drinking day ²			
1	32.6	35.5	28.3
1.1 to 2	59.5	57.2	62.8
2.1 to 4	8.0	7.3	9.0

¹Other locations include restaurants, automobiles, private events, and outdoor settings.

²Includes only persons who reported at least one drink in the last 7 days: 643 women, 435 men.

Table 2. Proportion of location episodes (N=3,701) resulting in intoxication (EBAC>0.08%), by location type

Location type	Percentage of location episodes with EBAC>0.08% ¹		
	Total sample	Women	Men
All locations (1976 for women, 1725 for men)	55.4	52.8	58.3*
Pub/bar/nightclub (886 for women, 790 for men)	60.6	57.1	64.4*
Student flat/house (186 for women, 167 for men)	55.0	55.9	53.9
Hall of residence (756 for women, 649 for men)	52.7	51.6	53.9
Other locations (148 for women, 119 for men) ²	37.5	29.7	47.1*

*p<.01, from chi squared test

¹The total number of location episodes exceeds the total number of drinking days because for many respondents, some drinking days involved consumption in more than one location type (e.g., residential hall and pub).

²Other locations include restaurants, automobiles, private events, and outdoor settings.

Table 3. Drinking location and demographic predictors of drinking to intoxication¹

Variable	Odds Ratio (95% C.I.)	
	Women	Men
<i>Residential hall level</i>		
Prevalence of hazardous drinking (AUDIT > 8)	3.50 (0.78, 15.69)	4.99 (1.33, 18.72)
<i>Student level</i>		
Ethnicity		
European/Pakeha	Reference	Reference
Other ethnicities	0.74 (0.51, 1.09)	1.09 (0.71, 1.68)
Student status		
2 nd year or higher	Reference	Reference
1 st year	1.69 (1.16, 2.58)	1.40 (1.03, 1.91)
Past year drinking pattern		
Moderate (AUDIT score <8)	Reference	Reference
Hazardous (AUDIT score ≥8)	1.99 (1.56, 2.56)	2.19 (1.67, 2.89)
Avg. number of drinking locations	0.88 (0.71, 1.09)	0.97 (0.77, 1.22)
<i>Episode level</i>		
Drinking location		
Hall of Residence	2.58 (1.71, 3.00)	1.27 (0.84, 1.91)
Pub/Bar/Nightclub	3.09 (2.05, 4.64)	1.92 (1.27, 2.89)
Flat/House	3.48 (2.11, 5.72)	1.19 (0.73, 1.97)
Other ²	Reference	Reference

¹Based on 3,701 location episodes (1976 for women, 1725 for men) among 1,088 student drinkers (646 women, 442 men) who were living in 12 residential halls.

²Other locations include restaurants, automobiles, private events, and outdoor settings.